

RESEARCH

BIO-EFFICACY OF BOTANICALS AND INSECTICIDES AGAINST THRIPS, *ISOTHRIPS ORIENTALIS* BAGNALL 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 thrips in jasmine. In the present study, pungam (Karanj) oil @ 2 per cent treated plants harboured minimum number of thrips on a par with *Vitex negundo* leaf extract @ 5 per cent (2.32/leaf), NSKE @ 5 per cent (2.41/leaf) stood next and were on a par between themselves. Among the insecticides, Imidacloprid 17.8 SL @ 0.30 ml /lit, Flubendiamide 39.35 SC @ 0.75 ml /lit and Thiacloprid 21.7 SC @ 0.60 ml/lit were found effective against thrips recording a reduction of 76.00, 74.67 and 72.00 per cent, respectively. The results from the present investigation can provide timely lead and valuable information towards the development and perfection in IPM programme in jasmine.

Keywords: Bio-efficacy, Botanical, Insecticides, Jasmine

INTRODUCTION

Jasmine (*Jasminum sambac* L.) is one of the most essential business plant cultivated in India (Ismail *et al.*, 2004; Sabharwal *et al.*, 2013). Apart from internal trade, fresh flowers of jasmine are exported to Malaysia, Singapore and Sri Lanka. 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 scourge by insect pests is of fundamental significance. There are about 50 different insect species belonging to more than eight orders harbouring fluctuated microhabitats of jasmine plants. Severe incidence of flower thrips, *Isotrips orientalis* Bagnall reduces the size of flower buds and imparts dull colouration, which reduces their market value (Hemalatha, 2009). Conducive weather and the crop phenology of jasmine favours the biology, growth and development of thrips (Pirithiraj *et al.*, 2022). They feed on the leaves, buds and flowers by their rasping and sucking mouthpart causing them to turn brown and eventually die. These pests are also known to spread viruses and other diseases to the plant. Farmers depend mostly on insecticides for managing thrips in jasmine. The decreased efficacy of conventional pesticides and increased concerns over their use in jasmine ecosystem have emphasised the need for identifying safer, more

effective botanical and insecticide molecules for management of thrips in jasmine. Hence, the present study was carried out to evaluate the efficacy of botanicals and newer insecticide molecules against thrips in jasmine.

MATERIALS AND METHODS

A field experiment was conducted in a farmer's field near Vallanad village, Thoothukudi district, Tamil Nadu, India. The experiment was conducted on existing jasmine crop of 1 ½ years old plant. Three rounds of foliar sprays were given at fortnight interval using battery operated hand sprayer. Pre-treatment observations on the incidence of thrips were recorded in each botanicals / synthetic insecticides treated plants. Post treatment counts were recorded on 1st, 3rd, 7th and 14th day after imposing treatment. A total of 20 terminal tender leaves were randomly selected and thrips population was recorded and the mean was worked out. The incidence was expressed as number of thrips per leaf (Neelima, 2005). Randomized Block Design was adopted in each treatment, three plants and three replications were maintained for observation.

PREPARATION OF BOTANICAL LEAF / KERNEL EXTRACTS

(i) Notchi (*Vitex negundo*) leaf extract

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The fresh leaves of Notchi, *V. negundo* were collected and dried under room temperature (25±2°C) and then powdered. One hundred gram of the powdered leaves were 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 upto 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).

(ii) Neem Seed Kernel Extract (NSKE)

A quantity of 50 g dried neem seed kernel was ground to a powder form 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 thus obtained was used for spraying (Sathyan, 2015).

(iii) Pungam (*Pongamia pinnata*) (Karanj oil)

Commercially available pungam oil was purchased from the market and sprayed at the rate of 20 ml per litre after thorough mixing with the surfactant.

(iv) 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).

(v) Wild sage (*Lantana camara*) leaf extract

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 under kept in shaker for 8 hrs. Then the extract was filtered. The filtrate thus obtained was used for spraying (Deshmukhe *et al.*, 2011).

