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SEASONAL INCIDENCE AND MANAGEMENT OF BUDWORM, *Hendecasis duplifascialis* (Hampson) IN *Jasminum Sambac* L.

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Abstract: A field experiment was conducted in Killikulam, Tuticorin, India, during summer season in 2018. The evaporation, sunshine hours and morning relative humidity had positive effect with 0.508*, 0.594* and 0.799**. The mean of evening relative humidity and rainfall had negative effect with -0.559* and -0.774**. A unit increase in the rainfall resulted in a decrease of 3.38 per cent damage. The efficacy of five botanicals and eleven insecticides were evaluate against jasmine bud worm, Hendecasis duplifascialis (Hampson) infesting Jasminum sambac. Chlorantriniliprole 18.5 SC @ 0.1 ml/l, flubendiamide 39.35 SC @ 0.75 ml/l, thiacloprid 21.7 SC @ 0.30 ml/l, dimethoate 30 EC @ 2.0 ml/l and novaluron 10 EC @ 1.00 ml/l recorded lower infestation (6.21, 6.64, 7.64, 7.92 and 13.69 per cent infested buds per five clusters per 10 plants, respectively). Among, the botanicals NSKE @ 5.0 per cent and pungam oil @ 2.0 per cent was superior against budworm followed by pungam oil @ 2.0 per cent with 81.67 and 76.10 per cent reduction, respectively.
Keywords: Bioefficacy, insecticides, botanicals, budworm, jasmine.

1. Introduction

Jasmine (*Jasminum sambac* L.) is an attractive important commercial crop in India. The importance of jasmine flower is felt in all religious, social and 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 is harmed by a variety of insect pests like jasmine budworm (*Hendecasis duplifascialis* Hampson), blossom midge (*Contarinia maculipennis* Felt), blossom thrips (*Isothrips orientalis* Bagnall) and so forth. Among them, jasmine budworm makes 30 to 70 per cent for every denomination yield misfortune (Gunasekaran, 1989). 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. The present investigation was undertaken during 2018 to manage the budworm in *Jasminum sambac* with insecticides.

2. Materials and Method

Field experiments were conducted in a farmer's field near Vallanad village, during the period of 2017-2018 to test the efficacy of selected insecticides against Budworm, *H. duplifascialis*. Randomized Block Design 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. *H. duplifascialis* incidence was recorded from 10 randomly selected jasmine bushes. Five twigs were selected from each bush. From these selected twigs, total number of flower buds and the number of flower buds showing budworm infestation were recorded and the per cent damage was worked out.

$$\text{Budworm infestation (\%)} = \frac{\text{Number of infested buds}}{\text{Total number of buds}} \times 100$$

(Neelima, 2005)

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

3. Results and Discussion

3.1 Seasonal incidence of budworm, H. Duplifascialis

Incidence of budworm, H. duplifascialis was observed from November II (18.19 %) fortnight to May II (32.09 %) fortnight and reached three peaks during October I fortnight (36.43 %), December I (22.28 %) fortnight and May I (32.49 %) fortnight (Table 1). budworm infestation also had negative association with evening relative humidity (-0.559*) and rainfall (-0.774**); and positive association with evaporation (0.508*), sunshine hours (0.594*) as well as morning relative humidity (0.799**).

Contribution of rainfall on the budworm damage was found to the tune of 60 per cent (R^2 = 0.599). A unit increase in the rainfall resulted in a decrease of 3.38 per cent damage (Table 2).

Initially the incidence of budworm was also in higher proportion level but declined to nil incidence during second to third fortnights of the study period. Budworm registered a steady increase thereafter throughout the study period.

Multiple regression analysis exposed the contribution of weather parameter to the tune of 60 per cent on the incidence of bud worm. Morning relative humidity, evaporation and sunshine hours had a significant and positive association. However, contrary reports are available from (Neelima, 2005) and (Merlin Kamala, 2017) who reported negative impact of relative humidity and rainfall. (Hemalatha, 2009) have reported that maximum temperature and minimum temperature had positive corroboration with bud worm damage. However, significantly positive impact could not be revealed in the present study.

