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Research Article

Acaricidal and Ovicidal Effects of *Vitex negundo*, Against *Oligonychus coffeae*, A Common Pest Found in Tea Gardens of North Bengal, India

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Abstract

Tea, a widely consumed and economical beverage across 65 nations, confronts substantial challenges from pests, notably the destructive Red spider mites, which pose significant hurdles for the industry due to their resilient nature and severe impact. Chemical pesticides, while effective against pests in tea production, degrade tea quality, prompting exploration into natural alternatives like floral diversity for pest control. A study in North Bengal, India, aims to the pest-controlling abilities of common weed found in tea gardens in the Terai and Dooars regions.The aqueous extracts of Vitex negundo L. as biocide employed in this study demonstrated substantial acaricidal and oviposition deterrent action against the tea Red Spider Mite Oligonychus coffeae after 48 hours of application. In the future, this aqueous extract could prove to be a fairly priced and efficient acaricide.

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Introduction

The majority of people in the world nearly two-thirds consume tea, which is their second favourite beverage after water. India produces a significant amount of tea, with North East India producing over 75% of all the country's tea (Roy et al.2020). India is also the world's greatest consumer of tea, with 90% of Indian families reporting regular tea consumption (Jain, 2012). Tea plants are subjected to many pest attacks though only around 380 species of phytophagous insects and mites pests are documented from India, it is predicted that more than 1000 species of arthropods infest tea throughout the world as pests, incidental visitors, as well as predators and parasitoids of pests (Hazarika et al. 2009a) (Roy et al. 2014). Pest-related crop loss is from 15% to 20%. (Muraleedharan and Selvasundaram 2002). Given the increased productivity and output, the magnitudes of losses are certain to be bigger today. Due to the frequent and uncontrollable reappearance of the pest and the prolonged usage of conventional pesticides, the mites developed high chemical resistance (Roy et al. 2019), resulting in crop loss and a consequent economic blow to India's tea trade. In order to combat significant pests of tea in Assam, Darjeeling, and West Bengal, (Gurusubramanian et al. 2008) utilized the ovicidal, antifeedant, and insecticidal or acaricidal properties of solvent extracts from a variety of plants, including *Heliotropium indicum* L., *Spilanthes calva* DC., *Polygonum* h*ydropiper* L., *Pogostemon parviflorus* Benth., *Polygonum glabra* (Willdenow) M. Gómez, *Azadirachta. Indica* A.Juss. etc against *Adalia bipunctata*. Similar *to P. hydropiper*, *Annona squamosa*, *Clerodendrum viscosum*, *Argyreia speciosa*, and *Leucas aspera*, aqueous extracts of these plants have demonstrated varying degrees of control over the black-inch looper *Hyposidra talaca* (Roy et al. 2015).

In *Vitex negundo* L. there are several secondary phytochemical metabolites present in every part of the plant (Vishwanathan and Basavaraju, 2010), from the root to the fruit, giving it an unheard-of range of medical benefits. Fresh leaves of *V. negundo* L. have anti-inflammatory, analgesic, and antihistamine properties (Dharmasiri et al. 2003). There is not much work regarding the efficacy of Vitex negundo against *Oligonychus coffeae* Neitner

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done in thease North Bengal region except a few (Deka et al.2017). Therefore, the present work has been designed to primarily evaluate the efficacy of aqueous extracts of *V. negundo* L. to control the tea red spider mite (*O.coffeae*) as a part of integrated pest management with inquisitive emphasis on adulticidal and ovicidal effects.

Materials and methods

Red Spider Mite (RSM) rearing

The detached leaf culture method of Roy et al. 2010 was used to maintain a red spider mite culture on a sensitive tea clone, like TV 25, and TV 26 in the lab at 25C and 70-80% relative humidity.

Preparation of botanicals

Locally available leaves and succulent stems of *Vitex negundo* L. (Lamiaceae) were collected in North Bengal, India. After drying in the shade, the plant material was pulverized with an electric grinder. Using soap nut powder as a surfactant, aqueous plant extracts from powder samples were created using the cold percolation technique. Using Whatman (no. 1) filter paper, the resulting extract was collected, filtered, and the volume was adjusted to produce the desired concentrations.

Bioassay studies of botanical aqueous extracts on Oligonychus coffeae adults

Twenty red spider mites, healthy gravid females, were introduced on Tea leaf discs with a 2 cm diameter, dipped in various extract strengths, and dried. Then, filter paper and a damp cotton bed are laid on top of the leaf discs. Leaf discs that had been wetted were utilized as a control. Each concentration of the investigated plants was subjected to three separate iterations of the experiment. We studied the leaf discs after 24 and 48 hours (Fig.1).

Statistical analysis

Probit analysis and IBM SPSS version 21 were used to find the LC50 values or lethal doses that caused 50% of the larvae to die. Results were considered statistically significant if they met the threshold of 0.05.

