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Journal of Agriculture and Ecology

ISSN: 2456-9410

Volume: 8

Journal of Agriculture and Ecology (2019) 8: 19-23
<http://doi.org/10.53911/JAE.2019.8202>

Research Article

Open Access

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Received: 10 September 2018

Accepted: 15 November 2018

Available online: 5 August 2019

Key Words: Bio-efficacy, blossom midge, insecticides, *Jasminum sambac*.**Abstract**

The bio-efficacy of five botanicals and eleven insecticides were evaluated against jasmine blossom midge, *Contarinia maculipennis* Felt infesting *Jasminum sambac*. Among the botanicals, pungam oil was the most effective treatment with least infestation followed by NSKE were able to reduce the infestation by 82.66 and 76.21 per cent, respectively. Flubendiamide 39.35 SC was the best treatment recording the greatest reduction of 85.47 per cent followed by chlorantraniliprole 18.5 SC, respectively. The results concluded that insecticides are more effective than botanic insecticides against blossom midge.

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Preferred citation: Harini K, Elanchezhyan K & Murugesan N. 2019. Bio-efficacy different insecticides against jasmine blossom midge, *Contarinia maculipennis* Felt in *Jasminum sambac* L.. *Journal of Agriculture and Ecology*, 8: 19-23; <http://doi.org/10.53911/JAE.2019.8202>.

Introduction

Jasmine (*Jasminum sambac* L.) is an attractive important commercial crop in India. The importance of jasmine flower is felt in all religious, social, cultural ceremonies and other functions performed by all religious people. There are around 50 distinctive insect-pests species having a place within excess of eight orders harbouring fluctuated microhabitats of jasmine plants (Hemalatha 2009). Jasmine budworm (*Hendecasis duplifascialis* Hampson), blossom midge (*C. maculipennis*), leaf webworm (*Nausinoe geometralis* Guenee)

and sucking insect viz., whitefly (*Dialeurodes kirkaldyi* Kotinsky), thrips (*Isotrips orientalis* Bagnall), lacewing bug (*Corythauma ayyari* Drake), red spider mite (*Tetranychus urticae* Koch) and eriophyid mite (*Aceria jasmine* Chanana) which are economically important insect-pests next to budworm cause economic losses to jasmine growers. At present, farmers depend mostly on conventional insecticides and acaricides for managing the jasmine insect-pests. This can lead to problems like resurgence, residue and resistance on jasmine ecosystem. Decreased efficacy of conventional pesticides as well as

increased concerns over their use in jasmine ecosystem have emphasised on the need for identifying safer, more effective botanical, insecticide and acaricide molecules for management of jasmine insect-pests.

Materials and Methods

A field experiment was conducted in a farmer's field near Vallanad village, during the period of 2017-2018 to test the efficacy of selected botanicals and insecticides against blossom midge, *Contarinia maculipennis*. Randomized block design (RBD) was adopted

in each treatment; three plants and three replications were maintained for observation. Three rounds of foliar sprays were given at fortnight interval using battery operated hand sprayer. *C. maculipennis* infestation was assessed from 10 randomly selected jasmine bushes on the basis of flowers that were discoloured to purple. Total number of flower buds and the number of flower buds showing purple discolouration due to blossom midge were recorded and the per cent damage was worked out.

$$\text{Blossom midge infestation (\%)} (\text{Neelima 2005}) = \frac{\text{Number of discoloured buds}}{\text{Total number of buds}} \times 100$$

Pre-treatment observations on the incidence of blossom midge were recorded one day before spraying. Post treatment counts were recorded on 1st, 3rd, 7th and 14th day after imposing treatment. The percentage data gathered were transformed into angular values for statistical scrutiny as suggested by Gomez & Gomez (1984).