3.2 Bio-efficacy of botanicals against budworm, *H. duplifascialis*

The statistical results from the bio-efficacy studies of botanicals against budworm are furnished in Table 3. The mean per cent infestation ranged from 6.54 to 44.02 per cent. Considering the spray rounds as well as period of observations together shown that NSKE @ 5.0 per cent recorded the least infestation (8.07 %) of *H. duplifascialis* along with the maximum reduction of infestation of budworm 81.67 per cent. *Pungam* oil resulted in 76.10 per cent reduction followed by sweet flag (*A. calamus),* profenophos 50 EC (Std. check) and *notchi (V. negundo)* leaf extract with 72.02, 71.18 and 70.25 per cent, respectively. Though wild sage *(L. camera)* leaf extract was the least effective one with 68.66 per cent reduction in budworm infestation but it was better than untreated check.

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. The efficacy of NSKE @ 5.0 per cent in managing jasmine pest brought out in the present study was supported by (Hemalatha, 2009) and (Merlin Kamala, 2017).

3.3 Bio-efficacy of insecticides against budworm, *H. duplifascialis*

The data from the bio-efficacy study with synthetic insecticides against budworm are exhibited in Table 4. The statistical scrutiny conceded the impact of treatments, spray rounds and period of observations on the insect pest’s infestation on buds; interaction effect was also significant. Budworm damage ranged from 5.06

to 34.86 per cent. Considering the overall mean infestation over spray rounds as well as period of observations affirmed most effectiveness of chlorantraniliprole 18.5 SC (6.21 %); it recorded the least infestation and was able to reduce the infestation by more than 81 per cent compared to untreated check. Flubendiamide 39.35 SC (6.64 %) was the next best treatment followed by thiacloprid 21.7 SC (7.64 %) and dimethoate 30 EC (7.92 %); the latter two were equal themselves also. Other treatments could reduce the infestation by less than 70 per cent only. Of them, thiamethoxam 25 WG (10.27 %), acetamiprid 20 SP (11.92 %), imidacloprid 17.8 SL (12.66 %), spinosad 45 SC (13.01 %) were inferior to the former treatment. On other hand, they were better than indoxacarb 14.5 SC (13.36 %), fipronil 5 SC (13.57 %) and novaluron 10 EC (13.69 %), respectively.

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). Earlier reports of effectiveness of chlorantraniliprole 18.5 SC @ 0.2 ml/lit against bud worm, *H. duplifascialis* (Hampson) infesting *Jasminum multiflorum* (Reddy *et al.*, 2016) was recorded lowest larval population with higher yield. (Merlin Kamala, 2017) reported that thiacloprid 240 SC @ 0.6 ml/lit proved its superiority in managing budworm followed by flubendiamide 480 SC @ 0.5 ml/lit and chlorantraniliprole 18.5 EC @ 0.75 ml/lit against leaf and flower feeders in jasmine.

