Formulation of natural insecticides against *Panchaetothrips indicus* Bagnall in *Curcuma longa* L. leaves of PTS and Erode varieties

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ABSTRACT

The toxicity of three concentrations (10%, 15% and 20% w/v) and foliar spraying schedules of plant extracts from *Azadiracta indica* (Meliaceae), neem kernel and *Vitex negundo* (Verbenaceae), *Aloe vera* (Asphodelacea) *Gloriosa superba* (Colchicaceae), *Chrysanthimum cinearifolium* (Asteraceae) and *Ocimum tenuiflorum* (Lamiaceae) for managing a major leaf pest of *Curcuma longa*, was investigated. The insect pest was *Panchaetothrips indicus* Bagnall (Thysanoptera : Thripidae) which causes the folding of leaves and affects the yield of its rhizome. Two concentrations of extracts which proved efficacy in lab studies were tried upon *P.indicus* in field in two seasons. Higher concentrations (20% w/v) and a combination of neem seed kernel and *Vitex negundo* leaf extracts significantly ($P < 0.05$) reduced the number of the insect pest compared to the untreated control in both years. Leaf damage was significantly reduced and rhizome yield increased compared to untreated plants.

Key words: Biopesticides, *Chrysanthimum cinearifolium*, neem seed kernel, turmeric, *Vitex negundo*

INTRODUCTION

Today**,** interest in biopesticides is growing, as they show promise in the protection of agricultural crops. Insect pest control strategy swings towards safer products which are called biopesticides which are derived from natural materials such as animals, plants and bacteria. These products are developed with a strong emphasis on protecting the environment and food consumers from the harmful effects of poisonous chemical pesticides. Experiments for standardizing and field testing natural products by determining the precise range and determining the optimum concentration at which they can be effective against pests without being harmful to useful organisms and predators should be carried out for unveiling their enormous potential. *Curcuma longa* is a major spice crop grown abundantly in India and other tropical countries. Turmeric rhizome is used as a food additive (spice), preservative and colouring agent (Agarwal *et al*., 2007) in Asian countries, including China and India. It is also considered as auspicious and is part of religious rituals. Erode region of Tamil Nadu, India is very famous for turmeric cultivation and is called as "Yellow city" as it is the leader in turmeric production and export. The plant is affected by many pests like shoot borer, leaf roller and thrips along with rhizome rot disease. The present study deals with the control of *Panchaetothrips indicus*, a serious pest of turmeric leaves causing it to fold inside. In the present study, two varieties of turmeric cultivated in Tamil Nadu, India namely the Erode variety and PTS Variety are taken for the *in vitro* and field studies.

Panchaetothrips indicus was reported as a pest of turmeric, *Curcuma domestica* in India (Bagnall, 1912). *P. indicus* commonly called as thrips is a sucking pest of leaves. Nymphs are gregarious in nature and feed on the upper surface of young turmeric leaves. Its occurrence starts in the month of August and lasts until November. There are two distinct stages, the nymphal stage which lasts for a week when it appears white and sluggish. The pest then becomes adult and is blackish and moves fast. They suck the sap of the leaves which in turn become yellow and roll inside within which the pests dwell. There is a considerable crop loss because following severe infestation, young plants die and the rhizome yield is proved to get decreased.

Lewis (1997) worked with *T. tabaci* and stated that the adults are more easily susceptible to insecticide action than larvae. The work of on onion thrips and green peas aphid revealed the efficacy of spinetoram has tested the efficacy of botanicals in white backed plant hopper of rice. Dharmadasa *et al*. (2008) tested seven pesticides against cardamom thrips in *Elettaria cardomomum*.L. The present study was carried out to evaluate the pesticidal action of a few plant extracts against *P.indicus*