The list of botanicals evaluated in the field experiments are furnished below:

Common Name	Botanical Name	Conc. (%)
T1 - <i>Notchi</i> leaf extract	<i>Vitex negundo</i>	5.00
T2 - NSKE	<i>Azadirachta indica</i>	5.00
T3 - Pungam oil	<i>Pongamia pinnata</i>	2.00
T4 - Sweet flag	<i>Acorus calamus</i>	5.00
T5 - Wild sage leaf extract	<i>Lantana camara</i>	5.00
T6 - Profenophos 50 EC (Std. check)	-	2 ml / lit
T7 - Untreated check	-	-

The list of newer insecticides evaluated in the field experiments are furnished below:

Treatment	Insecticides	Formulation	Dose
T1	Acetamiprid	20 SP	0.10 g/lit
T2	Chlorantraniliprole	18.5 SC	0.10 ml/lit
T3	Dimethoate	30 EC	2.00 ml/lit
T4	Fipronil	5 SC	1.50 ml/lit
T5	Flubendiamide	39.35 SC	0.75 ml/lit
T6	Imidacloprid	17.8 SL	0.30 ml/lit
T7	Indoxacarb	14.5 SC	0.35 ml/lit
T8	Novaluron	10 EC	1.00 ml/lit
T9	Spinosad	45 SC	0.32 ml/lit
T10	Thiacloprid	21.7 SC	0.60 ml/lit
T11	Thiamethoxam	25 WG	0.40 g/lit
T12	Untreated check	--	--

RESULTS AND DISCUSSION

(i) Bio-efficacy of botanicals against thrips, *I. orientalis* in jasmine

Field population of *I. orientalis* was influenced by the treatments, spray rounds and period of observations; interaction effect was also palpable (Table 1a-1c). Considering the spray rounds and period of observations together, pungam oil treated plants (1.84/leaf) harboured minimum number of

thrips on a par with *notchi* (*V. negundo*) leaf extract (2.32/leaf), NSKE (2.41/leaf) stood next and were on a par between themselves. Profenophos 50 EC was less effective than the above treatments; however, all these treatments were able to reduce the thrips population by more than 60 per cent. Sweet flag (*A. calamus*) (3.95/ leaf) and wild sage (*L. camara*) (4.14/ leaf) were equal between themselves but inferior to all other treatments except untreated check (Fig. 1); population

reduction was less than 47 per cent only. Similar was the trend at each spray round as well as period of observations of the botanicals.

Kumar (2007) reported that *pungam* oil @ 2.0 per cent was effective in reducing the thrips population followed by NSKE @ 5.0 per cent. The effectiveness of *pungam* oil @ 2.0 per cent for the control of jasmine pests revealed in the present study is confirmed by (Ponsekha and Muthusamy, 2016) with their laboratory bioassay as well as by the field studies reported by (Merlin Kamala, 2017) in jasmine. 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 differently influenced by ecological conditions.

(ii) Bio-efficacy of insecticides against thrips, *I. orientalis* in jasmine

The results of the statistical analysis of the bio-efficacy evaluation of insecticides against thrips revealed the incidence of the treatments, spray rounds and period of observations; on the field population of thrips, interaction effect was also apparent (Table 2a-2c). Considering the spray rounds and period of observations together, flubendiamide 39.35 SC (1.86/leaf) and imidacloprid 17.8 SL (1.84/leaf) were equally effective between themselves and significantly better than all the treatments in reducing the field population of thrips. Thiacloprid 21.7 SC (2.05 /leaf) was the next best treatment and all this three treatments were better than all other treatments. Hence, the results of the treatments significantly noted that reduction of thrips population by more than 70.00 per cent compared to untreated check. The treatments recorded more than 50 per cent but

less than 70 per cent reduction in thrips population were acetamiprid 20 SP (2.54 /leaf), fipronil 5 SC (2.70 /leaf), indoxacarb 14.5 SC (2.97 /leaf), chlorantraniliprole 18.5 SC (3.06 /leaf), novaluron 10 EC (3.21 /leaf) and thiamethoxam 25 WG (3.53 /leaf). Spinosad 45 SC (3.79 /leaf) and dimethoate 30 EC (3.88 /leaf) were less effective against thrips (Fig. 2); results in less than 50 per cent reduction in thrips population. Similar trend was recognized at each period of observations and at each spray rounds.

