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Acaricidal Activities of *Parthenium hysterophorus* L. against Red Spider Mite, Oligonychus Coffeae Nietner (Acarina: Tetranychidae) of Tea

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Abstract: ***The different solvent extracts (viz. Petroleum ether, Chloroform and Methanol) obtained from the leaves of Parthenium hysterophorus L. were tested for acaricidal effects against Oligonychus coffeae Nietner (Acarina: Tetranychidae). The methanol extract showed highest mortality against the adults of O. coffeae followed by petroleum ether and chloroform extracts. The LC50 value of methanol extract against the adult mite was 0.12% (48h). No mortality was observed in control. Thus methanol extract of Parthenium hysterophorus is known to be a promising source for the controlling of Oligonychus coffeae.***

Keywords: Red spider mite, *Oligonychus coffeae*, Mortality, *Parthenium hysterophorus*.

1. Introduction

Chemical control is the major means of insect pest control in the crop production worldwide. Use of hazardous chemicals have over the years manifested in a number of disadvantages, the most important of which are the risks involved for human health and for the environment. Recently, there has been a major concern for the promotion of botanicals to protect crop produce and the environment from synthetic pesticide pollution. Botanicals are eco-friendly, have low mammalian toxicity, causing less impact on non-target organisms and they are less expensive than their synthetic counterparts, due to their natural availability to the environment.

Parthenium hysterophorus L., is an annual herb belonging to the family Asteraceae. This aggressive weed is native to the subtropics of North and South America but now has invaded Asia, Africa and Australia during the last 50 years. The weed is noxious on two counts. Firstly, it is a highly adaptable weed and can grow luxuriantly in wastelands and vacant lands, orchards, forestlands, flood plains, scrub/shrub lands, urban areas, agricultural areas and cause substantive losses in the yield of agriculture [1]-[5] secondly it is a health hazard [6]. Direct contact with plant or plant parts, living or dead, results in dermatitis in mankind and the presence of pollens in the air cause diseases like air borne contact dermatitis [7], fever and asthma [8]-[11].

Parthenium introduced accidentally in India in 1955 through the imported food grains and at present has occupied almost all parts of India [12]. The weed has spread like wildfire throughout India. It occupies over 5 million hectare of land in the country. Parthenium has shown several prominent biological activities in animal and human models. It was used as a folk remedy against various affliction such as ulcerated sores, certain skin diseases facial neuralgia, fever and anemia. A report of 1921 indicates that the flowers of this plant were being used as tonic, blood purifier, abortive, vermifuge, ammenagague and as an insecticide in various parts of Europe [13]. Parthenin the active compound present in *P. hysterophorus* is known to show activity against termites, cockroaches [14] as well as migratory grasshoppers, *Melanoplus sanguinipes* F. [15], [16]. Whole plant extract of *P. hysterophorus* showed insect growth regulatory activity against the cotton stainer, *Dysdercus angulatus* F. [17], fifth instar larvae of S*podoptera litura* [18]. Petroleum ether extract of leaves, stem and inflorescence of *P. hysterophorus* shows toxic effect on mean life span and progeny production of adults of the mustard aphid, *Lipaphis erysimi* [19]. Parthenium has been shown to act as a feeding deterrent to the adult of *Dysdercus koenigii* F., *Tribolium castaneum* Hbst, *Phthorimaea operculella* (Zell), *Callosobruchus chinensis* L. [20] and sixth instar larvae of *Spodoptera litura* (F) [21]. Extract of *P. hysterophorus* show toxicity against root knot nematodes *Meloidogyne incognita* (Kofoid and white), Chitwood, *Helicotylendus dihyslera* (Cobb) sher. [22]. Crushed leaves admixed into the soil are used to reduced root galling in papaya caused by *M. incognita* [23].