in lab as well as field conditions. The extracts were taken from *Azadiracta indica, Aloe vera, Gloriosa superba, Chrysanthimum cinearifolium and Ocimum tenuiflorum.* Zahir *et al*. (2009) found that Glory Lily *G. Superba* had the potential to be used as an ideal ecofriendly parasite controlling agent. Its seeds and tubers are widely used for this. Agarry *et al*. (2005) and Baby Joseph (2010) have worked on the various applications of *Aloe vera*. *Ocimum tenuiflorum* commonly known as Krishna thulasi has been used for centuries as insect repellent. Neem products are also used selectively in controlling pests of various economically useful plants. The seeds contain a complex secondary metabolite azadirachtin which imparts a bitter taste. It acts as an anti-feedant, repellent, and egg-laying deterrent, protecting the crop from damage. The insects starve and die within a few days. Neem also suppresses the hatching of pest insects from their eggs. Pyrethrum is a natural insecticide made from the dried flower heads of *C. cinearifolium* and *C. coccineum.* Pyrethrum has been used for centuries as an insecticide and as a lice remedy in the Middle East.

MATERIALS AND METHODS

Plant materials

The two varieties of *C.longa* were grown in the Botanical garden of K.S.Rangasamy College of Technology, Tiruchengode, Tamil Nadu, India. A part of it was maintained in disease free conditions without any pest attack.

Preparation of plant extracts

The various parts of the plants were brought to the laboratory, washed twice in tap water to remove the soil particles and dried before extraction procedure. The leaves of *Azadiracta indica, Aloe vera* and *Ocimum tenuiflorum,* the flowers of *Chrysanthimum cinearifolium* and tubers of *Gloriosa superba* were used for this study. 200 gms of each crushed material was placed separately in a columnar extraction system and 250 ml of methanol was provided for extraction. The extraction process was carried up to 12–15 cycles .The recovered extracts were passed through rotary evaporator to remove the solvent. The extracts were partially dried under vacuum below 40°C. These crude extracts were used for preparing stock solution. The known amount of (100 mg/ml) crude extract obtained from the above process was diluted to obtain the desired concentration 10% 15% and 20%). A drop of emulsifier Tween 80 (Himedia, Mumbai) was added to the respective solvent extracts to ensure complete solubility of the material in water. Soap and starch were mixed with water during dilution to ensure stickiness of the extracts to the leaves and to avoid being readily washed out by mild showers of rain during the test season. The yields of different plant materials were recorded. The content of pesticidal ingredients can vary widely depending on plant variety, soil, climate, season, mode of preparation, etc.

Laboratory Bioassay

Leaf discs of 21cm diameter were cut in fresh unaffected turmeric leaves and dipped in various concentrations of plant extracts and kept above moistened cotton in Petri plates. *P.indicus* were collected, using 5 cm long transparent glass tube aspirators, from untreated turmeric plants and to each test dish, 30 insects were inoculated with a fine soft brush. All the Petri dishes were kept at 28°C and 85% RH in dessicators (Ghosh and Azhahianambi, 2007). The effect of individual extract at three different concentrations was recorded. A commercial pesticide, Imidachloprid was used for comparison and a control was maintained where water alone was sprayed.

Field trials

Field experiments were conducted in the turmeric field of K.S.Rangasamy College of Technology and in a turmeric field in Karungalpalayam, Erode to evaluate the field efficiency of the plant extracts which showed effectiveness in lab tests. The experimental region was divided into plots of 0.2 ha. The treatment was arranged in a randomized complete blocks design with three replicates each. Two concentrations of each extract were applied with a motor sprayer. The volume of mixture applied was about 120 L/ha. Leaf samples were taken at 6, 12, 18 and 24 hrs after treatment. Ten leaves were sampled from each treatment, every six hours after treatment, examined with a stereomicroscope and the number of dead individuals was noted.