Results and Discussion

Bio-efficacy of botanicals against blossom midge, *C. maculipennis*

The data on bio-efficacy studies with botanicals shown that the infestation of blossom midge ranged from 4.36 to 33.46 per cent (Table 1). Statistical investigation established that the significant influence of treatments, spray rounds and period of observations; interaction effect was also conspicuous. Overall mean indicated that pungam oil was the most effective treatment with least infestation (5.53 %) as well as the

greatest reduction (82.66 %) in blossom midge damage. NSKE (7.59 %) was the next best treatment followed by *notchi* (*V. negundo*) leaf extract (8.24 %), and wild sage (*L. camara*) leaf extract (9.57 %); they brought out a reduction of more than 70 per cent. Sweet flag (*A. calamus*) treated plants recorded lesser infestation (9.77 %) than untreated plants, nevertheless inferior to former treatments. The similar trend was observed at each spray rounds as well as period of observations. The effectiveness of *pungam* oil @ 2.0 per cent for the control of jasmine pests revealed in the present study is confirmed by (Ponsekha & Muthusamy 2016) with their laboratory bioassay as well as the field studies reported by (Merlin Kamala 2017) in jasmine. The efficacy of NSKE @ 5.0 per cent in managing jasmine pest brought out in the present study was also supported by (Hemalatha 2009).

Table 1. Bio-efficacy of botanicals against blossom midge, *C. maculipennis*

Treatment		Conc. (%)	Per cent infestation of buds												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>) extract	(V. leaf	5.00	7.53 (15.03)b	7.89 (16.31)c	8.12 (16.67)c	8.46 (16.10)b	7.26 (15.63)c	7.95 (16.48)c	8.21 (16.75)c	9.02 (17.58)c	8.10 (16.53)c	7.92 (16.35)c	8.90 (17.46)b	9.50 (17.95)c	8.24 (16.56)c	74.17
NSKE		5.00	6.32 (14.66)b	7.16 (15.52)b	7.61 (16.01)b	7.82 (16.24)b	6.50 (14.87)b	7.26 (15.63)b	7.52 (15.02)b	8.10 (16.53)b	7.56 (15.06)b	8.61 (15.06)b	8.42 (16.97)b	8.23 (16.77)b	7.59 (15.87)b	76.21
<i>Pungam</i> oil		2.00	4.36 (12.16)a	5.13 (13.19)a	5.68 (13.89)a	5.86 (14.01)a	4.36 (12.05)a	5.49 (13.55)a	6.10 (14.30)a	6.34 (14.65)a	5.32 (13.33)a	5.67 (13.33)a	5.84 (13.08)a	6.23 (14.45)a	5.53 (13.54)a	82.66
Sweet flag (<i>A. calamus</i>) rhizome extract		5.00	9.46 (17.01)d	9.27 (17.72)c	9.48 (17.93)e	9.56 (18.01)c	8.59 (17.04)d	8.98 (17.44)d	9.68 (18.12)d	9.84 (18.38)c d	9.89 (18.33)e	10.67 (18.33)e	10.84 (19.22)d	10.92 (19.30)d	9.77 (18.14)e	69.37
Wildsage (<i>L. camara</i>) leaf extract	(L.	5.00	8.65 (17.10)d	8.95 (17.41)de	9.27 (17.73)de	9.58 (18.03)c	8.98 (17.44)d	9.25 (17.71)d	9.49 (17.95)d	9.58 (18.03)d	9.30 (17.86)d	10.45 (17.86)d	10.63 (19.03)d	10.68 (19.17)d	9.57 (18.04)e	70.00
Profenophos EC (Std check)	50	2.00 ml/lit	8.46 (16.00)c	8.60 (17.16)d	8.94 (17.30)d	9.56 (18.01)c	8.50 (19.05)e	8.90 (17.46)d	9.20 (17.76)d	9.63 (18.17)d	8.94 (17.40)d	9.30 (17.40)d	9.64 (18.19)c	9.90 (18.34)c	9.13 (17.73)d	71.38
Untreated check	-		31.24 (33.06)e	32.16 (35.54)f	33.46 (35.34)f	33.04 (35.18)d	31.46 (34.12)f	31.87 (34.47)e	30.26 (33.47)e	31.59 (34.00)e	32.5 (34.74)f	31.6 (34.28)f	31.4 (34.10)e	32.6 (34.80)e	31.9 (34.34)f	0.00
Mean			10.86 (17.86)A	11.31 (18.84)C	11.79 (19.27)EF	11.98 (19.36)F	10.81 (18.20)B	11.39 (18.96)CD	11.49 (19.05)D	12.01 (19.62)G	11.66 (19.04)D	12.03 (19.66)G	12.24 (19.72)G	12.58 (20.11)H		-

