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Effect of certain indigenous extracts against tea mosquito bug, *Helopeltis theivora* (Waterhouse) (Hemiptera: Miridae) in tea

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Abstract
An investigation entitled "Effect of certain indigenous extracts against tea mosquito bug, *Helopeltis theivora* (Waterhouse) (Hemiptera: Miridae) in Tea" was carried out at Deha Tea Estate, Jorhat, Assam, India during 2015-2016 by using different indigenous extracts. Fish extract at (0.25, 0.5 and 1) %, *Polygonum hydropiper* at (2.5, 5 and 7.5) % and Azadirachtin-5% (Neemazal-F) were evaluated in field condition against tea mosquito bug. The result showed that fish extract in combination with cow dung, cow urine and water when sprayed at 1% concentration and *Polygonum hydropiper* in combination with cow urine and water when sprayed at 7.5% concentration significantly reduced the percentage of shoots infested by tea mosquito bug. Both Fish extract and *Polygonum hydropiper* extract combinations were found to increase plucking point density and yield of tea. Among all the ITKs, fish extract at 1% caused higher reduction of infestation of tea mosquito bug followed by *Polygonum hydropiper* extract at 7.5%. Influence of both the treatments on the management of tea mosquito bug was at par with that of commercial Azadirachtin (5%).

Keywords: Fish extract, *Polygonum hydropiper*, *Helopeltis theivora*, *Camellia sinensis*, management

Introduction
Tea, *Camellia sinensis* (L.) O. Kuntze, family Theaceae, is the most widely consumed non alcoholic beverage all over the world, and regarded as a miraculous drink with numerous rejuvenating properties. Tea is prepared from the tender leaves and buds of *Camellia sinensis*, a woody perennial plantation crop cultivated as monoculture on large and small holdings. Being grown as a monocrop, tea is subjected to attack of many insects pests and Tea mosquito bug (*Helopeltis theivora*) and looper caterpillar (*Buzura suppresseria*) in very severe form.

Tea mosquito bug, *Helopeltis theivora* (Waterhouse) (Hemiptera: Miridae) is a serious pest of tea in North-East India which causes serious infestation to its pluckable shoots (52-86%) during its peak period of activity from June-July and remains active from March to November (Sarmah and Phukan, 2004) [12]. It causes serious damage to tea plantations both in the quantity and in the quality of the tea. The nymphs and adults of the *H. theivora* suck the cell sap from tender stems, young leaves and buds, which results in the formation of reddish brown circular feeding punctures. The tea buds, shoots and tender leaves, which are the actual crop of tea, become curled, dried and black with many sucking stains and provide no yield. The damaged buds cannot be plucked which affects the next flush of shoots. The most seriously affected tea plants have a darker green color and are stunted (Hazarika, 2009) [4]. Additionally, oviposition causes the stems to develop cracks and causes over-callusing, which also results in stunted growth and the dieback of stems (Roy, 2008) [8]. An infestation by tea mosquito bug often starts from a small area in the tea field and then spreads to patches of neighboring plants. This gives the tea field an appearance of uneven development (Das, 1965) [2]. In summary, two types of damage are caused by the tea mosquito bug, direct loss of the harvestable shoots and acute debilitation of the bushes leading to dieback, which delays flushing and results in poor yields (Rao, 1970) [7].

In tea, pests attack various parts like leaf, stem, root and seed cause crop loss of around 10-15%. To control these pests, consumption of pesticides is excessively high and expensive particularly in tea plantation of North East India (Chakravartee and Hazarika, 1995) [1].

On the other hand, indiscriminate use of pesticides may promote speedier evolution of insect pests, affect non-target species, convert formerly innocuous species into pest and leave

undesirable residues in made tea (Hazarika *et al.*, 1994a) [5]. As a result of dissatisfaction of consumers, especially importers with pesticide residues and reluctance to accept such tea by importing countries, problem of residues has become a major concern to the tea industry. Now more than ever, therefore, the onus is on developing an alternative method of pest control - the biological control, to step in and fill the void resulting in shifting of importance from the chemical based plant protection to the adoption of an integrated approach based primarily on use of bio control measures and need based application of botanicals and safer pesticides. Such an approach may lead to reduction of residues and ancillary problems associated with pesticide applications (Hazarika *et al.*, 1994a) [5].

Chemical control has been used for a long time, as the primary mode of management of tea mosquito bug and other pests in tea. A wide range of acaricides and insecticides belonging to different chemical groups currently being used worldwide to control these pest have serious drawbacks such as toxicity to non targeted organisms, pesticide induced resistance, health hazard and presence of residues in tea (Sharaby, 1988) [9].