Efficacy of the plant extract was estimated with Henderson's formula (1955): $\mathbf{100 \times [1-(Ta \times Cb)/(Tb \times Ca)]}$

Statistical analysis

The experimental design for all trials was completely randomized. The data were analyzed using the analysis of variance (ANOVA) and the mean values were compared by using the Turkey multiple range tests ($P<0.05$) using statistical package for the social sciences (SPSS) package 11.5 version.

RESULTS

In the present study, the leaf extracts showed good efficiency in all concentrations. The results of the effect of plant extracts are presented in Table 1. The maximum efficiency was observed with neem kernel-*Vitex negundo* extract combination in its 20% concentration in both varieties in the lab assay. There was a slight difference in its lower concentration. *C. cinerifolium* extract also gave a very similar result of 80.67%

Table 1. The effect of plant extracts on *P.indicus* at three concentrations in laboratory conditions

VARIETY	PTS			ERODE		
conc	10%	15%	20%	10%	15%	20%
Azadiracta indica	21.67±1.5^{e}	23±1^{e}	26.33±0.6^{d}	22.67±1.2^{d}	20.67±1.2^{d}	23±1^{d}
Neem Kernel-*Vitex negundo*	25.33±1.5^{f}	25.67±1.2^{f}	27.67±1.5^{e}	23±1^{d}	23.67±1.5^{e}	25.33±0^{e}
Chrysanthemum cinearifolium	21.67±1.5^{e}	21.67±2.1^{d}	25.67±1.2^{d}	22.67±1.5^{d}	22.67±1.5^{e}	24.67±0.6^{de}
Gloriosa superba	19.33±0.6^{d}	21±1^{d}	23±1^{c}	18±1^{c}	19.33±0.6^{d}	22.33±0.6^{d}
Aloe vera	10.33±1.5^{b}	13.33±1.5^{b}	19±1^{b}	16.33±1.2^{c}	15.67±2.1^{c}	19.33±0.6^{c}
Ocimum.tenuiflorum	12.67±2^{c}	17.33±1.5^{c}	19±1^{b}	1.3±0.6^{a}	12±0^{b}	14.67±1.5^{b}
Imidachloprid	29.33±0.6^{g}	29±1^{g}	29.33±1.2^{f}	27±1^{e}	26.67±1.5^{f}	26.33±0.6^{f}
Control	0.33±0.6^{a}	3±1^{a}	1.67±1.2^{a}	2±1^{b}	1.67±0.6^{a}	1±0^{a}

The values are mean of three replicates ± SD.Means within a column marked by the same letter were not significantly different at P=0.05.

efficiency in 20%. The least efficiency was observed in case of *Aloe vera* 10%. when applied on Erode variety of leaves. Table 2 shows the efficiency of plant extracts against*P.indicus* infected leaves of *C. longa* in field studies which are expressed as percentage. The extracts which showed good efficiency on *P. indicus* were selected for field trials which were tested in two concentrations.

All the botanicals tested reduced the population of *P. indicus* in both PTS and Erode variety of turmeric plants. The maximum mortality rate of *P. indicus* was observed in 18 hrs in PTS variety and in 24 hrs in Erode variety. Neem seed kernel- *V. negundo* extract showed maximum mortality (6.67 for 10%) and (8.33 for 20%) as in lab conditions. Among the four extracts used for the field experiments, *G.superba* showed a minimal effect (1.33 at 6 hrs) in PTS. Although the activity of neem leaf extract was low at 6th hrs of observation, its activity increased at 18 hrs. Next to NKVM extract, *C. cinerifolium* showed a remarkable effect in killing the pest followed by *G.superba*. There was not much difference between these two extracts in both lab and field trials.

DISCUSSION

The use of synthetic chemicals to control pests should be avoided due to their carcinogenicity, residual toxicity, hormonal imbalance, long degradation period, environmental pollution and their adverse effects on food and side effects on humans (Kumar *et al.*, 2007). Since these chemical pesticides which are sprayed over the leaves of turmeric plants against different pests gets incorporated in the rhizomes which are directly consumed by the public daily through food, it is essential to restrict their use and a shift towards the use of botanicals and biopesticides should be emphasized.