Red spider mite, *Oligonychus coffeae* Nietner (Acarina: Tetranychidae) is an important pest of tea in most of the tea growing areas of the world. It has been recognized as a serious pest of other crops like mango, coffee, cotton and jute in Southeast Asia, South and East Africa and the Middle East including India, Sri Lanka, Malawi, Kenya, Taiwan, Bangladesh and Egypt [24], [25]. *O. coffeae* favors the upper surface of the mature tea leaves and forms dense aggregations along the midrib and veins of the leaves [25]. *O. coffeae* does not directly injure the commercially important young shoots, but causes the maintenance foliage to turn brown and drop. Such serious damage leads to a reduced flush of the young shoots. Nymph and adults of the mite produce reddish brown marking on the upper surface of mature tea leaf during feeding. Red spider mite causes 17-46% crop loss [26]. As one of the chemical control methods, dicofol and/or tetradifon were found effective against *O. coffeae* on tea and jute in India [24], [25].

In the present study the leaves of *P. hysterophorus* was extracted in various solvents successively and the extracts were tested against the adults of *O. coffeae* to establish in order to identify new some of control for this pest.

2. Materials and Method

2.1. Plant Materials

Plant was collected from Jorhat District (N=26º44´397´´,E=095º08´270´´) of Assam and identified in the Taxonomy laboratory of the North East Institute of Science & Technology, Jorhat, Assam, India. Herbarium voucher specimens were prepared and deposited for preservation in the above Department.

2.2. Preparation of Plant Extract

Approximately 2 kg of above ground parts, mainly leaf of the plant was collected and chopped into small pieces, shade-dried at room temperature for three days. Plant material was coarsely ground and material was extracted successively with petroleum ether, chloroform and methanol by cold extraction technique. Cold maceration was carried out for 72 h with 24 h intervals to ensure the extraction of a larger number of substances from the plant. The extract was filtered and evaporated at reduced pressure to minimize possible degradation of the chemical constituents at high temperatures. The solvent and moisture from each extract was removed completely in rotary evaporator and Lyophilizer respectively. The solvent crude extracts were then used for bioactive studies against adult red spider mite.

2.3. Preparation of Insect

The stock culture of *O. coffeae* Neitner ware started from females and males collected from tea, *Camellia sinensis* (L.) at Jorhat, Assam, India. The culture was maintained on tea leaf placed on a water saturated polyurethane mat in Petri dishes at laboratory room conditions at approximately 25±3°C, 53±16 % RH and 12:12 photoperiod. The mites were reared on the upper side of tea leaf. Tea leaves were changed every 5 days or when needed.

2.4. Acute Toxicity Screening Bioassay

Bioassays of the plant extracts were performed with adults of *O. coffeae* Nietner using concentrations viz. 1%, 0.5%, 0.25%, 0.125%, 0.062 % and 0.031%. The assay was carried out by leaf disc method [27], [28]. Leaf discs were prepared from mature tea leaves collected from experimental farm. Five leaf discs of 2 cm diameter was prepared and placed with its ventral surface down over the wet cotton taken in a petriplate (9 cm diameter) and each disc represents a replicate. Extract concentration were prepared by the use of A/R grade Acetone (99% pure). Tea leaf discs were sprayed uniformly with the plant extract by the help of an atomizer. Thereafter, the solvent was allowed to evaporate at room temperature and twenty adult mites were introduced on each disc with a No. 000 spotting brush and allowed to settle in the disc. A control was prepared in the same way with solvent acetone only. Twenty replicates were set up for each treatments and control. Mite mortality was recorded after 24 hours interval.

3. Results and Discussion

In the present investigation, the acaricidal activity of petroleum ether, chloroform and methanol extracts of *P. hysterophorus* was tested against the adult stage of *O. coffeae* by leaf disc method. Data regarding the collection of the plant material are presented in Table 1.

Table 1: Plant specimen information

Plant name	Family	Area collected	Parts used	GIS Data
Parthenium hysterophorus L.	Asteraceae	Parbotia Goan, Jorhat	Leaf	N=26º44´397´´ E=095º08´270´´

The extracts showed significant effect on the mortality of adult RSM. Among all the extracts of *P. hysterophorus* methanol extracts showed significant adult mortality of 97.25% at 1% concentration at 24 h of observation followed by chloroform ether (65.03%) and petroleum ether extracts (47.43%). The dose dependent effect of all the extracts was shown in figure 1.