Application of high inputs in agriculture in terms of chemical pesticides has endangered the sustainability of production system. Indigenous knowledge of agriculture, is the result of farmer's thousands years of experience with nature and known by the farmers often referred to as traditional knowledge or Indigenous Technical Knowledge (ITK). These are accumulated knowledge, skill and technology of ethnic groups, derived from their direct interaction with environment, which are ecologically sound, low cost and sustainable to deal with issues related to various agro-ecosystems. The role of traditional knowledge in sustainable agricultural production in developing countries has been gaining recognition within scientific circles. With the change from subsistence farming to the present-day commercial farming, humans brought in drastic changes in farming methods and consequently realized that the present-day technique adopted for commercial agriculture may be unsustainable in the long run.

Recently in Assam, these traditional plant protection practices have been adopted by many small tea growers in different pockets of the state. So, keeping in view the above facts, the present investigation "Effect of certain indigenous extracts against tea mosquito bug, *Helopeltis theivora* (Waterhouse) (Hemiptera: Miridae) in Tea" was carried out.

Materials and method

The experiment was conducted at Deha Tea Estate, Jorhat, Assam, India during the period 2015-2016. The hybrid of Assam-china type tea clone, TV_1 was used for the experiment. The experiment was laid out in Randomized Block Design (RBD) with nine treatments including control which were replicated thrice. The plant spacing were maintained at 120cm x 60cm with single hedge planting pattern. The treatments were Fish extract (0.25%), Fish extract (0.5%), Fish extract (1%), *Polygonum hydropiper* extract (2.5%), *Polygonum hydropiper* extract (5%), *Polygonum hydropiper* extract (7.5%), Azadirachtin-5% (Neemazal-F) and Control.

Methods of preparation

Fish extract

The extraction was prepared by mixing 80 kilograms of different parts of fish along with 50 litres cow urine, 15kg cow dung and 100 litres of water. The mixture was kept for 7 days in a plastic drum installed underground the filtrate was sprayed in the experimental plots.

Polygonum hydropiper extract

The plants *Polygonum hydropiper* (order-polygonaceae) were collected from nearby places of Deha Tea Estate, Jorhat for preparation of aqueous extracts. 30 kilograms of *Polygonum hydropiper* were crushed and mixed with 10 litres cow urine and 100 litres of water and was kept in a cement tank for 10 days and then filtration was done before spraying in the experimental plots.

Azadirachtin- 5%

Azadirachtin-5% is a neem extract concentrate insecticide manufactured by Parry India Limited. It is used to control different pests of tea.

Spray schedule

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 using ASPEE Bakpak hand sprayer with hollow cone nozzle.

Observations

Observations were recorded on plants selected randomly. In each plot plants were numbered for studying the tea mosquito bug infestation. The observations were made before and after imposing the treatments.

Number of shoots infested by tea mosquito bug

Infestation of shoots by tea mosquito bug was assessed by collecting fifty shoots randomly from twenty plants in each plot and number of infested shoots was counted to work out the percent infestation.

Number of plucking point

Plucking point density was observed by making a bamboo quadrant of 0.25m×0.25m in size. The quadrant was placed on the plucking surface of individual tea plant. Plucking points were counted within the quadrant of ten randomly selected plants in each plot. Observations were taken during the month from May to December.

Yield

Green leaf yield in each plot was recorded at every plucking round during the period of investigation.

Statistical analysis

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 by using the following formula:

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

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

Pre-treatment observation

Data recorded during pre treatment observation, May (2015) were presented in Table 1.

It was observed that percentage of shoots infested by tea mosquito bug, plucking point density and yield recorded non significant.

Effect of ITKs on percentage of shoots infested by tea mosquito bug

Data in respect of number of shoots infested by tea mosquito bug recorded at different months as influenced by various treatments are presented in Table 2.

Significant variations in respect of number of shoots infested by tea mosquito bug due to different treatments were observed in different months during the period of investigation. Application of ITKs showed significant reduction of shoots infested by tea mosquito bug by Fish extract at 1% concentration was more effective followed by *P. hydropiper* extract (7.5%). Influence of both the treatments was at par with that of Azadirachtin (5%).

Effect of ITKs on per cent reduction of shoots infested by tea mosquito bug

Data in respect of per cent reduction on number of shoots infested by tea mosquito bug recorded at different months as influenced by various treatments are presented in Table 3.

Among all ITKs tested, Fish extract 1% concentration was found to be significantly reduce number of shoots infested by tea mosquito bug (78.35-87.88%) followed by *P. hydropiper* extract at 7.5% concentration (72.60-84.84%) and Azadirachtin at 5% concentration (71.11-82.07%).

Effect of ITKs on number of plucking point (per 0.25m^2)

Data in respect of plucking points recorded at the experimental plots at different months during the period of investigation are presented in Table 4.