Results on the mortality of *P. indicus* by plant extracts confirm their potential to be used as biopesticides. Dubey *et al.* (2008) has studied the role of biopesticides in pest management. Among the different extracts tested in the present study, 20% concentration of a combination of neem seed kernel extracts along with *V. negundo* was found to be significantly effective against *P. indicus.* Previously, Gupta *et al.* (2000) evaluated the effectiveness of petroleum fractions of neem seed against

Table 2. The efficiency of plant extracts against *P.indicus* infected leaves of *C.longa* in fiels studies expressed as percentage.

VARIETY	PTS		ERODE	
Concentration	10% w/v	20%w/v	10% w/v	20%w/v
Neem leaf extract	68±5.7	77.67±2.1	62±5.6	69.33±2.5
NK-*Vitex negundo*	81.7±2.3	87.34±2.3	83±3	89±4.4
Chrysanthemum cinearifolium	67±2.6	80.67±4.7	61±2.6	65.67±1.5
Gloriosa superba	67.33±4.5	62.33±5	66±1.7	63.33±4.9
Aloe vera	18.67±2.1	33.67±3.1	11.67±5	67±4.6
Ocimum.tenuiflorum	44.67±2.5	19.67±2.3	28.67±4.2	34.67±4.6

The values are mean of three replicates±SD.

B. microplus by *in vitro* test. Their findings denote that neem seed extracts have good potential to develop neem products as biopesticides. Boricha *et al.* (2010) suggested that a combination of chemical pesticides and biopesticides are effective over *Thrips tabaci* affecting hybrid cotton. Sahayaraj *et al.* (2011) recorded the effectiveness of combinations of botanicals and fungal extracts. Babu *et al.* (2001) studied the toxicity of neem seed kernel extract (NSKE) and combination of NSKE and the entomopathogenic fungus *Beauvaria bassiana* on *S.litura* under laboratory trials and concluded that combination of both has significantly increased the mortality rather than the individual treatments.

Among the six extracts tested *in vitro* four were found to be promising and selected for field studies. When a treatment is compatible *in vitro*, there is a strong proof of its selective performance in field conditions. The mortality rate of thrips was high in both concentrations at 18 hours for PTS and 24 hrs for Erode variety. The reason for this variation may be due to the genetic variability of the varieties. PTS is said to be more tolerant than Erode variety which is more susceptible for pest attack. Generally, there was slight decrease in the efficacy in field conditions when compared to lab assays. Also, laboratory assays have the advantage of exposing the pest to the maximum activity possible of plant-based products, which has less chance under field conditions. The reason may be due to the slight showers during the tested period. The activity of Pyrethrin, a compound from *C. cinerifolium* was also in a considerable amount against *P.indicus*. Pyrethrin is a broad-spectrum insecticide that affects most insect pests through contact activity. In the present study, the extracts from the tubers of *G.superba* caused good mortality of thrips. *G.superba* is rich in colchicines which might act as an insecticide against thrips. The occurrence of natural enemies of leaf pests of turmeric was also observed in a considerable amount in the present study indicating that the botanicals used are non injurious to predators of the pests. A similar trend was observed by Waiganjo *et al.* (2008) against *T. tabaci* in onions Singh and Kumaresan (1996). In the present study, 10% soap solution and starch were used as stickers which have no proven insecticidal properties. They are easily available in local markets and can be easily used by farmers which are an essential category for preparation of botanicals.

To conclude, a combination of seeds of *A.indica* and *V. negundo* leaf extracts proved to be effective against *P.indicus* causing leaf rolling in turmeric plants. The combined effect of the bitter compounds of neem seeds and nochi leaf causes high mortality of the thrips as reported by Schumuterrer (1990). The present results combat with the results of Alice Sujeetha (2008).

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