Insecticide application is almost an important tactic to overcome the losses caused by insects. The insecticide application provides an immediate solution to control the insect pests and seems to be the most important pest management tool in boosting agricultural production. In the present study, imidacloprid 17.8 SL @ 0.30 ml /lit, Flubendiamide 39.35 SC @ 0.75 ml / lit and Thiacloprid 21.7 SC @ 0.60 ml/lit were found effective against thrips recording a reduction of 76.00, 74.67 and 72.00 per cent, respectively. Imidacloprid 17.8 SL and Thiacloprid 21.7 SC belongs to the main group of nicotinic acetylcholine receptor (nAChR) agonists and exemplifying Active Ingredient of neonicotinoids. They inhibit synaptic transmission in insects (IRAC, 2009). Chloronicotinyl compound has good xylem mobility and it is found effective against sucking pests (Omkar Gavkare *et al.*, 2013).

The results from the present investigation can provide timely lead and valuable information with special emphasis on selection of insecticides as well as development of pest forecast models towards the development and perfection in IPM programme in jasmine.

Table 1a. Bio-efficacy of botanicals against thrips, *I. orientalis* in Jasmine, *J. sambac*

Treatment	Conc. (%)	No of thrips / leaf												Overall Mean	Reduction over untreated check (%)
		1 st Spray				2 nd Spray				3 rd Spray					
		DAS				DAS				DAS					
		1	3	7	14	1	3	7	14	1	3	7	14		
<i>Notchi negundo</i> (V. leaf extract)	5.00	2.52 (1.59) _a	2.11 (1.45) _a	3.26 (1.81) _b	3.30 (1.82) _a	2.01 (1.42) _a	1.71 (1.31) _a	2.58 (1.61) _b	1.95 (1.40) _a	2.06 (1.44) _b	2.06 (1.44) _c	2.26 (1.50) _b	2.05 (1.43) _b	2.32 (1.52) _b	69.10
NSKE	5.00	3.23 (1.80) _b	2.52 (1.59) _a	2.11 (1.45) _a	3.01 (1.73) _a	2.20 (1.48) _a	2.01 (1.42) _{ab}	1.86 (1.36) _a	2.58 (1.61) _b	2.03 (1.41) _b	2.16 (1.44) _c	2.58 (1.58) _c	2.31 (1.50) _b	2.41 (1.54) _b	67.91
<i>Pungam</i> oil	2.00	2.84 (1.69) _a	2.36 (1.54) _a	2.26 (1.50) _a	2.98 (1.73) _a	1.97 (1.40) _a	1.87 (1.37) _a	1.56 (1.25) _a	2.31 (1.52) _a	1.34 (1.12) _a	0.85 (0.89) _a	0.56 (0.71) _a	0.72 (0.84) _a	1.84 (1.34) _a	75.50
Sweet flag (<i>A. calamus</i>) rhizome extract	5.00	4.86 (2.20) _d	4.79 (2.19) _{bc}	4.20 (2.05) _c	4.91 (2.22) _b	4.30 (2.07) _c	2.60 (1.61) _{bc}	4.32 (2.08) _c	4.53 (2.13) _d	3.60 (1.90) _d	3.90 (1.97) _d	0.44 (0.63) _a	4.00 (2.00) _d	3.95 (1.97) _d	47.40
Wild sage (<i>L. camara</i>) leaf extract	5.00	4.95 (2.22) _d	4.86 (2.20) _c	4.23 (2.06) _c	4.64 (2.15) _b	4.23 (2.06) _c	4.10 (2.02) _d	4.26 (2.06) _c	4.02 (2.00) _d	3.65 (1.90) _d	3.52 (1.86) _d	3.66 (1.90) _d	3.11 (1.76) _d	4.14 (2.02) _d	44.87
Profenophos 50	2.00	3.79	4.02	3.26	4.23	2.98	3.00	2.64	3.24	2.46	1.61	1.71	2.42	2.93	60.99

