Original Article

Insecticidal Effect of *Adathoda vasica* (Leaf) and *Trigonella foenum – Graecum* (Seed) Extracts against Mealy Bugs (*Maconellicoccus hirsutus*) On *Hibiscus Rosa sinensis* Plant

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ABSTRACT

Biopesticides are natural plant products which are environmentally safe, less hazardous, economic and easily available. Mealy bugs are white to pink in colour and measure 3–4 mm in length. In case of *M. hirsutus*, eggs as well as crawlers are pink in colour. Two plant species; were tested as an alternative insecticidal. *A. vasica* leaves and *T. foenum-graecum* seeds. The insecticidal results are also comparable with earlier reports, the data on the mortality of the mealy bug nymph's show that all the treatments were highly significant over control. The experiments were conducted in a petriplate at 25-26°C and under long daylight Analyses of data were performed using statistical program SPSS. Toxicity of two different types of botanical extracts tested against hibiscus mealy bug adults was determined by calculating median lethal concentration (LC_{50}) values. The 24 hr LC_{50} values for the seed extract of *Trigonella foenum-graecum* is 28.18ppm and 24.54ppm respectively for ethanol against *Maconellicoccus hirsutus*. The 24 hr LC_{50} values for the leaf extract of Adathoda vasica is 25.70ppm and 39.81ppm respectively for ethanol *Maconellicoccus hirsutus*. The extracts were relatively more toxic to the mealy bug *Maconellicoccus hirsutus*. The leaf extract of these two plants therefore could be potential source of herbal insecticide for mealy bug population control and could be used in integrated vector management.

Key words: *Trigonella foenum-graecum, Adathoda vasica, Maconellicoccus hirsutus*, Lethal concentration, Vector management.

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INTRODUCTION

The pink hibiscus mealy bug, *Maconellicoccus hirsutus* (Hemiptera, Pseudococcidae), apparently of origin in Southeast Asia, is presently widely-distributed in the Afro tropical, Australia, North America, Central America, South America, Caribbean region, Oceania and the Palaearctic regions.[1] *Maconellicoccus hirsutus* is a polyphagous insect pest which feeds on a wide range of imperative species together with but not restricted to; coffee, guava, citrus, grape, peanuts, rose, beans, coconuts, maize, sugar cane, sour soup, soybean, cotton, and other fiber crops. The feeding of *M. hirsutus* causes malformation of shoots and leaves supposed to be caused by the insertion of toxic saliva.[2] Replacement of synthetic insecticides by bio-rational insecticide is a universally acceptable and practicable approach worldwide. *A. vasica* belongs to the medicinal family Acanthaceae. It is an evergreen shrub of 1-3 feet in height with many long opposite branches. Leaves are large and lance-shaped. Stem herbaceous above and woody below. Leaves opposite and exstipulate. Flower spikes or panicles, small irregular zygomorphic, bisexual, and hypogynous.[3] The various components of the IPM practices in tea with a few specific examples are described by, since the success stories with the use of

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IPM practices are numerous and increasing day by day. Biopesticides are being considered as environmentally safe, selective, biodegradable, economical and renewable alternatives for use in IPM programmers. Biopesticides are belonging to the so called secondary metabolites, which include alkaloids, terpenoids, phenolics, and minor secondary chemicals etc. plant species belonging to different families and genera have been reported to contain toxic principles, which are effective against insects.[4,5]

MATERIALS AND METHODS

Collection of plants and seeds

Two plant species; were tested as an alternative insecticidal. *A. vasica* leaves and T. *foenum-graecum* seeds (Figure 1) were collected from Alagar swami temple street, Gudalur, Theni district, Tamil nadu.

Collection of mealy bug

M. hirsutus were collected from Alagar swami temple street, Gudalur, Theni district, Tamil nadu (Figure 2).

Preparation of Extracts

The materials were stored in the laboratory to dry up. The dried materials were grounded using a blender (Figure 3). The crude extracts were extracted by using Ethanol and water as a solvent with the help of Soxhlet apparatus. This mixture was extracted in 5-6 hr using a Soxhlet machine. For each plant sample 50 g of dried materials were used to prepare the extract.[6]

Phytochemical screening

Leaves of *A. vasica* and *T. foenum-graecum* contain Alkaloids, Saponins, Tannins, Phlobatannins, Xanthoproteins, Steroids, Terpenoids, and Flavonoids etc. The phytochemical compounds present in the leaf of *Adathoda vasica* and *Trigonella foenum-graecum* was identified qualitatively (Figure 4).[7]

Leaf-Spraying Method

Green hibiscus leaf discs were placed into Petri dishes on moisturized cotton. Ten adults were placed in every Petri dish. Then extracts were sprayed with different concentrations using a small hand-held sprayer (Figure 5). The results were assayed after 24hr by counting the number of dead.[8,9]

