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Bio-efficacy of Botanicals and Newer Insecticide Molecules against Red spider mite, *Tetranychus urticae* Koch (Tetranychidae: Acarina) in Jasmine (*Jasminum sambac* L.)

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ABSTRACT

Field experiments were conducted to evaluate the efficacy of botanicals and newer insecticide molecules against red spider mite, *Tetranychus urticae* Koch in Jasmine. In the present study, NSKE @ 5.0 per cent was found to be the best followed by *pungam* oil @ 2.0 % against red spider mites in Jasmine. Among the acaricides, Diafenthiuron 50 WP @ 0.80 g/l was effective with a reduction of mite population by 87.58% in Jasmine. The results from the present investigation can provide valuable information towards the development of IPM module in Jasmine and seems to be the most significant pest management tool in IPM programme to increase the flower production in Jasmine.

Key Words: Acaricides, Bio-efficacy, Botanicals, Jasmine, Red Spider Mites.

INTRODUCTION

Jasmine (*Jasminum sambac* L.) is important flowering plants which is commercially grown for its fragrant flowers and used for oil production (El-Amir *et al,* 2020). India exports Jasmine flowers to the adjacent countries like Sri Lanka, Singapore, Malaysia and Gulf countries. In South India, huge quantities of Jasmine flowers are used by women folk for beautifying their hairs. Tamil Nadu is the leading state in Jasmine production in the country. The least yield of Jasmine flower production might be due to various reasons, among which the menace by insect pests is of fundamental consequence.

The spider mites generally feed on the lower surface of the leaves as a result the infested leaves initially show speckling and later turn yellowish. The mites spread to all parts of the plants as the population increases especially during day periods and produce webbing over the entire plants. Moderate population may greatly affect crop production and heavy infestation results in death of the plants (Jeppson *et al*, 1975). Farmers depend mostly on acaricides for controlling red spider mites in Jasmine. The decreased efficacy of acaricides and increased concerns over their use in Jasmine ecosystem have emphasized the need for identifying safer, more effective botanicals and newer insecticide molecules for the management of red spider mites in Jasmine. Hence, the present study was carried out to study the efficacy of botanicals and newer insecticide molecules against red spider mites in Jasmine.

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Table 1. Bio-efficacy of botanicals against red spider mites, *T. urticae* in Jasmine.

Treatment	Conc. (%)	Mite population per cm²												Overall Mean	Reduction over untreated check (%)
		1st Spray				2nd Spray				3rd Spray					
		DAS													
		1	3	7	14	1	3	7	14	1	3	7	14		
Notchi (*V. negundo*) leaf extract	5.00	8.56 (2.93)b	8.06 (2.84)b	7.26 (2.69)b	11.59 (3.40)bc	7.59 (2.75)b	7.59 (2.75)c	11.56 (3.40)c	9.42 (3.07)c	11.53 (3.40)b	10.94 (3.31)d	8.43 (2.90)c	12.06 (3.47)bc	9.55 (3.09)a	43.89
NSKE	5.00	7.46 (2.73)a	7.11 (2.67)ab	6.03 (2.46)a	9.06 (3.01)a	6.31 (2.51)ab	5.19 (2.28)a	9.46 (3.08)b	7.06 (2.66)a	10.36 (3.22)a	8.06 (2.84)ab	6.05 (2.46)a	10.59 (3.25)a	7.73 (2.78)b	54.58
Pungam oil	2.00	7.86 (2.80)ab	7.49 (2.74)ab	7.08 (2.66)b	10.32 (3.21)ab	6.98 (2.64)ab	6.25 (2.50)b	10.56 (3.25)c	8.04 (2.84)c	10.59 (3.25)a	9.05 (3.01)bc	7.26 (2.69)b	11.26 (3.36)ab	8.56 (2.93)c	49.70
Sweet flag (A. calamus) rhizome extract	5.00	7.95 (2.82)ab	7.59 (2.75)b	7.43 (2.73)b	10.86 (3.30)b	7.26 (2.69)ab	6.49 (2.55)b	11.04 (3.32)c	8.91 (2.98)c	11.25 (3.35)ab	9.86 (3.14)c	7.38 (2.72)bc	11.86 (3.44)abc	8.99 (3.00)d	47.18
Wildsage (*L. camara*) leaf extract	5.00	9.00 (3.00)ab	7.70 (2.77)b	6.00 (2.45)a	12.60 (3.55)c	9.54 (3.09)c	7.59 (2.75)c	7.25 (2.69)a	12.59 (3.55)d	11.56 (3.40)b	9.59 (3.10)c	8.53 (2.92)c	16.00 (4.00)c	9.61 (3.10)e	43.53
Profenophos 50 EC (Std check)	2.00 ml/lit	7.32 (2.71)	6.51 (2.55)a	5.26 (2.29)a	10.56 (3.25)b	6.25 (2.50)a	4.98 (2.23)a	8.94 (2.99)b	6.80 (2.61)a	10.26 (3.20)a	7.56 (2.75)a	5.49 (2.34)a	12.65 (3.56)bc	7.52 (2.74)a	55.82
Untreated check	-	18.02 (4.25)	17.56 (4.19)c	19.43 (4.41)c	17.53 (4.19)d	16.23 (4.03)d	13.20 (3.63)d	15.43 (3.93)d	16.02 (4.00)e	17.62 (4.20)c	18.46 (4.30)e	16.49 (4.06)d	18.25 (4.27)d	17.02 (4.13)f	0.00
Mean		9.45 (3.07)E	8.86 (2.98)C	8.36 (2.89)B	11.79 (3.43)H	8.59 (2.93)C	7.33 (2.71)A	10.61 (3.26)G	9.83 (3.14)H	11.88 (3.45)H	10.50 (3.24)G	8.52 (2.92)C	13.24 (3.64)I		-