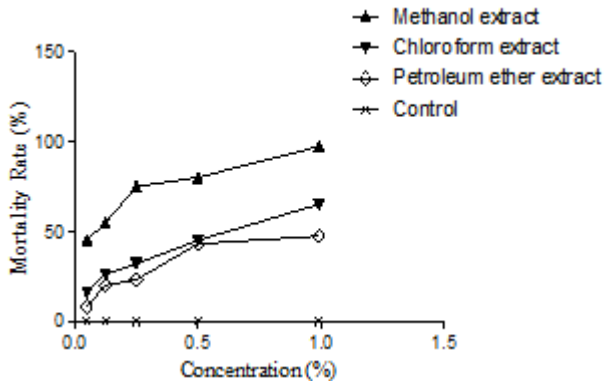

Figure 1: Concentration mortality response data of petroleum ether, chloroform and methanol extracts of *P. Hysterophorus* against the adults of *O. coffeae* Nietner. (After 24 hours).

The LC_{50} value of all extracts was calculated and presented in table 2. At 48 hour exposure, the LC_{50} value of petroleum ether, chloroform and methanol extracts were 1.02%, 0.55% and 0.12% respectively (Table 2).

Table 2: Log-probit analysis of acaricidal efficacy of petroleum ether, chloroform and methanol extracts of *P. hysterophorus* against the adults of *O. coffeae* Nietner. (After 24 hours).

Solvent	*LD_{50} (%)*	*Regression equation*	*R^2*	*Degree of freedom*	*Slope ± SE*
Petroleum ether	1.02	Y=0.1047+0.0940X	0.76	59	0.104 ± 0.037
Chloroform	0.55	Y=0.1538+0.0774X	0.79	59	0.153 ± 0.034
Methanol	0.12	Y=0.1659+0.0431X	0.78	59	0.153 ± 0.038

There was no mortality observed in the control group. Similarly Pavela (2009) [29], obserced 100% mortality of *Tetranychus urticae* Koch by spraying pongam oil at 1% and 3% concentration. Attia *et. al.* (2011) [30], reported that garlic jouce at a concentration of 7.49 showed LD_{50} value

against *Tetranychus urticae* Koch. B. Radhakrishnan and P. Prabhakaran (2014) [31], evaluated The commonly available weeds found in tea plantations such as, *Ageratum houstonianum*, *Allamanda catharitica*, *Bidens pilosa*, *Casuarina equisetifolia*, *Conyza bonariensis*, *Crassocephalum crepidioides*, *Gliricidia sepium*, *Lantana camara*, *Ocimum basilicum* and *Tithonia diversifoila* for their adulticidal efficacy against RSM under laboratory condition at the 2.5 and 5.0% concentration and revealed that the aqueous extracts of *A. catharitica* and *C. bonariensis* showed 100% and 80% adult mortality respectively at 5% concentration after 96 h of observation. The remaining plants show moderate adulticidal effect on RSM. Sarmah *et.al.* (2009) [32], evaluated Four aqueous plant extracts of *Acorus calamus* L., *Xanthium strumarium* L., *Polygonum hydropiper* L. and *Clerodendron infortunatum* (Gaertn) under both laboratory as well as in field conditions at 2.5, 5.0 and 10.0% (w/v) concentrations against tea red spider mite, *Oligonychus coffeae* (Nietner). They revealed that maximum mortality of RSM was attained in *C. infortunatum* (100%), followed by *A. calamus* (88.7%) and *X. strumarium* (94.8%), and finally by *P. hydropiper* (84.8%).

4. Conclusion

The present investigation revealed that methanolic extract of *P. Hysterophorus* has good acaricidal activity and may find scope in integrated pest management system of *O. coffeae*. However further studies are necessary for optimization of bioactive compounds.

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