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Bio-efficacy of pesticides on major pests of *Jasminum sambac* cv. Mysuru Mallige

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Abstract
Jasminum sambac cv. Mysuru Mallige, a Geographical Indication (GI) crop of the Mysuru region in Karnataka, faces significant challenges from three primary pests: bud borer *Hendecasis duplifascialis*, leaf web worm *Nausinoe geometralis*, and red spider mite *Tetranychus urticae*. Separate evaluations were conducted to assess the efficacy of pesticides against these pests. In the case of bud borer infestation, Chlorantraniliprole 18.5% SC at a concentration of 0.2 ml/l demonstrated superior effectiveness, with a recorded mean percent of affected buds as low as 0.83. Following closely were Spinosad 45% SC at 0.3 ml/l (3.68) and Flubendiamide 39.35% SC at 0.25 ml/l (3.88). For leaf web worm management, Chlorantraniliprole 18.5% SC at 0.2 ml/l exhibited the most promising results, with a mean percent of damaged leaves as minimal as 0.53. This was followed by Flubendiamide 39.35% SC at 0.25 ml/l (3.44) and Spinosad 45% SC at 0.3 ml/l (3.82). In the evaluation of acaricides against red spider mite infestation, etoxazole 10% SC at 1 ml/l emerged as the most effective, recording the lowest mite population. Following this was Spiromesifen 22.9% SC at 0.8 ml/l.

Keywords: *Jasminum*, Mysuru Mallige, bud borer, leaf web worm, red spider mite

Introduction

Jasmine, a member of the Oleaceae family and the order Oleales, is a versatile flowering shrub that can climb, trail, or stand erect. The genus *Jasminu*m comprises approximately 200 species found in tropical and subtropical regions worldwide. In India, around 40 species are documented, with 20 species native to South India. However, commercially, only four species, namely *Jasminum grandiflorum* Linn., *Jasminum auriculatum* Vahl., *Jasminum sambac* Ait., and *Jasminum multiflorum* (Burm. f.) Andrews, are cultivated in Karnataka. Historical Tamil literature dating back to 500 B.C to 200 A.D mentions three species of jasmine, namely *sambac*, *auriculatum*, and *grandiflorum*, suggesting South India's potential as a significant center of origin for many jasmine species (Bose and Yadav, 1989) [4].

Jasmine cultivation is widespread across India, covering approximately 8,000 hectares and yielding flowers worth eight to ten crores annually (Muthuswamy and Shanmugavelu, 1982) [7]. Tamil Nadu leads in jasmine production, with an annual output of 77,247 tons from 9,360 hectares. Karnataka follows closely, ranking second in both area and production, with 1,600 hectares and 20,000 tons of flowers, respectively (Anon., 2000) [1]. Currently, jasmine cultivation in Karnataka spans 5.76 thousand hectares, yielding 36.91 metric tons of flowers with a productivity of 86.41 metric tons (Anon., 2016) [2].

Jasminum sambac cv. Mysuru Mallige, a specific cultivar of Jasmine, holds the prestigious status of a Geographical Indication (GI) crop in the Mysuru region of Karnataka, India. The term "Mallige" translates to jasmine in the local Kannada language. This cultivar is esteemed for its captivating fragrance and delicate white flowers. However, its cultivation by farmers in and around Mysuru has declined due to a limited flowering period and increased pest infestations. Therefore, this study aims to investigate the pest complex, seasonal incidence, and management strategies affecting *Jasminum sambac* cv. Mysuru Mallige.

Materials and Methods

An experiment was conducted to evaluate the bio-efficacy of pesticides against bud borer (*Hendecasis duplifascialis*) infesting *Jasminum sambac* cv. Mysuru Mallige at the College of

Horticulture, Mysuru, during 2017-18. Additionally, another experiment focusing on the bio-efficacy of pesticides against leaf web worm (*Nausinoe geometralis*) was conducted in a farmer's field at Doddamaragowdanahalli near Ilavala, Mysuru, during the same period. Eight treatments were tested, including five synthetic insecticides, two biopesticides, and an untreated control. Both experiments were laid out in a randomized complete block design with three replications. Each treatment involved six plants, with observations recorded on four tagged plants. The treatments were imposed on one year old plants. The bud borer experiment involved three sprays of insecticides at 15-day intervals, while the leaf web worm experiment included two sprays at the same intervals. Observations were made before treatment and 3rd, 7th and 12th days for bud borer, and 3rd, 7th and 14th day for leaf web worm. Observations were made on four randomly selected flower clusters in tagged plants for bud borer and on five randomly selected shoots in tagged plants for leaf web worm. Statistical analysis, including ANOVA, was performed on the data to interpret the results at a significance level of 5%.