Mean of three replications.
Figures in parentheses are square root transformed values.
In a column/row, means followed by a common letter are not significantly different at 5% level (LSD).

	T	S	D	S x D	T x D x S
Significance	0.01	0.01	0.01	0.01	0.01
CD (P=0.05)	0.02	0.01	0.01	0.02	0.06

Table 2. Bio-efficacy of insecticides against red spider mites, *T. urticae* in Jasmine in Jasmine

Treatment	Dose	Mite population (No./cm²)												Overall Mean	Reduction over untreated check (%)
		1st Spray				2nd Spray				3rd Spray					
		DAS													
		1	3	7	14	1	3	7	14	1	3	7	14		
Emamectin benzoate 5 SC	0.30 g/lit	9.00 (3.00)f	7.70 (2.77)e	6.00 (2.45)e	12.60 (3.55)f	9.54 (3.09)e	7.59 (2.75)f	7.25 (2.69)d	12.59 (3.55)g	11.56 (3.40)e	9.59 (3.10)f	8.53 (2.92)e	16.00 (4.00)f	9.61 (3.10)f	61.70
Diafenthiuron 50 WP	0.80 g/lit	2.11 (1.45)a	2.01 (1.42)a	1.25 (1.12)a	3.50 (1.87)a	4.20 (2.05)a	3.25 (1.80)a	2.10 (1.45)a	4.89 (2.21)a	4.25 (2.06)a	2.03 (1.42)a	3.00 (1.73)a	6.10 (2.47)a	3.12 (1.77)a	87.58
Fenazaquin 10 EC	2.00 ml/lit	6.80 (2.61)d	5.20 (2.28)c	3.60 (1.90)c	8.45 (2.91)d	4.92 (2.22)b	3.66 (1.91)b	7.89 (2.81)e	5.89 (2.43)c	5.57 (2.36)c	5.00 (2.24)d	5.00 (2.24)c	13.56 (3.68)e	6.00 (2.45)d	76.10
Fenpyroximate 5 EC	1.20 ml/lit	4.65 (2.16)b	4.60 (2.14)b	2.54 (1.59)b	6.70 (2.59)b	4.44 (2.11)a	3.56 (1.89)b	2.56 (1.60)b	5.54 (2.35)b	4.20 (2.05)a	2.78 (1.67)b	3.59 (1.89)b	8.30 (2.88)b	4.28 (2.07)b	82.93
Propargite 57 EC	2.50 ml/lit	5.60 (2.37)c	5.00 (2.24)c	2.49 (1.58)b	7.56 (2.75)c	4.96 (2.23)b	3.98 (1.99)c	3.23 (1.80)c	6.23 (2.50)d	4.80 (2.19)b	3.64 (1.91)c	3.56 (1.89)b	9.50 (3.08)c	4.85 (2.20)c	80.67
Spiromesifen 22.9 SC	0.50 ml/lit	7.30 (2.70)e	6.50 (2.55)d	5.20 (2.28)d	10.56 (3.25)e	6.20 (2.49)c	4.98 (2.23)d	8.90 (2.98)f	6.78 (2.60)e	10.25 (3.20)d	7.54 (2.75)e	5.48 (2.34)d	12.64 (3.56)d	7.52 (2.74)e	70.03
Wettable Sulphur 50 WP	2.00 g/lit	11.00 (3.32)g	9.25 (3.04)f	5.23 (2.29)d	10.96 (3.31)e	8.63 (2.94)d	6.55 (2.56)e	7.10 (2.66)d	11.58 (3.40)f	13.10 (3.62)f	20.00 (4.47)g	17.70 (4.21)f	30.45 (5.52)h	12.22 (3.50)g	51.30
Untreated check	-	20.10 (4.48)h	20.80 (4.56)g	22.10 (4.70)f	23.08 (4.80)g	24.11 (4.91)f	25.00 (5.00)g	28.45 (5.33)g	28.33 (5.32)h	27.59 (5.25)g	27.31 (5.23)h	27.22 (5.22)g	27.27 (5.22)g	25.09 (5.01)h	0.00
Mean		8.32 (2.76)E	7.63 (2.63)C	6.05 (2.24)A	10.43 (3.13)J	8.38 (2.75)E	7.32 (2.52)B	8.44 (2.67)D	10.23 (3.05)I	10.17 (3.02)H	9.74 (2.85)G	9.26 (2.80)F	15.48 (3.80)K		-