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)	0.14	0.09	0.11	0.19	0.50

Table 2. Bio-efficacy of insecticides against blossom midge, *C. maculipennis*

Treatment	Dose	Per cent infestation of buds												Overall Mean	Reduction over untreated check (%)
		1 st Spray DAS				2 nd Spray DAS				3 rd Spray DAS					
		1	3	7	14	1	3	7	14	1	3	7	14		
Acetamiprid 20 SP	0.10 g / lit	6.29 (14.53)c	7.09 (15.44)c	7.59 (15.99)c	7.81 (16.23)d	6.49 (14.86)c	7.26 (15.63)e	7.49 (15.88)d	8.06 (16.50)e	7.54 (15.93)e	8.60 (17.15)ef	8.40 (16.85)d	8.20 (16.64)c	7.57 (15.97)d	71.29
Chlorantraniliprole SC	18.5 0.10 ml / lit	4.03 (11.68)b	4.56 (12.33)a	4.89 (12.87)a	5.13 (13.09)a	4.45 (12.28)a	4.97 (12.99)a	5.46 (13.50)a	5.87 (14.02)b	3.80 (11.24)b	4.60 (12.48)a	5.60 (13.79)b	6.00 (14.28)b	4.95 (12.88)a	85.47
Dimethoate 30 EC	2.00 ml / lit	6.48 (14.74)c	7.15 (15.51)cd	7.68 (16.19)c	7.98 (16.41)d	6.49 (14.86)c	7.58 (15.09)d	7.89 (16.31)e	8.49 (16.94)f	7.56 (15.06)d	8.80 (17.35)fg	8.59 (17.04)e	8.67 (17.12)d	7.78 (16.05)d	75.63
Fipronil 5 SC	1.50 ml / lit	8.46 (16.91)e	8.59 (17.04)f	8.89 (17.35)e	9.45 (17.91)f	8.46 (16.01)e	8.86 (17.32)g	9.18 (17.64)f	9.53 (17.98)gh	8.94 (17.40)g	9.26 (17.72)g	9.59 (18.04)f	9.84 (18.38)f	9.09 (17.48)h	71.53
Flubendiamide 39.35 SC	0.75 ml / lit	3.59 (10.92)a	4.26 (11.92)a	4.59 (12.47)a	4.87 (12.75)a	4.25 (17.90)g	4.86 (12.74)a	5.31 (13.33)s	5.49 (13.a55)	3.46 (10.72)a	4.40 (12.11)a	5.23 (13.22)a	5.40 (13.43)a	4.64 (12.92)a	84.50
Imidacloprid 17.8 SL	0.30 ml / lit	7.26 (15.63)d	7.49 (15.88)de	7.89 (16.32)cd	8.42 (16.87)e	7.08 (15.43)d	7.69 (16.10)f	7.84 (16.36)e	8.67 (17.f12)	7.69 (16.10)ef	8.30 (16.74)ef	8.59 (17.04)e	9.12 (17.68)e	8.00 (16.44)e	74.94
Indoxacarb 14.5 SC	0.35 ml / lit	9.02 (17.57)f	9.25 (17.71)g	9.46 (17.92)f	9.80 (18.24)f	8.80 (17.36)f	9.26 (17.72)g	9.48 (17.92)f	9.89 (18.h33)	9.56 (18.01)h	10.26 (18.78)h	10.49 (18.90)g	10.89 (19.37)g	9.68 (18.15)j	69.68
Novaluron 10 EC	1.00 ml / lit	8.64 (17.19)ef	8.95 (17.41)fg	9.26 (17.71)ef	9.54 (17.90)f	8.97 (17.43)f	9.23 (17.68)g	9.48 (17.93)f	9.84 (17.9gh3)	9.26 (17.72)gh	10.43 (18.85)gh	10.59 (18.00)f	10.65 (19.05)g	9.54 (17.90)i	70.12
Spinosad 45 SC	0.32 ml / lit	7.46 (15.85)d	7.89 (16.32)e	8.04 (16.57)d	8.46 (16.91)e	7.26 (15.63)de	7.86 (16.28)f	8.16 (16.60)e	9.02g (17.58)	8.06 (16.50)f	7.90 (16.33)f	8.90 (17.45)e	9.50 (17.06)cd	8.21 (16.59)f	74.29
Thiacloprid 21.7 SC	0.60 ml / lit	6.23 (14.44)c	5.32 (13.33)b	6.13 (14.33)c	6.49 (14.86)c	5.64 (13.74)b	6.28 (14.51)c	6.94 (15.37)c	7.05d (15.40)	6.46 (14.72)d	6.84 (15.26)d	7.14 (15.50)c	7.29 (16.76)cd	6.48 (14.85)c	79.71
Thiamethoxam 25 WG	0.40 g / lit	4.35 (12.03)b	5.12 (13.18)b	5.64 (13.74)b	5.84 (13.98)b	4.35 (12.03)a	5.43 (13.57)b	6.01 (14.19)b	6.23c (14.55)	5.32 (13.33)c	5.67 (13.88)c	5.89 (14.04)b	6.10 (14.30)b	5.50 (13.57)b	82.77
Untreated check	-	31.24 (33.98)g	32.16 (34.55)h	33.46 (35.34)g	33.04 (35.19)g	31.46 (34.12)h	31.87 (34.57)h	30.26 (33.37)g	31.59 (34.20)i	32.48 (34.75)i	31.56 (34.28)i	31.44 (34.12)h	32.58 (34.80)h	31.93 (34.44)k	0.00
Mean		8.59 (16.29)A	8.99 (16.72)B	9.46 (17.23)D	9.74 (17.53)F	8.64 (16.80)B	9.26 (17.02)C	9.46 (17.37)E	9.95 (17.84)G	9.18 (16.79)B	9.72 (17.58)F	10.04 (17.83)G	10.35 (18.24)H		-