EC (Std check)	ml/lit	(1.95)c	(2.00)b	(1.81)b	(2.06)c	(1.73)b	(1.73)c	(1.62)b	(1.80)c	(1.54)b	(1.28)b	(1.31)b	(1.53)c	(1.71)c	
Untreated check	-	5.94 (2.44)e	6.10 (2.47)a	6.86 (2.62)d	6.49 (2.55)c	7.00 (2.65)d	7.38 (2.72)a	8.03 (2.83)d	7.33 (2.71)e	8.00 (2.83)d	8.63 (2.94)e	9.01 (3.00)e	9.33 (3.05)e	7.51 (2.74)e	0.00
Mean		4.02 (2.00) EF	3.82 (1.96) E	3.74 (1.93) DE	4.22 (2.05)F	3.53 (1.88)C	3.24 (1.80) B	3.61 (1.90) D	3.71 (1.93)D	3.27 (1.81) BC	3.22 (1.79) B	2.86 (1.69) A	3.39 (1.69) A		-

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
CD (P=0.05)	0.05	0.04	0.04	0.07	0.19

Table 1b. Bio-efficacy of botanicals against thrips, *I. orientalis* (on spray basis) in *J. sambac*

Treatment	Conc. (%)	No of thrips / leaf			Overall Mean	Reduction over untreated check (%)
		Spray				
		1	2	3		
<i>Notchi</i> (<i>V. negundo</i>) leaf extract	5.00	2.80C (1.67)a	2.06A (1.44)a	2.10B (1.45)b	2.32 (1.52)b	69.10
NSKE	5.00	2.72C (1.65)a	2.16A (1.47)a	2.20B (1.48)b	2.41 (1.54)b	67.91
<i>Pungam</i> oil	2.00	2.61C (1.62)a	1.93B (1.39)a	0.80A (0.90)a	1.84 (1.34)a	75.50
Sweet flag (<i>A. calamus</i>) rhizome extract	5.00	4.69C (2.17)c	3.94B (1.98)c	3.01A (1.72)c	3.95 (1.97)d	47.40
Wild sage (<i>L. camara</i>) leaf extract	5.00	4.67C (2.16)c	4.15B (2.04)c	3.42A (1.85)d	4.14 (2.02)d	44.87
Profenophos 50 EC (Std check)	2.00 ml/lit	3.83C (1.96)b	2.97B (1.72)b	2.00A (1.42)b	2.93 (1.71)c	60.99
Untreated check	-	6.35C (2.52)d	7.44B (2.73)d	8.71C (2.96)e	7.51 (2.74)e	0.00
Mean		3.95C (1.99)	3.52B (1.88)	3.18A (1.78)		-

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	T x S
Significance	0.01	0.01	0.01	0.01
CD (P=0.05)	0.05	0.04	0.04	0.09

Table 1c. Bio-efficacy of botanicals against thrips, *I. orientalis* (on day basis) in jasmine

Treatment	Conc. (%)	No of thrips / leaf				Overall Mean	Reduction over untreated check (%)
		Day					
		1	3	7	14		
<i>Notchi</i> (<i>V. negundo</i>) leaf extract	5.00	2.20B (1.48)b	1.96A (1.40)b	2.70D (1.64)d	2.43C (1.56)b	2.32 (1.52)b	69.10
NSKE	5.00	2.48C (1.57)c	2.20B (1.48)c	2.16A (1.47)b	2.62D (1.62)c	2.41 (1.54)b	67.91
<i>Pungam</i> oil	2.00	2.02C (1.42)a	1.68B (1.29)a	1.44A (1.20)a	2.00C (1.41)a	1.84 (1.34)a	75.50
Sweet flag (<i>A. calamus</i>) rhizome extract	5.00	4.25C (2.06)e	3.76B (1.94)e	2.97A (1.72)e	4.48D (2.12)f	3.95 (1.97)d	47.40

Wild sage (<i>L. camara</i>) leaf extract	5.00	4.26D (2.06)e	4.14C (2.03)f	4.03B (2.01)f	3.92A (1.98)e	4.14 (2.02)d	44.87
Profenophos 50 EC (Std check)	2.00 ml/lit	3.04C (1.74)d	2.88B (1.70)d	2.54A (1.59)c	3.27D (1.81)d	2.93 (1.71)c	60.99
Untreated check	-	6.98A (2.64)f	7.37B (2.71)g	7.97D (2.82)g	7.71C (2.78)g	7.51 (2.74)e	0.00
Mean		3.60C (1.90)	3.43B (1.85)	3.40A (1.84)	3.77D (1.94)		-

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	T x D
Significance	0.01	0.01	0.01	0.01
CD (P=0.05)	0.05	0.04	0.04	0.11