Statistical analysis

The experiments were conducted in a petriplate at 25-26°C and under long daylight Analyses of data were performed using statistical program SPSS. Data regarding mortality of test mealybugs were recorded at 24 post-treatment and was corrected using Abbot's formula. Toxicity of two different types of botanical extracts tested against hibiscus mealy bug adults was determined by calculating median lethal concentration (LC_{50}) values of each type of extract at each observation time by probit analysis using SBSS software.[10-12] For all the data obtained the differences among the mortality of mealybugs at all treatments were subjected to analysis of variance (one way ANOVA) and differences among means were considered significant at a probability level of five percent ($p \leq 0.05$).

RESULTS

Qualitative Analysis of *Trigonella Foenum-Graecum Seed* and *Adathoda Vasica* Leaf Extracts : The phytochemicals were obtained qualitatively by following the standard procedure. The phytochemicals obtained were alkaloids, steroids, Tannins, saponins, flavonoids, terpenoids, Phenolic compounds, aromatic acid and Xanthoproteins from the two different solvents of ethanol and water[13,14] is shown in the Table 1.

Insecticidal Activity of Trigonella *foenum-graecum Seed Extracts* against Mealy Bug *Maconellicoccus hirsutus*

The results of the Insecticidal activity of Ethanol and water extracts of *T.foenum-graecum* against the *M. hirsutus.*[15-17] is shown in Table 2.

Ethanol Extract

The LC_{50} value of the Ethanol extract of *T.foenum-graecum* was 28.18 ppm against the Mealy bug, *M.hirsutus.* Regression equation were y =4.10x-0.98. The 95% lower and upper confidence limits of LC_{50} were 1.13.88 and 75.53ppm. The chi-square value 30 and *p* value is 0.224 was not significant at $p< 0.05$ level. Percent mortality of *M.hirsutus* exposed to ethanol extract of *T. foenum-graecum* is shown in the Table 3. Insecticidal Activity of *Trigonella foenum-graecum* Seed Water Extracts against Mealy Bug *Maconellicoccus hirsutus* were shown in Table 4.

Aqueous Extract

The LC_{50} value of the water extract of *T.foenum-graecum* was 24.54 ppm against the Mealy bug, *M.hirsutus.* Regression equation were y =1.73x+2.60. The 95% lower and upper confidence limits of LC_{50} were 28.11 and 75.89ppm. The chi-square value 30 and *p* value is 0.224 was not significant at $p< 0.05$ level. Percent mortality of *M.hirsutus* exposed to water extract of *T. foenum-graecum* is shown in the Table 5. Mortality rate of *M.hirsutus* exposed to water extract of *T. foenum- graecum* is shown in Table 6.

DISCUSSION

The insecticidal properties of number of plants have been discovered long ago. Botanical plant extracts are environ-mentally less harmful than synthetic pesticides to control pests. They possess one or more useful properties such as biodegradability, broad spectrum of activity and ability to reduce insect resistance.[19-22] Plant derived insecticides encompasses an array of chemical compounds which protect the plants from the attack of insect-pests and moreover botanical insecticides exhibit a limited effect on beneficial insects, rarely toxic to mammals and man, and development of resistance in insects is limited. Therefore the present study attempts to evaluate the efficacies of *Trigonella*

Table 1: Qualitative Analysis of *Trigonella foenum-graecum* Seed and Adathoda *vasica* Leaf Extracts.

Sl.No	Phytochemical	Ethanol (*Adathoda vasica*)	Water (*Adathoda vasica*)	Ethanol (*Trigonella foenum-graecum*)	Water (*Trigonella foenum-graecum*)
1	Alkaloids	+	+	+	+
2	Steroids	+	+	+	+
3	Tannins	+	-	+	-
4	Saponins	-	+	-	+
5	Flavanoids	+	+	+	+
6	Terpenoids	+	+	+	+
7	Cardiac Glycosides	-	-	-	-
8	Phenolic Compound	+	+	+	+
9	Aromatic acid	+	-	+	-
10	Xanthoproteins	+	+	+	+
11	Phyllopatanins	-	-	-	-

Figure 1: (a) *Adathoda vasica* leaves (b) *Trigonella foenum*- graecum seeds Collection of mealy bug

Figure 2: Collection of Mealy Bugs.