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)	0.12	0.06	0.07	0.12	0.42

Bio-efficacy of insecticides against blossom midge, *C. maculipennis*

The data from the field trial in the bio-efficacy of insecticides against blossom midge shown the percentage infestation on the bud of jasmine ranged from 3.59 to 33.46 per cent. The statistical analysis of the data brought out the marked influence of treatments, spray rounds and period of observations; interaction effect was also obvious (Table 2). Considering the spray rounds, as well as period of observations together flubendiamide 39.35 SC (4.64 %) as well as chlorantraniliprole 18.5 SC (4.95 %) were found to be the most effective treatments recording the minimum infestation; they could assert a reduction of infestation by more than 84 per cent compared to the untreated plants. Thiamethoxam 25 WG (5.50 %) was the next best treatment recording 82.77 per cent reduction over untreated check. A reduction in infestation by less than 70 per cent reduction in bud damage was observed on thiacloprid 21.7 SC, acetamiprid 20 SP, dimethoate 30 EC, imidacloprid 17.8 SL, spinosad 45 SC, fipronil 5 SC and novaluron 10 EC treated plants; they recorded an infestation of 6.48, 7.57, 7.78, 8.00, 8.21, 9.09 and 9.54 per cent respectively. Indoxacarb 14.5 SC was the least effective treatment with 69.68 per cent, reduction in bud infestation. Chlorantraniliprole 18.5 SC @ 0.10 ml/lit and flubendiamide 39.35 SC @ 0.75 ml/lit belongs to the main group of ryanodine receptor modulators and chemical sub group of diamides (IRAC 2009). They inhibit the nerve and muscle action in insects. These two insecticides were used against broad spectrum of lepidopterous insects. These molecules

affect intercellular Ca^{2+} channels (Omkar Gavkare et al. 2013; Singh et al. 2017). Merlin Kamala (2017) reported that thiacloprid 240 SC @ 0.6 ml/lit proved its superiority in managing blossom midge.

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