Table 1. Seasonal incidence of population on jasmine during 2017-18

Std. FN		Bud worm Damage (%)	Max. Temp. (°C)	Min. Temp. (°C)	RH (%)		Rainfall (mm)	Sunshine (hrs)	Evaporation (mm)	Wind speed (Km/hr)
					Morng.	Eveng.				
Oct	I	36.43	36.34	22.29	66.87	61.98	0.33	6.60	7.65	4.75
	II	0.00	35.17	21.80	81.05	67.63	3.38	4.63	5.93	4.93
Nov	I	0.00	32.33	22.59	80.2	63.67	8.13	6.30	6.15	3.50
	II	18.19	32.18	20.95	81.07	71.87	5.27	4.55	3.45	5.55
Dec	I	22.28	30.90	18.86	80.00	76.87	4.33	5.05	5.35	3.52
	II	21.73	29.98	19.07	78.00	56.63	0.19	7.60	7.40	8.10
Jan	I	22.85	31.58	20.39	82.86	57.00	0.00	7.25	6.84	4.52
	II	26.01	31.91	20.49	83.00	49.25	0.00	7.60	7.46	6.65
Feb	I	27.01	33.26	25.19	86.25	48.8	0.23	6.01	9.15	8.43
	II	28.50	33.98	24.55	84.62	45.31	0.00	8.56	8.30	8.22
Mar	I	29.01	36.42	22.76	82.00	48.52	0.00	7.54	8.02	6.54
	II	30.75	35.45	23.50	83.23	55.43	0.72	8.33	7.55	7.00
Apr	I	31.26	37.11	25.56	84.35	43.42	0.86	8.56	8.26	3.46
	II	31.53	38.25	24.32	85.46	42.56	0.00	8.91	8.49	4.29
May	I	32.49	32.19	23.56	83.20	50.59	0.59	7.53	6.16	5.34
	II	32.09	34.56	25.61	80.49	52.67	0.26	6.84	7.42	6.49

Table 2. Correlation matrix showing relationship between budworm, *H. duplifascialis*

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Y_1	0.333	0.366	0.799**	-0.559*	-0.774**	0.594*	0.508*	0.262

* Correlation is significant at 0.01 level
**Correlation is significant at 0.05 level

Regression Model

$Y_1 = 29.516 - 0.907X_1 + 2.645X_2 – 0.357X_3 + 0.391X_4 – 3.771X_5 + 2.209X_6 - 0.610X_7 –0.443X_8$ ($R^2 = 0.599$)
Std. FN = Standard Fortnight
X1= Maximum temperature (°C)
X2= Minimum temperature (°C)
X3= Mean relative humidity morning (%)
X4= Mean relative humidity evening (%)
X5= Rainfall (mm)
X6= Sunshine (hrs)
X7= Evaporation (mm)
X8= Wind speed (Km/hr)

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Table 3. Bio-efficacy of botanicals against bud worm, *H. duplifascialis*