Significant variations in respect of plucking point due to different treatments were recorded after continuous application of treatments. Fish extract at 1% concentration recorded the highest number of plucking points (66.32) followed by *P. hydropiper* extract at 7.5% concentration (64.99) followed by Azadirachtin at 5% concentration (63.94) which is significantly more than the control (46.72).

Effect of ITKs on green leaf yield (kg/plot)

Data in respect of yield recorded at different months as influenced by different treatments are presented in Table 5.

Significant variations in respect of yield due to different treatments were recorded after continuous application of treatments. Fish extract at 1% concentration recorded the highest yield in all the treated plots at different monhts followed by *P. hydropiper* extract at 7.5% concentration followed by Azadirachtin 5%.

Discussion

Many studies and scholarly articles on evaluation of different traditional practices and plant products against tea pests but the efficacy of fish extract or use of any fish product have not studied till date. Therefore, an effort was made to study this traditional practice of using fish product and *Polygonum hydropiper*. A total of 8 treatments at different concentration were evaluated in the field condition. Fish extract was found effectively manage tea mosquito bug in tea fields. The results showed that on mixing fish extract in combination with cow dung, cow urine and water at 1% concentration significantly reduced the percentage of shoots infested by tea mosquito bug upto 78.35-87.88% and there was an increased in plucking point density and yield of tea in the treated plots where Azadirachtin 5% was at par with this combination. This might be due to presence of pesticidal properties of these extract, Mahmood. *et al.* (1984) [6]. Tea mosquito bug also causes serious infestation to its pluckable shoots during its peak period of activity from June-July and remains active from March to November (Sarmah and Phukan, 2004) [12].

Polygonum hydropiper in combination with cow urine and water also showed significant reduction of shoots infested by tea mosquito at 7.5% concentration which was similar with the findings reported by Sarmah and Bhola (2011) [10]. This combination was at par with Azadirachtin 5% and corroborated by many other workers (Devi *et al.*, 2008 and Sarmah *et al.*, 2015) [11]. There was an increased in plucking point density and yield of tea in the treated plots where Azadirachtin 5% was at par with this combination. The reduction of damage percentage might be due to having antifeedant and repellent properties of these products, Mahmood. *et al.* (1984) [6].

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

Treatments	Dilution (HV)	Percentage of shoots infested by tea mosquito bug	Plucking Point Density (per 0.25m^2)
T_1 (Control)	Water spray	46.83	36.81
T_2 (Fish extract-0.25%)	1:400	44.97	30.22
T_3 (Fish extract-0.5%)	1:200	45.88	35.99
T_4 (Fish extract-1%)	1:100	47.12	34.42
T_5 (*P. hydropiper* extract-2.5%)	5:200	44.88	35.67
T_6 (*P. hydropiper* extract-5%)	10:200	46.72	34.67
T_7 (*P. hydropiper* extract-7.5%)	15:200	45.03	34.93
T_8 (Azadirachtin-5%)	1:1500	43.68	36.43
F test		N.S	N.S
NS= Non Significant			

Table 2: Effect of ITKs on percentage of shoots infested by tea mosquito bug

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	47.13	44.82	42.20	42.02	43.30	35.24	19.33	11.99
T_2 (Fish extract-0.25%)	1:400	25.27	23.02	22.02	24.91	23.65	19.70	7.98	4.64
T_3 (Fish extract-0.5%)	1:200	25.01	23.38	19.32	20.24	22.46	19.38	8.43	4.94
T_4 (Fish extract-1%)	1:100	8.96	8.11	6.48	7.99	6.48	5.23	1.99	1.08

T_5 (*P. hydropiper* extract-2.5%)	5:200	23.13	23.02	22.66	24.86	25.66	21.70	8.86	5.33
T_6 (*P. hydropiper* extract-5%)	10:200	24.20	23.32	20.42	22.50	23.52	15.99	8.79	5.02
T_7 (*P. hydropiper* extract-7.5%)	15:200	11.21	10.50	8.76	9.12	8.68	6.89	2.80	1.53
T_8 (Azadirachtin-5%)	1:1500	11.59	10.19	9.35	8.95	8.35	8.10	2.48	1.52
F test		-	-	-	-	-	-	-	-
S.Ed (±)		4.01	4.19	3.21	3.26	3.61	3.28	2.01	0.97
C.D. (P=0.05)		7.06	7.38	5.65	5.74	6.36	4.85	3.55	1.70
(P=0.01)		10.50	10.99	8.42	8.55	9.47	8.61	5.29	2.54