Table 2a. Bio-efficacy of insecticides against thrips, *I. dorsalis* in Jasmine, *J. sambac*

Treatment	Dose	No. of Thrips /leaf												Overall Mean	Reduction over untreated check (%)
		1 st Spray				2 nd Spray				3 rd Spray					
		DAS				DAS				DAS					
		1	3	7	14	1	3	7	14	1	3	7	14		
Acetamidrid 20 SP	0.10 g / lit	3.03 (1.74) c	2.52 (1.59)c	2.11 (1.45)b	3.01 (1.73)b	2.20 (1.48)c	2.01 (1.42)d	1.71 (1.31)c	2.58 (1.61)d	1.78 (1.33)d	2.06 (1.44)f	2.03 (1.42)e	2.26 (1.50)e	2.54 (1.59) c	66.67
Chlorantraniliprole 18.5 SC	0.10 ml / lit	4.80 (2.19) g	4.61 (2.15)g	4.00 (2.00)e	4.51 (2.12)e	4.01 (2.00)g	3.58 (1.89)g	3.48 (1.87)g	3.94 (1.98)h	3.26 (1.81)g	3.21 (1.79)h	3.01 (1.73)g	3.21 (1.79)g	3.06 (1.75) f	58.66
Dimethoate 30 EC	2.00 ml / lit	4.86 (2.20)g	4.79 (2.19)g h	4.20 (2.05)f	4.91 (2.22)f	4.30 (2.07)i	4.02 (2.00)j	4.32 (2.08)h	4.53 (2.13)j	3.60 (1.90)h	3.90 (1.97)j	3.59 (1.89)i	3.99 (2.00)i	3.88 (1.97) j	48.00
Fipronil 5 SC	1.50 ml / lit	3.56 (1.89)d	3.12 (1.77)d	2.67 (1.63)c	3.56 (1.89)c	2.46 (1.57)d	2.56 (1.60)e	2.00 (1.41)d	3.05 (1.75)e	1.58 (1.26)c	1.26 (1.12)d	1.56 (1.25)c	1.89 (1.37)d	2.70 (1.64) d	64.00
Flubendiamide 39.35 SC	0.75 ml / lit	2.62 (1.62)a	2.24 (1.50)b	1.73 (1.32)a	2.84 (1.69)b	1.90 (1.38)b	1.73 (1.32)c	1.34 (1.16)e	2.15 (1.47)b	1.24 (1.11)b	0.56 (0.75)b	0.20 (0.45)b	0.60 (0.77)b	1.86 (1.36) a	74.67
Imidacloprid 17.8 SL	0.30 ml / lit	2.56 (1.60)a	2.00 (1.41)a	1.98 (1.41)b	2.50 (1.58)a	1.21 (1.10)a	1.12 (1.06)a	1.06 (1.03)a	1.64 (1.28)a	0.86 (0.93)a	0.25 (0.50)a	0.10 (0.32)a	0.15 (0.39)a	1.84 (1.36) a	76.00
Indoxacarb 14.5 SC	0.35 ml / lit	3.79 (1.95)e	4.02 (2.00)e	3.26 (1.81)d	4.23 (2.06)d	2.98 (1.73)e	2.99 (1.73)f	2.64 (1.62)e	3.24 (1.80)f	2.36 (1.54)e	1.63 (1.28)e	1.71 (1.31)d	2.35 (1.53)e	2.97 (1.72) e	60.00
Novaluron 10 EC	1.00 ml / lit	4.60 (2.14) f	4.33 (2.08)f	3.9 (1.97)e	4.82 (2.20)f	3.51 (1.87)f	3.42 (1.85)g	3.08 (1.75)f	3.68 (1.92)g	2.59 (1.61)f	2.26 (1.50)g	2.19 (1.48)e	2.75 (1.66)f	3.21 (1.79) g	57.33
Spinosad 45 SC	0.32 ml / lit	4.95 (2.22)g	4.86 (2.20)h	4.23 (2.06)f	4.64 (2.15)e	4.23 (2.06)j	4.10 (2.02)i	4.26 (2.06)h	4.02 (2.00)i	3.60 (1.90)h	3.45 (1.86)j	3.60 (1.90)j	3.10 (1.76)g	3.79 (1.95) i	49.33
Thiacloprid 21.7 SC	0.60 ml / lit	2.84 (1.69)b	2.36 (1.54)b	2.00 (1.41)b	2.98 (1.73)b	1.97 (1.40)b	1.87 (1.37)c	1.40 (1.18)g	2.31 (1.52)c	1.26 (1.12)b	0.65 (0.81)c	0.20 (0.45)b	0.70 (0.84)c	2.05 (1.43) b	72.00
Thiamethoxam 25 WG	0.40 g / lit	4.86 (2.20)g	4.68 (2.16)g h	4.20 (2.05)f	4.62 (2.15)e	4.10 (2.02)g h	3.76 (1.94)h	3.56 (1.89)g	3.99 (2.00)i	3.50 (1.87)h	3.40 (1.84)j	3.20 (1.79)h	3.60 (1.90)h	3.53 (1.88) h	53.33
Untreated check	-	5.94 (2.44)h	6.10 (2.47)i	6.86 (2.62)j	6.49 (2.55)g	7.00 (2.65)j	7.38 (2.72)j	8.03 (2.83)i	7.33 (2.71)k	8.00 (2.83)i	8.62 (2.94)k	9.02 (3.00)j	9.30 (3.05)j	6.81 (2.74) k	0.00
Mean		4.03 (2.01) J	3.80 (1.95) I	3.43 (1.85) G	4.09 (2.02) J	3.32 (1.82) F	3.21 (1.79) E	3.07 (1.75) D	3.54 (1.88) H	2.80 (1.67) C	2.60 (1.61) B	2.53 (1.59) A	2.83 (1.68) C		-