Furthermore, an experiment was conducted to evaluate the bio-efficacy of acaricides against the red spider mite (*Tetranychus urticae*) infesting *Jasminum sambac* cv. Mysuru Mallige. This experiment took place in a jasmine field at the Horticulture Department Farm, Kukkarahalli Kere, Mysuru, during the 2017-18 period. Similar to the previous experiments, eight treatments were tested, including six acaricides, one botanical, and an untreated control. The experiment followed a randomized complete block design with three replications, each consisting of six plants. Each treatment was consisted six plants and among these, four plants

were selected and tagged for recording observations. Treatments were imposed on five year old plants when the peak population ofmites was observed. Two sprays of each acaricides were taken at an interval of 30 days. Observations were made before treatment and at 3rd, 7th and 10th days after each spray to assess the mite population. Three leaves each from top, middle and bottom portion of the tagged plants were sampled and mite population counts were made under a stereo-binocular microscope in the laboratory. Statistical analysis, including ANOVA, was performed on the data, and results were interpreted at a significance level of 5%.

Results and Discussion

Among the insecticides evaluated for managing bud borer (*H. duplifascialis*) in the field, Chlorantraniliprole 18.5% SC @ 0.2 ml/l exhibited superior efficacy after the third spray at 12 days after spraying (DAS), recording the lowest mean percent affected buds (0.83). Following Chlorantraniliprole, Spinosad 45% SC @ 0.3 ml/l (3.68) and Flubendiamide 39.35% SC @ 0.25 ml/l (3.88) were also effective. Quinalphos 25% EC @ 2 ml/l (8.01) and Profenophos 50% EC @ 2 ml/l (10.45) were identified as the next best insecticides. Similar trends were observed after each spray application. Reddy *et al.* (1978) [12] reported the effectiveness of quinolphos and monocrotophos in controlling bud borer. Sudhir (2002) found that indoxacarb 14.5 SC at 0.0073% and spinosad 45 SC at 0.023% provided effective control. Roopini (2016) [13] identified Chlorantraniliprole 18.5% SC @ 0.1 ml/l and spinosad 45 SC @ 0.2 ml/l as superior, while quinolphos 25 EC @ 2 ml/l was inferior in reducing bud borer damage. Among all the insecticides tested, Azadirachtin 10000 ppm @ 2.5 ml/l exhibited inferior efficacy compared to *Bacillus thuringiensis* var. *kurstaki* 5% WP @ 1g/l. This finding aligns with Neelima's (2005) [8] report, which indicated that *Bacillus thuringiensis* var. *kurstaki* 5% WP @ 1g/l was superior to NSKE% in reducing bud borer population.

After the second spray at 14DAS, Chlorantraniliprole 18.5% SC @ 0.2 ml/l demonstrated superior efficacy in managing leaf web worm (*Nausinoe geometralis*) in the field, recording the lowest mean percent damaged leaves (0.53). Following Chlorantraniliprole, Flubendiamide 39.35% SC @ 0.25 ml/l (3.44) and Spinosad 45% SC @ 0.3 ml/l (3.82) were also effective compared to the standard check Quinalphos 25% EC @ 2 ml/l (8.53). Profenophos 50% EC @ 2 ml/l (9.66) was identified as inferior. Consistent results were observed after each spray application. While research on this aspect in jasmine remains limited, Rajabaskar (2006) [10] from Coimbatore found that Jatropha oil at 0.5% and Palmarosa oil at 0.1% were effective in reducing the larval population of leaf web worm. Sandhu and Shukla (1983) [14] observed that Monocrotophos 40 SC at 0.025% was effective in controlling the leaf web worm population on *Jasminum sambac* in Ludhiana. Chlorantraniliprole has emerged as highly effective in reducing damage caused by both bud borer and leaf web worm. This insecticide, a new green-labeled anthranilic diamide insecticide, exhibits a novel mode of action by activating ryanodine receptors via stimulation of calcium release from the sarcoplasmic reticulum of muscle cells. This mechanism causes impaired regulation, paralysis, and ultimately death of sensitive species, particularly chewing insect pests (Cordova *et al.*, 2006) [5]. Chlorantraniliprole demonstrates selective activity towards insect ryanodine receptors, explaining its low mammalian toxicity profile. It primarily acts on chewing pests through ingestion and, to a lesser extent, through contact, exhibiting ovicidal and larvicidal activity (Bassi *et al.*, 2007) [3]. Given the significant role of natural enemies in tri-trophic interactions in jasmine ecosystems, the use of less toxic insecticides that are less harmful to non-target arthropods should be emphasized.

