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Effect of neem formulations on the management of purple mite, *Calacarus carinatus* L. infesting tea

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Abstract

Tea, *Camellia sinensis* L. being a perennial crop is attacked by an array of pests round the year. Amog them the eriophyid purple mite, *Calacarus carinatus* (Green) causes damage to the leaves thereby reducing the briskness and flavour of the tea. In an attempt to scale down the ill effects caused by chemical pesticides to this beverage crop the neem formulations viz., TNAU neem 0.03 EC and Neem Gold 0.15 EC were evaluated for bio efficacy in laboratory and in field. In laboratory assay the neem formulations exhibited acute toxicity to the mite causing 66 – 68 per cent mortality in 72 hours after treatment. Tea leaf discs treated with Neem Gold 0.15 EC and TNAU neem 0.03 EC prevented the orientation of the mites to the treated surface thereby exhibiting the deterrence. In the field trials *C. carinatus* population was reduced to more than 70 per cent after 7 days of application. No phytotoxic symptoms were observed on tea bushes treated with the neem formulations. The residues of Neem Gold 0.15 EC and TNAU neem 0.03 EC were below detectable limit in made tea samples taken one day after treatment. Hence the neem formulation is a best bet in the IPM schedule for the purple mite.

Key words: Neem formulation, purple mite, tea

Introduction

The beverage crop tea, *Camellia sinensis* L. occupies an important position among the agricultural commodities produced in India due to their contribution to nation's economy. Tea, being a perennial crop provides a favorable breeding ground for a variety of pest. About 1034 arthropod species are found to feed on tea (Chen and Chen, 1989). Tea in South India is attacked by six species of mites (Muraleedharan, 1991). Among them the eriophyid, purple mite *Calcarus carinatus* (Green) is of common occurrence. Damage by mite may not lead to reduction in yield but reduces the briskness and flavor of processed tea (Muraleedharan, 1997).

Chemical control continues to play a vital role in scaling down the damage caused by eriophyid mite. Organochlorines, DDT and BHC used in the past have resulted in buildup of mite population (Muraleedharan, 1997). Pyrethroids used in large scale had poor acaricidal properties (Kodomari, 1988). Since sizable quantity of tea in India is exported to various global destinations the use of pesticides on them has to be rationalized in order to adhere to the residue tolerance limits prescribed by EPA and EEC. The biological activity of neem has been established against tea pests (Muraleedharan, 1995; Bisen and Hajra, 1997). The main hurdle in exploitation of neem derivatives was its stability when applied. On this line efforts were made to evaluate the bio efficacy of neem formulations developed by the Toxicology laboratory at Tamil Nadu Agricultural University, Coimbatore (TNAU Neem 0.03 EC) and Southern Petrochemicals Industries Corporation (Neem Gold 0.15 EC) against the purple mite and to determine the azadirachtin residues in processed tea.

Materials and Methods

Mass culturing of mites

Purple mite, *C. carinatus* was reared on tea leaf disc of 1.5 cm dia. The leaf discs were placed on a water

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saturated cotton swab in a petridish of 10 cm. dia. Field collected adult mites were transferred to leaf discs in petridish using an eye brow hair fixed to a coconut mid rib. The leaf discs were changed as and when necessary but the water in the petridish was changed regularly. The development of the mites was observed under Stereo binocular microscope.

Acute toxicity

C. carinatus adults were transferred from stock culture with an eye brow hair disc of 2 cm. dia. Five discs were maintained per replicate. These tea discs were treated by spraying with selected concentration of neem formulations using a hand atomizer and they were then shade dried for 10 minutes. The discs were then transferred to petridish containing water saturated cotton. Mortality of the mites was recorded 24, 48 and 72 hours after imposing the treatment and per cent mortality values were subjected to arcsine transformation prior to analysis. Each treatment was replicated five times.

Deterrence to tea mite

Tea leaf discs of 2 cm^2. were treated with selected concentration of neem formulations on one half of the disc while the other half served as control. Discs were placed with lower surface upwards and in a petridish containing water saturated cotton. Batches of ten adult mites were placed at the centre of each disc and the orientation of mites towards treated or the control area was recorded 3,6 and 24 hrs. after imposing the treatment.

Field evaluation

To study the bio efficacy of neem formulation developed at Pesticide residue lab. Tamil Nadu Agricultural University, Coimbatore (TNAU neem 0.03 EC and commercial neem formulation Neem Gold 0.15 EC (Developed by SPIC) against *C.carinatus* field trials were initiated at Coonoor, The Nilgiris (1600m above MSL). There were six treatments and each treatment was imposed on 100 bushes with three replications. Two rounds of application of treatments were given at 30 days interval. The population of the mites was counted from 50 leaves collected at random. Thus the total number of mites per leaf before and 1, 3, 7 and 15 days after spraying were recorded. The percent reduction in mite population over control was worked as Henderson and Tilton formula (1955). The corrected per cent values were subjected to arcsine transformation prior to analysis.