Mean of three replications.
Figures in parentheses are square root transformed values.
In a column / row, means followed by a common letter are not significantly different at 5% level (LSD).

	T	S	D	S x D	T x S x D
Significance	0.01	0.01	0.01	0.01	0.01

MATERIALS AND METHODS

A field trial was conducted in a farmer's field near village Vallanad, Thoothukudi district, Tamil Nadu, India. The experiment was conducted on existing Jasmine crop of 1.5 years old plants. Three rounds of foliar sprays were given at fortnightly interval using battery operated knapsack sprayer. Pre-treatment observations on the incidence of mites were recorded in each botanicals / synthetic insecticides treated plants. Post treatment counts were recorded on 1st, 3rd, 7th and 14th day after imposing treatment. The population of mites were recorded from twenty randomly selected leaves. In each leaves, one cm^2 area was selected and number of mites were counted and expressed as number of mites per cm^2 (Kiran *et al*, 2017). Randomized Block Design was adopted in each treatment. Three plants per replication and three replications were maintained for each treatment.

To prepare Notchi (*Vitex negundo*) leaf extract, its fresh leaves were collected and dried under room temperature (25±2 °C) and then powdered. A total of 100 gram powdered leaves soaked in 1.0 litre of petroleum ether (boiling range 60–80 °C) was shaken for 24 hours and kept under room temperature for 10 days. After 10 days, the extract was made up to 1000 ml and maintained as standard solution. At the time of spray, 50 ml of standard solution was added in 1000 ml of water and used for spraying (Karunamoorthi *et al*, 2008). Notchi leaf extract was used at a concentration of 5%.

For preparing Neem Seed Kernel Extract (NSKE), a quantity of 50 g dried neem seed kernel was powdered and it was tied in a small muslin cloth bag and dipped in 100 ml of water and kept overnight for 12 hours and the suspension was separated. Then, 900 ml water was added to it and stirred well. The filtrate was used for spraying (Sathyan, 2015). NSKE was used at a concentration of 5%.

Pungam (*Pongamia pinnata*) Oil (Karanj oil) was purchased from the market and sprayed at the rate of 20 ml per litre after thorough mixing with the surfactant. Pungam oil was used at a concentration of 2%.

Sweet flag, *Acorus calamus* (AC 10 % D) rhizome powder of 300 g was added into 1000 ml of distilled water and kept for 24 hours. Then the solvent was filtered. At the time of spray, 50 ml of solvent was used (Shinthiya and Razak, 2017). Sweet flag rhizome powder was used at a concentration of 5%.

Similarly one kg fresh leaves of wild sage, *L. camara* was dried at room temperature and then powdered. One litre of petroleum ether was added to the dried leaves and kept in shaker for 8 hrs. Then, the extract was filtered. The filtrate thus obtained was used for spraying (Deshmukhe *et al*, 2011). Wild sage leaf extract was used at a concentration of 5%. Profenophos 50 EC at a concentration of 2 ml/ lit was used as a standartd check

Similarly newer insecticides like Emamectin benzoate 5 SC @ 0.30 g/l, Diafenthiuron 50 WP @ 0.80 g/ lit, Fenazaquin 10 EC @ 2.00 ml/ li,t Fenpyroximate 5 EC @ 1.20 ml/ lit, Propargite 57 EC @ 2.50 ml/ lit, Spiromesifen 22.9 SC @ 0.50 ml/ lit and Wettable Sulphur 50 WP @ 2.00 g/ lit evaluated against Red spider mites, *Tetranychus urticae* in Jasmine in the field experiments.