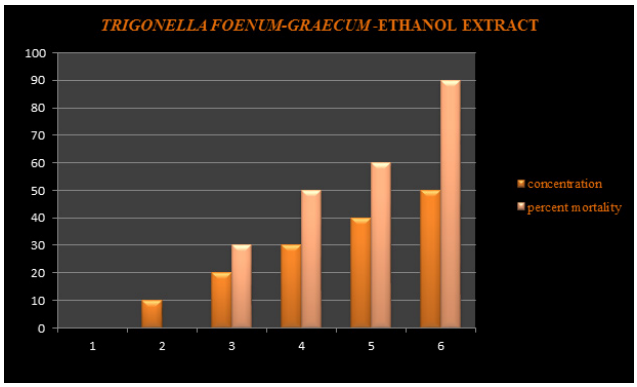
Figure 3: Powdered Adathoda leaves and Fenugreek seeds.

Table 2: Insecticidal Activity of *Trigonella foenum-graecum Seed* Ethanol Extracts against Mealy Bug *Maconellicoccus hirsutus.*

Sl.No	Concentration (ppm)	Mean	Standard Error	LC_{50} (ppm) for 24hours	Regression equation y=ax+b	95% fiducial limit for LC_{50} (ppm)	
						LCL	UCL
1	Control	38.33	14.47	28.18	4.10x-0.98	1.13	75.53
2	10						
3	20						
4	30						
5	40						
6	50						

Table 3: Percent Mortality of *Trigonella foenum-graecum* Seed Ethanol Extracts against Mealy Bug *Maconellicoccus hirsutus.*

	TRIGONELLA FOENUM-GRAECUM -ETHANOL EXTRACT								
Concentration (ppm)	Exposure period(Hours)								
	1	2	3	4	5	6	7	8	24
0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
20	0	0	0	1	0	1	0	1	30
30	0	1	1	1	0	1	0	1	50
40	1	0	0	2	1	1	1	1	60
50	2	1	1	1	2	1	1	1	90
Concentration(ppm)	0	10	20	30	40	50			
Percent mortality (%)	0	0	30	50	60	90			



foenum -graecum seed and *Adathoda vasica* leaf extracts against mealy bug[13,21] *Maconellicoccus Hirsutus*. For this study, *Trigonella foenum -graecum* seed and *Adathoda vasica* leaf extracted using two different solvents namely Ethanol and water. *Trigonella foenum -graecum* seed and *Adathoda vasica* leaf extract tested for the Mealy bug insecticidal activity at different concentration for 24 hr exposure period against *Maconellicoccus hirsutus*. The phytochemicals obtained from *Trigonella foenum-graecum Seed and* Adathoda *vasica* Leave Extracts against Mealy Bug *Maconellicoccus hirsutus* were alkaloids, steroids, Tannins, saponins, flavonoids, terpenoids, Phenolic compounds, aromatic acid and Xanthoproteins from the two different solvents of ethanol and water. Table 7 represents the LC_{50} Value of *Trigonella foenum-graecum* Seed and *Adathoda vasica* Leave Extracts against Mealy Bug *Maconellicoccus hirsutus*. In *Trigonella foenum -graecum* the high efficacy of toxicity with the LC_{50} was found to be in the Ethanol extract(28.18ppm) followed by Water extract (24.54ppm) and in *Adathoda vasica* the high efficacy of toxicity[23,24] with the LC_{50} was found to be in the Water extract (39.81ppm) followed by Ethanol(25.70ppm) as shown in Figure 6.

SUMMARY AND CONCLUSION

To reduce the use of synthetic pesticides on fruit and vegetable plantations, phytochemicals and plant extracts have long been a subject of research in an effort to develop alternatives to conventional insecticides but with reduced health and environmental impact. In view of these facts, the present study, deals with the Insecticidal effect of ethanol and aqueous extracts of *Adathoda*

Table 4: Insecticidal Activity of Trigonella *foenum-graecum Seed* Water Extracts against Mealy Bug *Maconellicoccus hirsutus.*

Sl.No	Concentration (ppm)	Mean	Standard Error	LC_{50} (ppm) for 24hours	Regression equation y=ax+b	95% fiducial limit for LC_{50} (ppm)	
						LCL	UCL
1	Control	52	8.6	24.54	1.73x+2.60	28.11	75.89
2	10						
3	20						
4	30						
5	40						
6	50						

Table 5: Percent Mortality of *Trigonella foenum-graecum Seed* Water Extracts against Mealy Bug *Maconellicoccus hirsutus.*

Concentration(ppm)	0	10	20	30	40	50
Percent mortality	0	30	40	50	60	80

Table 6: Mortality Rate of Trigonella *foenum-graecum Seed* Water Extracts against Mealy Bug *Maconellicoccus hirsutus.*

	TRIGONELLA FOENUM-GRAECUM -AQUEOUS EXTRACT								
Concentration (ppm)	Exposure period(Hours)								
	1	2	3	4	5	6	7	8	24
0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	1	1	1	30
20	0	0	0	0	1	1	1	1	40
30	0	0	1	1	0	1	1	1	50
40	0	1	0	1	1	1	1	1	60
50	0	1	1	2	1	1	1	1	80