Treatment	Conc. (%)	Per cent infestation of buds												Overall Mean	Reduction over untreated check (%)
		1st Spray				2nd Spray				3rd Spray					
		DAS				DAS				DAS					
		1	3	7	14	1	3	7	14	1	3	7	14		
Notchi (*V. negundo*) leaf extract	5.00	11.64 (19.95)d	12.23 (20.47)d	12.64 (20.83)d	13.06 (21.18)d	12.09 (20.34)cd	12.34 (20.67)de	12.58 (20.87)de	12.94 (21.08)cd	12.8 (21.00)cd	12.99 (21.12)e	13.66 (21.69)d	14.03 (22.00)d	12.75 (20.93)e	70.25
NSKE	5.00	7.23 (15.60)a	7.56 (13.05)a	7.49 (15.88)a	8.06 (16.50)a	6.54 (14.82)a	7.09 (15.44)a	7.85 (16.27)a	8.46 (16.01)a	8.54 (16.99)a	9.06 (17.52)a	9.46 (17.91)a	9.54 (17.99)a	8.07 (16.17)a	81.67
Pungam oil	2.00	8.23 (16.78)b	8.40 (16.85)b	9.48 (17.93)b	10.26 (18.68)b	8.64 (17.09)b	9.54 (17.09)b	10.95 (19.32)b	11.23 (19.32)b	11.02 (19.39)b	11.23 (19.58)b	11.78 (20.07)b	12.06 (20.32)b	10.24 (18.57)b	76.10
Sweet flag (*A. calamus)* rhizome extract	5.00	10.32 (18.80)c	10.65 (19.05)c	11.03 (19.40)c	12.46 (20.67)c	11.54 (19.96)c	11.64 (19.06)c	12.05 (20.31)c	12.54 (20.84)cd	12.30 (20.53)c	12.66 (20.85)c	13.06 (21.18)c	13.57 (21.61)cd	11.99 (20.19)c	72.02
Wild sage (*L. camara*) leaf extract	5.00	12.97 (21.10)e	13.32 (21.40)e	13.97 (21.05)d	14.34 (22.52)e	12.46 (20.67)e	12.75 (20.91e	13.02 (21.15)e	13.24 (21.34)d	13.40 (21.47)d	13.65 (21.69)d	13.87 (21.87)d	14.20 (22.14)d	13.43 (21.44)f	68.66
Profenophos 50 EC (Std check)	2.00 ml/lit	11.23 (19.66)d	12.21 (20.46)d	12.54 (20.74)d	12.76 (20.93)cd	11.87 (20.15)d	12.12 (20.37)d	12.34 (20.57)cd	12.44 (20.75)c	12.40 (20.62)c	12.56 (20.76)c	12.78 (20.95)c	13.00 (21.13)bc	12.35 (20.59)d	71.18
Untreated check	-	40.26 (39.48)f	41.35 (40.02)f	42.37 (40.61)e	42.56 (40.72)f	42.94 (40.94)f	43.06 (41.01)f	43.21 (41.00)f	43.28 (41.14)e	43.53 (41.29)e	43.76 (41.42)e	43.89 (41.57)e	44.02 (41.44)e	42.85 (40.89)g	0.00
Mean		14.55 (21.62)A	15.10 (21.61)A	15.65 (22.35)C	16.21 (23.03)F	15.15 (22.00)B	15.51 (22.08)B	16.00 (22.78)B	16.30 (22.98)E	16.29 (23.04)F	16.56 (23.28)G	16.93 (23.59)H	17.20 (23.82)I		-