Phytotoxicity

The phytotoxic effects of neem formulations on tea was observed on 1,3,7 and 15 days after spraying by recording the leaf injury on tips, leaf surface wilting and necrosis.

Residues of azadirachtin

Azadirachtin residues in tea were estimated by following the method suggested by Sundaram and Curry (1993) with slight modifications. Ten grams of made tea was soaked in 100 ml methanol overnight and filtered under gentle aspiration through buchner funnel using methanol washed filter paper. The extract was concentrated under low pressure to about 80 ml and was partitioned with hexane. The azadirachtin present in the mother liquor was extracted into dichloromethane layer. Residues were dissolved in 10 ml HPLC grade methanol. This was injected into HPLC for final determination.

Fortification

Standard mixture containing 1,5 and 10 ppm azadirachtin was prepared and were used to fortify the samples by adding 10 ml. Of standard mix to 10 gms. of sample. The estimation was done in HPLC –Hitachi model with L-4200 UV-Vis detector and Spherex X suc8 column with a wavelength of 217 nm. The flow rate of the solvent was 1 ml/min.

Results and Discussion

Acute toxicity

Synthetic insecticide ethion caused a highest mortality of *C. carinatus* (95.2%) 42 hours after treatment.Among the neem formulations tested highest mortality of *C. carinatus* (66 – 68%) was observed on discs treated with NSKE 5 % and Neem gold (0.1%) and TNAU neem (0.5%) 72 hours after treatment (Table 1). Lower doses of neem formulations (Neem gold and TNAU neem) and neem oil at 0.3% were par. The toxicity of neem formulations to mite is in agreement with the reports from UPASI (1994).

The order of toxicity was: ethion > neem gold (0.1%) = TNAU neem (0.3%).

Deterrency of neem formulations to C. carinatus.

In the choice test neem formulations Neem gold 0.15 EC and TNAU neem 0.03 EC as well as NSKE 5% and neem oil 3 % strongly prevented the orientation of *C. carinatus* to the treated surface. The per cent alightment of *C. carinatus* ranged from 31.0 – 39.3 % 24 hours after treatment (Table2). The repellent effect of neem formulations to *T. utricae* has been reported by Dimetry and Schmidt (1982).

Table 1. Acute toxicity of neem products on purple mite, *Calacarus carinatus* infesting tea

Treatments	Concentration (%)	Per cent mortality after *(hrs) 24	48	72
T1 Neem gold 0.15 EC	0.02	26.5 ^{bc}	37.8 ^{a}	38.0 ^{a}
T2 Neem gold 0.15 EC	0.05	34.4 ^{cd}	46.8 ^{a}	47.4 ^{a}
T3 Neem gold 0.15 EC	0.1	44.7 ^{d}	67.2 ^{b}	68.0 ^{b}
T4 TNAU neem 0.03EC	0.1	13.7 ^{as}	37.5 ^{a}	39.0 ^{a}
T5 TNAU neem 0.03EC	0.3	31.1 ^{cd}	67.2 ^{b}	67.0 ^{b}
T6 Neem oil 3 %	3.0	12.8 ^{ab}	40.5 ^{a}	40.8 ^{a}
T7 NSKE 5%	5.0	25.9 ^{bc}	65.9 ^{b}	66.0 ^{b}
T8 Ethion 50 EC	.05	66.1 ^{e}	95.2 ^{c}	95.2 ^{c}

* Mean of four replications;
Means followed by same letter in a column are not significantly different by (p=0.05) DMRT

Table 2. Feeding deterrence of neem products to purple mite, *Calacarus carinatus*

Treatments	Concentration (%)	% mite alightment on treated surface after *3 hrs 3	6	24
T1 Neem gold 0.15 EC	0.15	8.0 ^{b}	13.0 ^{b}	38.0 ^{bc}
T2 Neem gold 0.15 EC	0.3	5.0 ^{a}	6.0 ^{a}	31.0 ^{a}
T3 Neem gold 0.15 EC	0.6	4.0 ^{a}	7.6 ^{a}	33.0 ^{a}
T4 TNAU neem 0.03EC	0.06	7.0 ^{ab}	14.0 ^{b}	39.3 ^{c}
T5 TNAU neem 0.03EC	0.1	5.0 ^{a}	10.0 ^{ab}	35.0 ^{ab}
T6 Neem oil 3 %	3.0	4.0 ^{a}	6.0 ^{a}	31.0 ^{a}
T7 NSKE 5%	5.0	4.0 ^{a}	7.0 ^{a}	32.0 ^{a}

* Mean of four replications;
Means followed by same letter in a column are not significantly different by (p=0.05) DMRT

Bio efficacy of neem formulations

The population of *C. carinatus* varied from 143.2 – 187.2 / 50 leaves prior to first round of application of insecticides. Mite population was reduced to a maximum level of 71.8 – 84.7 and 31.2 – 76.4 % on day 7 after first application of Neem gold and TNAU neem respectively. A maximum of 85.2 % reduction was observed seven days after application in the plots that received the ethion spray.