After each spray application, etoxazole 10% SC @ 1 ml/l emerged as the most effective acaricide in managing red spider mite populations, recording the lowest mite population. Following etoxazole, Spiromesifen 22.9% SC @ 0.8 ml/l showed effectiveness in controlling the mite population. Fenazaquin 10% EC @ 2.5 ml/l, Propergite 57% EC @ 2.5 ml/l, and Dicofol 18.5% EC @ 2.5 ml/l were also among the top treatments. However, Sulphur 80% WP @ 5g/l and Azadirachtin 10000 ppm @ 2.5 ml/l resulted in the highest mite populations. These findings align closely with previous studies. Venugopal *et al.* (2003) [15] reported similar results in their study on *T. cinnabarinus* on okra in Raichur, where abamectin and dicofol were effective in controlling mite populations. Similarly, Jayachandran (2003) [6] found that abamectin was effective against rose mite, *T. urticae*, while dicofol and ethion provided moderate control. Commercial neem products were less effective in mite management, consistent with the findings of Patel *et al.* (1990) [9]. Moreover, the application of insecticides and acaricides significantly improved flower yield in jasmine, consistent with the findings of Rajkumar *et al.* (2005) [11], who evaluated pesticides against red spider mites on *J. sambac* in Raichur. They found that abamectin and dicofol were particularly effective in controlling mite populations.

Table 1: Bio-efficacy of insecticides against bud borer, *Hendecasis duplifascialis* on *Jasminum sambac* cv. Mysuru Mallige during 2017-18

Treatment	Dosage (per liter of water)	Mean per cent bored buds									
			First spray			Second spray			Third spray		
		1DBS	3DAS	7DAS	12DAS	3DAS	7DAS	12DAS	3DAS	7DAS	12DAS
Profenophos 50 EC	2.00ml	23.00 (28.653)	21.58 (27.67)bc	13.54 (21.58)c	13.88 (21.87)c	13.19 (21.30)c	13.00 (21.14)c	13.08 (21.20)c	12.06 (20.32)c	11.02 (19.38)c	10.45 (18.85)d
Chlorantraniliprole 18.5 SC	0.20ml	26.96 (31.278)	15.60 (23.26)f	7.42 (15.80)f	8.09 (16.53)f	7.03 (15.37)f	5.50 (13.56)g	4.98 (12.90)g	2.61 (9.30)f	1.26 (6.44)f	0.83 (5.19)g
Bacillus thuringiensis var. *kurstaki* 5 WP	1.00g	21.81 (27.832)	21.07 (27.31)bcd	16.18 (23.71)b	16.48 (23.95)b	15.62 (23.28)b	13.40 (21.47)c	13.53 (21.58)c	12.59 (20.78)c	11.50 (19.82)c	11.83 (20.12)c
Spinosad 45 SC	0.30ml	25.05 (30.033)	17.78 (24.93)ef	10.08 (18.51)e	11.02 (19.39)e	10.05 (18.49)e	8.76 (17.21)f	8.46 (16.90)f	6.04 (14.22)e	4.78 (12.63)e	3.68 (11.05)f
Flubendiamide 39.35 SC	0.25ml	22.72 (28.448)	19.01 (25.84)de	11.78 (20.07)d	12.10 (20.35)de	11.19 (19.54)de	9.96 (18.39)e	9.73 (18.18)e	6.53 (14.80)e	4.98 (12.90)e	3.88 (11.36)f
Azadirachtin 10000 ppm	2.50ml	24.29 (29.521)	22.96 (28.62)ab	17.35 (24.62)b	18.00 (25.10)b	17.03 (24.37)b	16.45 (23.92)b	16.53 (23.99)b	15.39 (23.09)b	14.24 (22.16)b	15.10 (22.86)b
Quinalphos 25 EC	2.00ml	22.36 (28.193)	20.48 (26.89)cd	13.12 (21.24)cd	13.40 (21.47)cd	12.52 (20.72)cd	11.37 (19.70)d	11.52 (19.84)d	9.96 (18.40)d	8.66 (17.11)d	8.01 (16.44)e
Water spray (Control)	--	23.01 (28.635)	25.54 (30.34)a	26.06 (30.68)a	27.07 (31.33)a	27.30 (31.48)a	27.51 (31.63)a	27.97 (31.91)a	28.09 (32.00)a	29.02 (32.59)a	29.10 (32.64)a
F 7, 14		NS	*	*	*	*	*	*	*	*	*
SEm±		1.731	0.961	0.632	0.60	0.524	0.401	0.448	0.353	0.335	0.413
CD @ 5%		--	1.717	1.392	1.357	1.268	1.109	1.173	1.040	1.013	1.125
CV %		4.525	3.651	3.609	3.443	3.319	3.032	3.217	3.108	3.235	3.711

DBS - Days before spray; DAS - Days after spray; * Significant @ 5%; NS: Non-significant; Values in the parenthesis are arc sine transformed values; Values with same alphabetical superscript within a column are not significantly different.