*DAS – Days after spray
Mean of three replications. Figures in parentheses are arc sin transformed values.
In a column/row, means followed by a common letter are not significantly different at 5% level (LSD).

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	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

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Table 4. Bio-efficacy of insecticides against budworm, *H. duplifascialis*

Treatment	Dose	Per cent infestation of buds												Overall Mean	Reduction over untreated check (%)
		1st Spray				2nd Spray				3rd Spray					
		DAS				DAS				DAS					
		1	3	7	14	1	3	7	14	1	3	7	14		
Acetamiprid 20 SP	0.10 g / lit	10.24 (18.76) e	10.54 (18.95)f	11.06 (19.42)e	12.52 (20.72)e	11.35 (19.79)c	11.54 (19.96)e	12.05 (20.31)ef	12.56 (20.86)g	12.06 (20.32)e	12.57 (20.86)d	13.06 (21.29)e	13.43 (21.50)ef	11.92 (20.23)e	63.55
Chlorantraniliprole 18.5 SC	0.10 ml / lit	5.43 (13.57)a	6.02 (14.20)b	6.84 (15.16)b	7.13 (15.50)b	6.20 (14.42)a	5.06 (12.90)a	5.84 (13.08)a	6.13 (14.33)a	5.29 (13.30)a	6.15 (14.45)a	6.84 (15.27)a	7.60 (15.00)a	6.21 (14.27)a	81.01
Dimethoate 30 EC	2.00 ml / lit	7.61 (16.01)c	7.54 (15.93)d	8.05 (16.58)c	8.44 (16.89)c	6.43 (14.79)a	7.46 (15.85)c	7.86 (16.39)c	8.53 (16.08)c	7.69 (16.10)c	8.10 (16.53)b	8.49 (16.94)c	8.88 (17.34)c	7.92 (16.29)c	77.71
Fipronil 5 SC	1.50 ml / lit	13.24 (21.34)g	13.59 (21.63)i	14.19 (22.13)hi	15.26 (22.90)h	12.59 (20.88)d	12.78 (20.95)f	13.10 (21.22)f	13.24 (21.34)gh	13.34 (21.42)g	13.56 (21.00)f	13.78 (21.89)fg	14.20 (22.14)gh	13.57 (21.62)i	58.50
Flubendiamide 39.35 SC	0.75 ml / lit	5.67 (13.88)ba	5.83 (13.05)a	6.03 (14.23)a	6.84 (15.16)ab	6.05 (14.23)a	6.84 (15.16)b	7.06 (15.40)b	7.46 (15.95)b	6.04 (14.23)b	6.43 (14.79)a	7.40 (15.88)b	7.98 (16.41)b	6.64 (14.86)b	79.70
Imidacloprid 17.8 SL	0.30 ml / lit	11.67 (19.08)e	12.04 (20.30)g	12.56 (20.86)f	12.86 (21.01)e	12.06 (20.32)c	12.23 (20.57)f	12.49 (20.79)f	12.84 (20.00)f	12.64 (20.83)f	12.84 (20.00)c	13.66 (21.70)ef	13.99 (21.07)e	12.66 (20.54)f	61.28
Indoxacarb 14.5 SC	0.35 ml / lit	12.94 (21.18)g	13.24 (21.34)i	13.87 (21.86)h	14.29 (22.20)g	12.38 (20.60)cd	12.64 (20.83)f	12.98 (21.12)f	13.10 (21.22)gh	13.24 (21.34)fg	13.54 (21.69)ef	13.89 (21.88)fg	14.20 (22.13)gh	13.36 (21.45)h	59.14
Novaluron 10 EC	1.00 ml / lit	13.46 (21.52)g	13.69 (21.72)i	14.67 (22.52)i	14.86 (22.67)gh	12.74 (20.91)d	12.53 (20.73)f	12.84 (20.00)e	13.30 (21.49)h	13.46 (21.54)g	13.87 (21.97)f	14.30 (22.21)g	14.56 (22.43)h	13.69 (21.64)i	58.13
Spinosad 45 SC	0.32 ml / lit	12.34 (20.56)f	12.59 (20.79)h	13.16 (21.28)g	13.68 (21.72)f	12.26 (20.50)cd	12.69 (20.85)f	12.97 (21.10)f	13.10 (21.22)gh	12.97 (21.13)fg	13.20 (21.30)de	13.46 (21.50)ef	13.75 (21.88)fg	13.01 (21.15)g	60.21
Thiacloprid 21.7 SC	0.60 ml / lit	6.20 (14.42)c	6.54 (14.82)c	7.00 (15.34)b	7.59 (15.00)a	7.06 (14.41)a	7.58 (20.93)d	7.98 (16.41)c	8.26 (16.71)d	7.85 (16.37)c	8.23 (16.77)b	8.61 (17.16)c	8.78 (17.23)c	7.64 (16.30)c	76.64
Thiamethoxam 25 WG	0.40 g / lit	8.46 (16.91)d	8.79 (17.25)e	9.40 (17.95)d	10.53 (18.94)d	8.54 (16.09)b	9.46 (17.91)g	10.87 (19.24)d	11.02 (19.48)e	10.99 (19.46)d	11.26 (19.61)c	11.89 (20.27)d	12.06 (20.32)d	10.27 (18.62)d	68.59
Untreated check	-	32.46 (34.73)h	30.56 (33.66)j	33.49 (35.45)j	34.86 (36.19)i	32.16 (34.55)e	31.06 (33.97)	32.44 (34.72)g	33.46 (35.34)i	31.60 (32.28)h	32.45 (34.72)g	33.52 (35.47)h	34.61 (36.02)i	32.7 (34.92)j	0.00
Mean		11.64 (19.33)A	11.75 (19.47)B	12.53 (20.23)C	13.24 (20.74)E	11.65 (19.29)A	11.82 (20.06)C	12.37 (19.98)C	12.75 (20.34)D	12.26 (20.03)C	12.68 (20.36)D	13.24 (20.95)F	13.67 (21.12)G		-

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CD (P=0.05)	0.13	0.06	0.07	0.13	0.45

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