The population varied from 53.1 – 203 per 50 leaves prior to second round of application. The maximum per cent reduction due to neem formulations (Neem gold and TNAU neem) was 39.8 – 89.8 & DAT of second application. In second application also ethion recorded a maximum reduction of 87.2 per cent (Table 3).

Both neem formulations TNAU neem and Neem Gold effected a significant reduction of *C. carinatus* in the field trials at Coonoor. Neem formulations gave significant protection upto seven days after treatment. The observed reduction in mite population in field could be due to the contact toxicity and repellent effect. The effect of neem formulations were more pronounced on *C. carinatus* as they were distributed more in the middle and bottom level. The presence of mites at this level helps the neem formulations to have a prolonged effect as the degradation of the neem formulation sprayed may be much slower in the middle as compared to the top level.

Phytotoxicity

None of the treatments of neem formulations caused phytotoxicity. During the period of record from 0 – 14 days after spraying the mean grade of 0 was recorded for all the treatments. Neem products generally do not have any phytotoxic or deleterious effects on crops. However at higher concentrations they have been reported to cause phytotoxic symptoms (Meenakshisundaram, 1991).

Table 3. Bio efficacy of neem formulations applied against purple mite, *C. carinatus*

Treatments	Dose ml/ha	Pre treatment count *	Corrected per cent mortality 1 DAIT	3 DAIT	7 DAIT	15 DAIT	Pre treatment count*	Corrected per cent mortality 1 DAIIT	3 DAIIT	7 DAIIT	15 DAIIT
T1 Neem gold 0.15 EC	625 .	187.2	27.7^{c}	49.9^{c}	71.8^{b}	64.1^{b}	97.1	30.5^{b}	56.0^{c}	79.8^{bc}	37.4^{b}
T2 Neem gold 0.15 EC	1250	152.7	36.27^{b}	53.0^{c}	77.2^{b}	72.^{a}	84.8	32.9^{ab}	56.8^{c}	85.8^{ab}	49.5^{b}
T3 Neem gold 0.15 EC	2500	157.2	38.2^{b}	76.2^{ab}	84.7^{a}	79.40^{a}	69.7	38.2^{ab}	66.9^{ab}	89.8^{a}	52.4^{c}
T4 TNAU neem0.03EC	250	173.4	22.9^{c}	26.5^{d}	31.2^{c}	26.80^{c}	121.6	21.3^{d}	28.1^{d}	39.8^{d}	41.1^{c}
T5 TNAU neem 0.03EC	500	151.1	46.5^{a}	71.5^{b}	76.4^{b}	72.90^{a}	76.2	37.3^{ab}	62.1^{b}	74.9^{c}	49.3^{b}
T6 Ethion 50 EC	500	143.2	51.5^{a}	80.7^{a}	85.2^{a}	77.0^{a}	53.1	42.6^{a}	71.8^{a}	87.2^{a}	41.7^{a}
T7 Control *		167.8	173.2	175.1	189.2	203.0	203.0	209.2	212.1	220.2	221.2

DAIT- Days after Ist treatment, DAIIT – Days after II treatment; * Number of mites per 50 leaves
Means followed by same letter in a column are not significantly different by (p=0.05) DMRT

Residue of azadirachtin

The mean recovery of the azadirachtin residue from the fortified leaf samples of made tea was 80 per cent. The determinability level of azadirachtin was 1.00 ppm. In all the treatments the residues were below detectable limit in samples taken one day after treatment. The presence of azadirachtin residue below the detectable limit may be due the time lag between the application, harvesting and processing. Azadirachtin is highly labile when exposed to air heat and UV. During the tea manufacture the tea leaves are dried at 100 – 150^0 C during which 30 – 60 per cent of the pesticide present in the shoot is lost due to thermal decomposition (Muraleedharan, 1997). The series of operation from plucking to manufacturing reduces the azadirachtin residues.

As the neem formulations TNAU neem 0.03 EC and Neem Gold 0.15 EC have desirable on the scaling down the population of *C. carinatus* without causing phytotoxicity and leaving undesirable residues on the crop matrix they would be an ideal component of Integrated Pest Management of *C. carinatus*.

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