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	D	S	S x D	T x S x D
Significance	0.01	0.01	0.01	0.01	0.01
CD (P=0.05)	0.01	0.01	0.01	0.01	0.04

Table 2b. Bio-efficacy of insecticides against thrips, *I. dorsalis* (on spray basis) in *J. sambac*

Treatment	Dose	No. of Thrips / leaf				Overall Mean	Reduction over untreated check (%)
		Spray					
		1	2	3			
Acetamiprid 20 SP	0.10 g / lit	2.67 B (1.63) d	2.91C (1.71) f	2.03A (1.43) ef	2.54 (1.59) c	66.67	
Chlorantraniliprole 18.5 SC	0.10 ml / lit	4.48 C (2.12) g	1.52 A (1.23) a	3.17 B (1.78) h	3.06 (1.75) f	58.66	
Dimethoate 30 EC	2.00 ml / lit	4.69 C (2.17) ij	3.19 A (1.79) h	3.77 B (1.94) j	3.88 (1.97) j	48.00	
Fipronil 5 SC	1.50 ml / lit	3.70 B (1.92) e	2.82B (1.68) de	1.57 A (1.25) d	2.70 (1.64) d	64.00	
Flubendiamide 39.35 SC	0.75 ml / lit	2.36 B (1.54) b	2.58 C (1.61) bc	0.65A (0.81) b	1.86 (1.36) a	74.67	
Imidacloprid 17.8 SL	0.30 ml / lit	2.26 C (1.5) a	2.92 C (1.71) f	0.34A (0.58) a	1.84 (1.36) a	76.00	
Indoxacarb 14.5 SC	0.35 ml / lit	3.83 C (1.96) f	3.06 B (1.75) g	2.01A (1.42) e	2.97 (1.72) e	60.00	
Novaluron 10 EC	1.00 ml / lit	4.41 C (2.10) g	2.78 B (1.67) d	2.45A (1.56) g	3.21 (1.79) g	57.33	
Spinosad 45 SC	0.32 ml / lit	4.67 C (2.16) hi	3.25 A (1.80) hi	3.44 B (1.85) i	3.79 (1.95) i	49.33	
Thiacloprid 21.7 SC	0.60 ml / lit	2.55 C (1.60) c	2.90C (1.70) ef	0.70 A (0.84) c	2.05 (1.43) b	72.00	
Thiamethoxam 25 WG	0.40 g / lit	4.59C (2.14) gh	2.56A (1.60) b	3.43 B (1.85) i	3.53 (1.88) h	53.33	
Untreated check	-	6.35 A (2.52) k	7.44B (2.73) j	8.74C (2.96) k	6.81 (2.74) k	0.00	
Mean		3.88 C (1.97)	2.99 B (1.73)	2.69 A (1.64)		-	