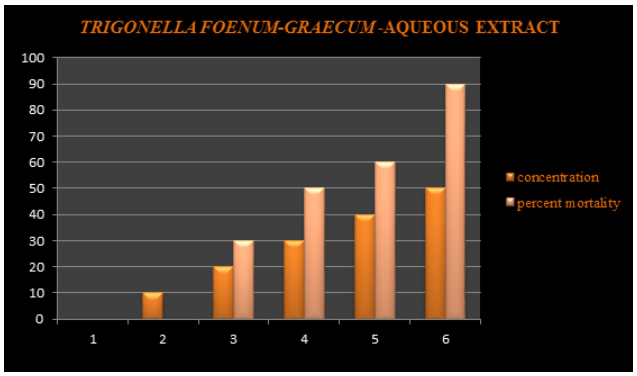


Table 7: LC_{50} Value of *Trigonella foenum-graecum Seed and* Adathoda *vasica* Leave Extracts against Mealy Bug *Maconellicoccus hirsutus.*

SL.NO	EXTRACT	LC_{50}
1	*TRIGONELLA FOENUM-GRAECUM-AQUEOUS*	***24.54ppm***
2	***ADATHODA VASICA-AQUEOUS***	***39.81ppm***
3	*TRIGONELLA FOENUM-GRAECUM-ETHANOL*	***28.18ppm***
4	***ADATHODA VASICA-ETHANOL***	***25.70ppm***

Figure 4: Effects of the Extracts of two Plants on *Maconellicoccus hirsutus.*

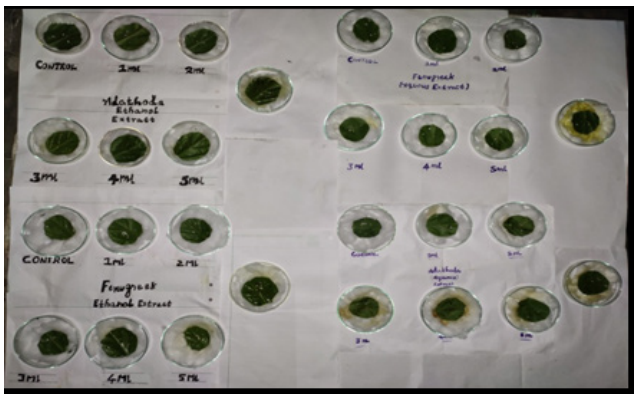


Figure 5: Leaf spraying method.

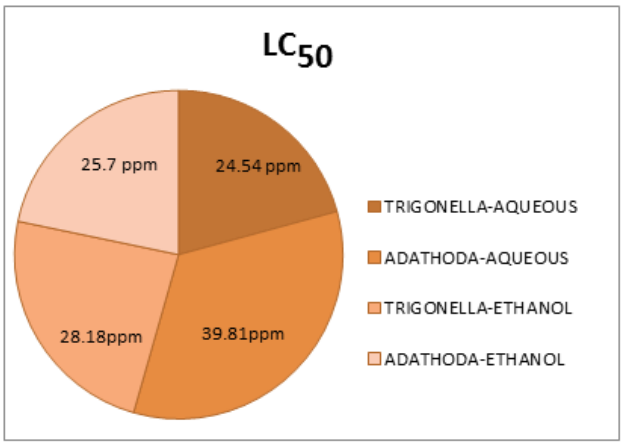


Figure 6: LC_{50} Value of *Trigonella foenum-graecum Seed* and Adathoda *vasica* Leave Extracts against Mealy Bug *Maconellicoccus hirsutus*.

vasica (leaf) and *Trigonella foenum-graecum* (seed) against mealy bugs, *Maconellicoccus hirsutus* on Hibiscus plant. The 24 hr LC_{50} values for the seed extract of *Trigonella foenum-graecum is 28.18ppm and 24.54ppm* respectively for ethanol and water against *Maconellicoccus hirsutus*. The 24 hr LC_{50} values for the leaf extract of *Adathoda vasica* is 25.70ppm and 39.81ppm respectively for ethanol and water against *Maconellicoccus hirsutus*. The extracts were relatively more toxic to the mealy bug *Maconellicoccus hirsutus*. The leaf extract of these two plants therefore could be potential source of herbal insecticide for mealy bug population control and could be used in integrated vector management.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

LC_{50}: Lethal Dose 50%; **Hr:** Hour; **ppm:** Parts Per Million; **IPM:** Integrated Pest Management; **g:** Gram; **SPSS:** Statistical Package for the Social Sciences; **ANOVA:** Analysis of variance.

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