Table 3: Percent reduction of shoots infested by tea mosquito bug

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	+4.68	+6.68	+4.31	+3.35	+4.23	+4.19	+2.66	+1.78
T_2 (Fish extract-0.25%)	1:400	39.73	40.29	40.61	37.73	38.89	39.63	48.69	48.04
T_3 (Fish extract-0.5%)	1:200	41.76	42.17	43.63	43.59	41.43	41.70	50.45	51.52
T_4 (Fish extract-1%)	1:100	78.35	79.67	80.49	78.90	80.31	81.05	86.61	87.88
T_5 (*P. hydropiper* extract-2.5%)	5:200	38.50	39.09	39.36	36.12	37.40	38.44	44.47	47.79
T_6 (*P. hydropiper* extract-5%)	10:200	40.57	41.41	41.78	40.42	40.07	40.76	47.04	50.01
T_7 (*P. hydropiper* extract-7.5%)	15:200	72.60	73.86	74.14	74.18	76.98	77.73	81.05	84.84
T_8 (Azadirachtin-5%)	1:1500	71.11	72.77	72.18	72.26	74.51	72.86	80.93	82.07
F test		-	-	-	-	-	-	-	-
S.Ed (±)		15.56	16.17	15.80	15.71	16.35	16.28	16.77	16.97
C.D. (P=0.05)		27.38	28.46	27.81	27.66	28.78	28.66	29.52	29.88
(P=0.01)		40.76	42.36	41.41	41.17	42.84	42.67	43.95	44.48

+ Represents the percent increase

Table 4: Effect of ITKs on plucking point density (number per 0.25m^2)

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	27.22	24.25	46.72	35.22	39.75	30.35	26.35	12.24
T_2 (Fish extract-0.25%)	1:400	34.79	35.22	53.54	41.22	47.77	36.89	38.56	16.98
T_3 (Fish extract-0.5%)	1:200	36.80	37.00	54.69	43.33	49.26	38.89	39.19	17.55
T_4 (Fish extract-1%)	1:100	43.01	47.59	66.32	55.70	61.50	49.48	50.01	30.22
T_5 (*P. hydropiper* extract-2.5%)	5:200	32.54	33.66	51.03	40.14	45.98	37.42	38.46	15.60
T_6 (*P. hydropiper* extract-5%)	10:200	34.85	36.28	53.35	42.95	48.94	38.26	38.85	17.45
T_7 (*P. hydropiper* extract-7.5%)	15:200	41.75	46.45	64.99	53.13	59.44	48.69	47.39	27.98
T_8 (Azadirachtin-5%)	1:1500	41.47	45.14	63.94	52.34	57.58	45.53	46.22	25.58
F test		-	-	-	-	-	-	-	-
S.Ed (±)		2.62	3.84	2.10	2.57	3.62	3.10	3.59	3.18
C.D. (P=0.05)		4.62	6.76	3.70	4.53	6.38	5.45	6.31	5.60
(P=0.01)		6.88	10.07	5.51	6.75	9.50	8.12	9.40	8.34

Table 5: Effect of ITKs on green leaf yield per plot (kg/plot)

Treatments	Dilution (HV)	May	June	July	August	September	October	November	December
T_1 (Control)	Water spray	2.30	2.85	4.26	4.08	4.01	3.56	1.55	0.63
T_2 (Fish extract-0.25%)	1:400	3.89	4.40	6.50	5.43	6.63	4.82	2.13	1.54
T_3 (Fish extract-0.5%)	1:200	4.04	4.14	6.81	5.53	6.86	5.01	2.63	1.97
T_4 (Fish extract-1%)	1:100	4.99	5.02	7.58	6.41	7.69	5.86	3.33	2.09
T_5 (*P. hydropiper* extract-2.5%)	5:200	3.57	3.81	6.19	5.37	6.13	4.78	2.01	1.30
T_6 (*P. hydropiper* extract-5%)	10:200	3.92	3.98	6.72	5.45	6.41	4.97	2.37	1.67
T_7 (*P. hydropiper* extract-7.5%)	15:200	4.96	4.99	7.46	6.40	7.54	5.86	3.30	2.08
T_8 (Azadirachtin-5%)	1:1500	4.91	4.94	7.36	6.33	7.49	5.71	3.12	1.85
F test		-	-	-	-	-	-	-	-
S.Ed (±)		0.43	0.30	0.30	0.33	0.31	0.31	0.27	0.24
C.D. (P=0.05)		0.77	0.53	0.54	0.71	0.56	0.67	0.47	0.43
(P=0.01)		1.15	0.79	0.80	0.99	0.83	0.93	0.70	0.64

Conclusion

From the present investigation, it can be concluded that fish waste mixed with cow dung, cow urine and water when applied at 1% concentration can effectively manage tea mosquito bug in tea field and *P. hydropiper* mixed with cow urine and water when applied at 7.5% concentration also can effectively manage tea mosquito bug in tea field. Both fish extract and *P. hydropiper* extract combinations were found to increase plucking point density and yield of tea.

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