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

Table 2c. Bio-efficacy of insecticides against thrips, *I. dorsalis* (on day basis) in jasmine

Treatment	Dose	No. of Thrips / leaf				Overall Mean	Reduction over untreated check (%)
		Day					
		1	3	7	14		
Acetamiprid 20 SP	0.10 g / lit	2.34 C (1.53) d	2.20 B (1.48) d	1.95 A (1.40) d	2.62 D (1.62) d	2.54 (1.59) c	69.64
Chlorantraniliprole 18.5 SC	0.10 ml / lit	4.02 D (2.01) h	3.80 B (1.95) h	3.50 A (1.87) h	3.89 C (1.97) h	3.06 (1.75) f	49.40
Dimethoate 30 EC	2.00 ml / lit	4.25 B (2.06) j	4.24B (2.06) k	4.04 A (2.01) j	4.48 C (2.12) k	3.88 (1.97) j	43.41
Fipronil 5 SC	1.50 ml / lit	2.53 C (1.59) e	2.31 B (1.52) e	2.08 A (1.44) e	2.83D (1.68) e	2.70 (1.64) d	67.51
Flubendiamide 39.35 SC	0.75 ml / lit	1.92D (1.39) b	1.51B (1.23) b	1.09 A (1.04) ab	1.86 C (1.37) b	1.86 (1.36) a	78.70
Imidacloprid 17.8 SL	0.30 ml / lit	1.54 D (1.24) a	1.12 B (1.06) a	1.05 A (1.02) a	1.43 C (1.20) a	1.84 (1.36) a	82.82
Indoxacarb 14.5 SC	0.35 ml / lit	3.04 C (1.74) f	2.88 B (1.70) f	2.54 A (1.59) f	3.27 D (1.81) f	2.97 (1.72) e	60.99
Novaluron 10 EC	1.00 ml / lit	3.57 C (1.89) g	3.34 B (1.83) g	3.06 A (1.75) g	3.75 D (1.94) g	3.21 (1.79) g	54.33
Spinosad 45 SC	0.32 ml / lit	4.26 C (2.06) ij	4.14 B (2.03) j	4.03 A (2.01) j	3.92 D (1.98) hi	3.79 (1.95) i	45.54
Thiacloprid 21.7 SC	0.60 ml / lit	2.02 D (1.42) c	1.63B (1.28) c	1.20 A (1.10) c	2.00 C (1.41) c	2.05 (1.43) b	77.23
Thiamethoxam 25 WG	0.40 g / lit	4.15 D (2.04) i	3.95 B (1.99) i	3.65 A (1.91) i	4.07 C (2.02) j	3.53 (1.88) h	47.27
Untreated check	-	6.98 A (2.64) k	7.37 B (2.71) l	7.97 D (2.82) k	7.71 C (2.78) l	6.81 (2.74) k	0.00
Mean		3.39 (1.84) C	3.21 (1.79) B	3.01 (1.74) A	3.49 (1.87) D		-