Ovipositional deterrence

By using the technique developed by Roy et al. 2011, the ovipositional deterrent generated by aqueous extract after 48 hours was investigated.MS Excel was used to determine the discrimination quotient using the formula provided by Roobakkumar et al. 2010. On each of the variably treated leaf discs, five gravid females were transplanted and permitted to oviposit. After transferring all the mites, the number of eggs laid was counted. As a baseline for all tests, water-treated leaf discs were used.

Results and Discussion

The mite populations in the Terai and Dooars showed high resistance to widely used acaricides like Fenazaquin 10 EC and Propargite 57 EC because they were used for a long period. The present bioassay and ovipositional deterrence studies were done by using pieces of tea leaves dipped in different concentrations of aqueous extracts of *Vitex negundo* against *O. coffeae* and LC50 and LC90 values were determined which shows the lethal concentration of mite mortality. By using probit analysis, it was discovered that adult O. coffeae mortality was linearly proportional to the length of time following treatment for each increasing concentration. the LC50 and LC90 values after 48 hours for *Vitex negundo* aqueous extract is 19.551 mg/ml and 93.437 mg/ml. In control the mortality was null (Fig 1 and 2).

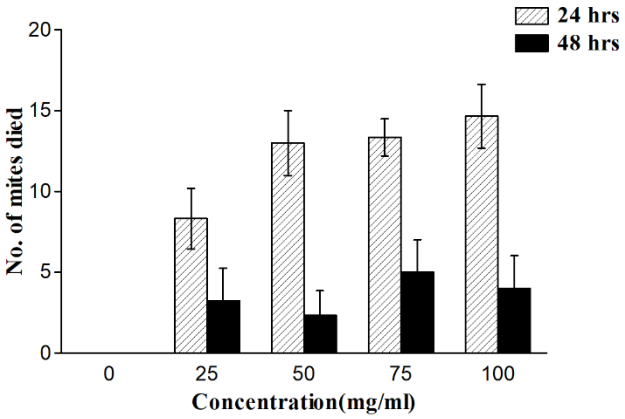

Figure 1. Mortality rate of *O. coffeae* with the treatment of botanicals

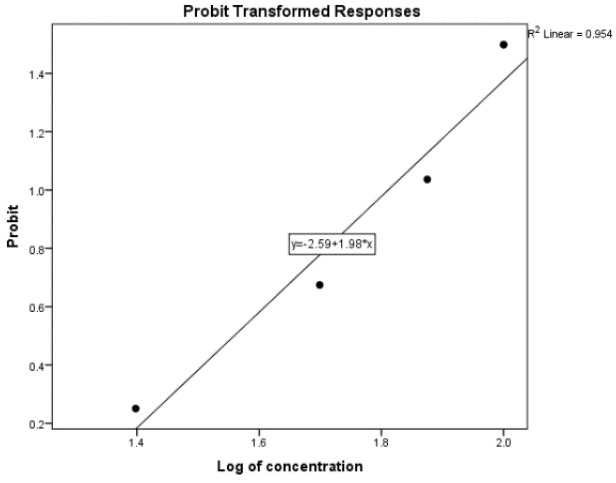

Figure 2. Probit analysis of *Vitex negundo* plant extract

The botanicals demonstrated ovipositional deterrents, and their discrimination quotient was assessed (DQ). The discriminating quotient, which runs from 0 to 1.0, is a technique for assessing how drugs affect insects' egg-laying behavior. The mites made a distinction between the treated leaves based on the number of eggs deposited when the leaves were treated with botanicals. On leaf discs treated with various doses of the botanicals' aqueous extract, red spider mites did not produce eggs. The value of the Ovipositional Discrimination and Deterrence Quotient is stated in Table 1.

Table 1. Ovipositional deterrence and discrimination quotient (DQ) value of *Vitex negundo* extracts on *Oligonychus coffeae*

Treatment	Dosages mg/ml	No. of egg laid	DQ value
Vitex negundo	25	8.3	0.566
	50	5.1	0.709
	75	4	0.764
	100	2	0.875
Control	0	30	

The number of mite eggs placed on leaf discs treated with the strongest aqueous extract of *Vitex negundo* during the investigation of ovipositional deterrence was zero, and the DQ value it provided was 1.0, which is consistent with the findings of (Thanigaivel et al. 2017). The cost of making botanicals from weeds that occur often in tea plantations is virtually nothing, therefore, economically; botanicals can also reduce the cost load of controlling red spider mites at least impeding them from reaching the economic threshold level.

Conclusion

The importance of biopesticides has increased due to the risk or adverse effects of chemical pesticides and their growing resistance to pests. Thus, the use of traditional chemical pesticides is declining daily as a result of increased awareness of the deleterious effects of chemicals. Significant acaricidal and ovipositional deterrent effects were found in the aqueous extracts of *V. negundo* L which was used for this study. However, since the experiments were conducted in a lab setting, its effectiveness in the plantations of the North Bengal region is still unknown. Further studies are required to validate the findings in field conditions, with respect to the present climate changes.

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Conflicts of interest

There are no actual or potential conflicts of interest to declare.

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