RESULTS AND DISCUSSION

Bio-efficacy of botanicals against Red spider mites in Jasmine

Bio-efficacy studies with botanicals against *T. urticae* brought out the variability due to the treatments, spray rounds and period of observations. The influence of interaction was also found significant (Table 1). Overall mean population revealed that all the treatments were able to reduce the mite incidence. Among the botanicals, NSKE @ 5.0 per cent alone was able to reduce the mite population by 54.58 per cent. Though NSKE recorded the least population (7.73 / cm^2), it was inferior to profenophos 50 EC (7.52 /cm^2); profenophos 50 EC recorded the highest reduction of 55.82 per cent. Among the botanicals, *Pungam* oil (8.56/cm^2), sweet flag *(A. calamus)* (8.99 /cm^2), wild sage (L. camara) leaf extract (9.61 /cm^2) and *notchi (V. negundo)* leaf extract (9.55 /cm^2) were better than untreated check recording more than 43 per cent reduction in the mite population, but were inferior to NSKE. Wild sage (L. *camara*) leaf extract and *notchi (V. negundo)* leaf extract were equal between themselves but inferior to all other treatments. The trend was complementary at each spray rounds as well as at each period of observations.

The use of botanical pesticides, an essential component in bio-intensive pest management, helps to reduce the dependence on chemical pesticides and ecological deterioration; and they serve as insecticides, insect repellents and insect feeding deterrents (John *et al*, 2007; Devanand and Rani, 2008). In the present study, wild sage (*L. camara*) leaf extract @ 5.0 per cent and sweet flag (*A. calamus*) rhizome extract were found less effective which may be probably due to the different locations which are influenced differently by different ecological conditions.

Bio-efficacy of insecticides against Red spider mites in Jasmine

The statistical analysis revealed that the variability due to the insecticides, spray rounds and period of observations; their interaction effect was also significant (Table 2). Considering the spray rounds as well as period of observations together the mean population for the treatment ranged from 3.12 (Diafenthiuron 50 WP) to 25.09 (Untreated check) per cm^2. All the treatments were able to reduce the mite population over untreated check. Taking everything into account, diafenthiuron 50 WP shows least population (3.12 / cm^2). Fenpyroximate 5 EC (4.28/ cm^2) stood next and was better than propargite 57 EC (4.85 / cm^2) but inferior to diafenthiuron 50 WP. All other treatments *viz.,* fenazaquin 10 EC (6.00 / cm^2), spiromesifen 22.9 SC (7.52 / cm^2), emamectin benzoate 5 SC (9.61 / cm^2) and wettable sulphur 50 WP (12.22 / cm^2) were found to be less effective than the above three treatments recording less than 80 per cent reduction in mite population over untreated check. Similar was the trend at each spray rounds as well as at each period of observations.

Manju (2013) reported lesser number of mite population on plants treated with diafenthiuron 50 WP followed by fenazaquin 10 EC in carnation. Ramjibhai (2015) has also claimed that fenazaquin 10 EC @ 0.01 per cent is effective against red spider mite, *T. urticae* on okra plants followed by propargite 57 EC @ 0.05 per cent. Diafenthiuron 50 WP was effective in reducing mite population in tomato under polyhouse condition (Pokle, 2015).

Hence, the acaricide application provides an immediate solution to control red spider mites and seems to be the most significant pest management tool in IPM programme to increase the flower production in Jasmine.

CONCLUSION

In the present study, NSKE @ 5.0 per cent found to be the best botanical against red spider mites followed by *Pungam* oil @ 2.0 per cent. Wild sage (*L. camara)* leaf extract @ 5.0 per cent and sweet flag (*A. calamus*) rhizome extract were found less effective against red spider mites in Jasmine. The effectiveness of diafenthiuron 50 WP @ 0.80 g /lit, fenpyroximate 5 EC @ 1.20 ml /l against red spider mites with a reduction of mite population by 87.58 and 82.93 per cent, respectively was brought out by this study. The results from the present study can provide valuable information towards the development of IPM module in Jasmine with special emphasis on selection of acaricides as well as development of pest forecast models.

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