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

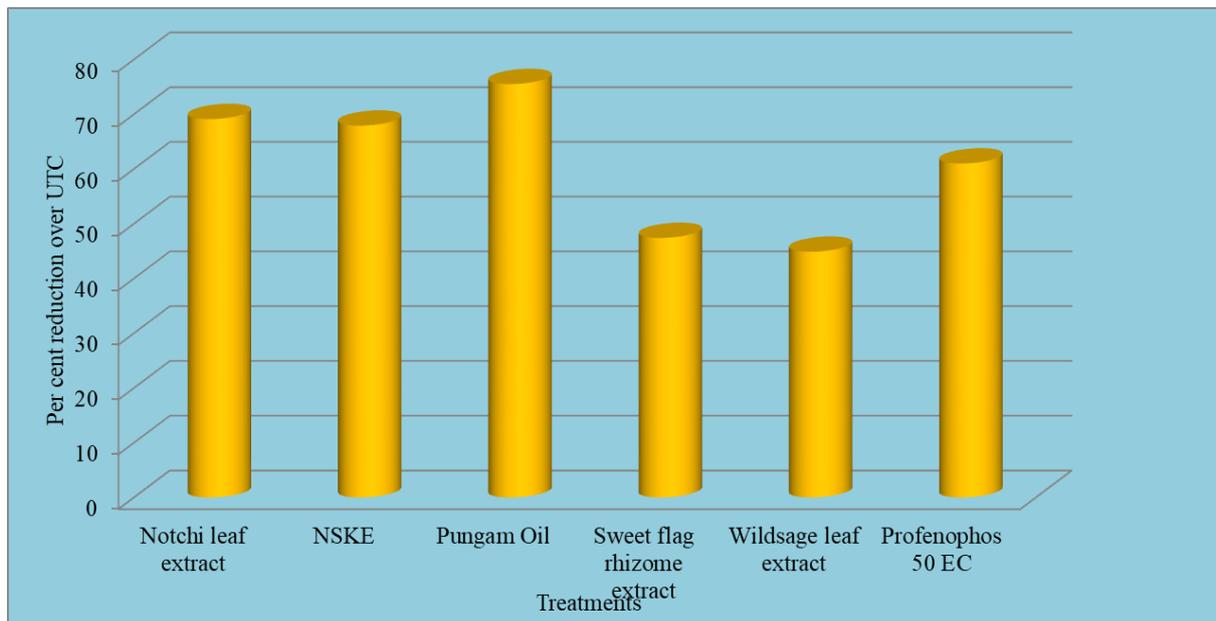


Fig. 1. Bio-efficacy of botanicals against thrips, *Isothrips orientalis* in jasmine

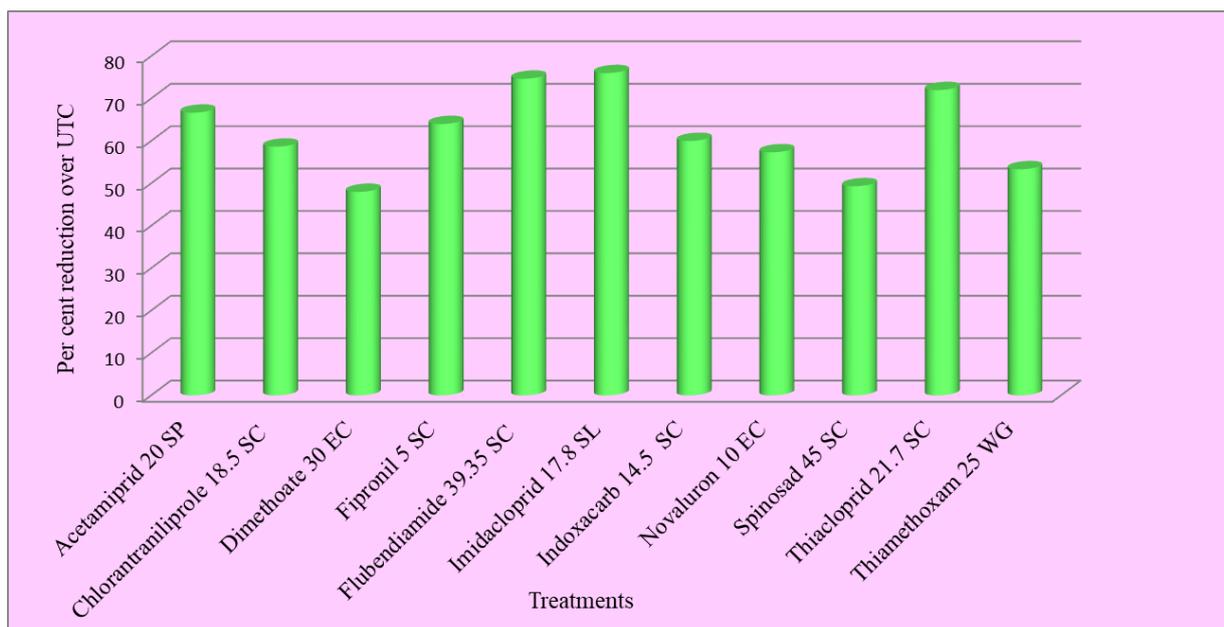


Fig. 2. Bio-efficacy of insecticides against thrips, *Isothrips orientalis* in jasmine

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