Table 2: Bio-efficacy of insecticides against leaf web worm, *Nausinoe geometralis* on *Jasminum sambac* cv. Mysuru Mallige during 2017-18

Treatment	Dosage (per liter of water)	Mean per cent affected leaves						
			First spray			Second spray		
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS
Profenophos 50 EC	2.00ml	19.94 (26.48)	18.10 (25.13)^{bc}	16.80 (24.16)^{bc}	16.01 (23.54)^{bc}	13.97 (21.88)^{bc}	10.86 (19.14)^{cd}	9.66 (17.98)^{cd}
Chlorantraniliprole 18.5 SC	0.20ml	25.14 (30.09)	14.41 (23.30)^{c}	7.37 (15.70)^{e}	6..19 (14.34)^{e}	3.71 (11.03)^{e}	1.60 (7.18)^{f}	0.53 (3.78)^{f}
Bacillus thuringiensis var. *kurstaki* 5 WP	1.00g	20.08 (26.56)	19.46 (26.11)^{b}	16.53 (23.93)^{bc}	16.24 (23.71)^{bc}	14.35 (22.19)^{bc}	13.61 (21.58)^{bc}	12.11 (20.29)^{c}
Spinosad 45 SC	0.30ml	23.66 (29.11)	17.46 (24.70)^{bc}	10.35 (18.76)^{d}	9.46 (17.91)^{d}	7.80 (16.20)^{d}	4.71(12.49)^{e}	3.82 (11.2)^{e}
Flubendiamide 39.35 SC	0.25ml	21.68 (27.75)	16.57 (24.02)^{bc}	9.48 (17.92)^{de}	8.58 (17.01)^{de}	6.60 (14.87)^{d}	4.50 (12.24)^{e}	3.44 (10.69)^{e}
Azadirachtin 10000 ppm	2.50ml	20.21 (26.59)	19.40 (26.00)^{b}	18.25 (25.15)^{b}	18.00 (24.96)^{b}	17.03 (24.21)^{b}	16.10 (23.47)^{b}	16.73 (23.96)^{b}
Quinalphos 25 EC	2.00ml	20.70 (27.06)	18.73 (25.64)^{b}	14.12 (22.07)^{c}	13.01 (21.14)^{c}	11.05 (19.40)^{c}	9.47 (17.91)^{d}	8.53 (16.98)^{d}
Water spray (Control)	--	22.62 (28.39)	24.14 (29.43)^{a}	25.21 (30.14)^{a}	25.35 (30.23)^{a}	25.91 (30.60)^{a}	26.23 (30.81)^{a}	26.84 (31.20)^{a}
F 7, 14		NS	*	*	*	*	*	*
SEm±		2.84	2.73	2.68	2.97	3.21	3.18	3.56
CD @ 5%		--	2.89	2.86	3.02	3.13	3.12	3.30
CV%		5.80	6.50	7.36	7.99	8.94	9.85	11.10

DBS - Days before spray; DAS - Days after spray; * Significant @ 5; NS: Non significant; Values in the parenthesis are arc sine transformed values; Values with same alphabetical superscript within a colu % mn are not significantly different.

Table 3: Bio-efficacy of acaricides against red spider mite, *Tetranychus urticae* infesting *Jasminum sambac* cv. Mysuru Mallige during 2017-18

Treatment	Dosage (per liter of water)	Mean number of mites per leaf							
			First spray				Second spray		
		1DBS	3DAS	7DAS	10DAS	1DBS	3DAS	7DAS	10DAS
Spiromesifen 22.9% SC	0.80ml	8.99 (3.00)	7.76 (2.78)^{bc}	5.67 (2.38)^{b}	3.24 (1.80)^{b}	8.13 (2.85)	6.94 (2.64)^{b}	4.68 (2.16)^{b}	2.03 (1.41)^{b}
Sulphur 80% WP	5.00g	10.07 (3.17)	9.10 (3.02)^{d}	8.24 (2.87)^{d}	7.45 (2.73)^{d}	8.10 (2.85)	7.52 (2.74)^{b}	6.89 (2.62)^{cd}	6.03 (2.45)^{cd}
Fenazaquin 10% EC	2.50ml	9.77 (3.12)	7.28 (2.70)^{ab}	6.74 (2.60)^{c}	5.63 (2.37)^{c}	8.04 (2.84)	7.02 (2.65)^{b}	6.38 (2.53)^{c}	4.91 (2.22)^{c}
Propergite 57% EC	2.50ml	8.51 (2.91)	7.61 (2.76)^{bc}	6.68 (2.58)^{bc}	5.75 (2.40)^{c}	7.53 (2.74)	7.06 (2.66)^{b}	6.27 (2.50)^{c}	4.99 (2.23)^{c}
Etoxazole 10% SC	1.00ml	9.85 (3.13)	6.53 (2.56)^{a}	2.36 (1.54)^{a}	1.16 (1.08)^{a}	8.95 (2.99)	5.92 (2.43)^{a}	1.97 (1.40)^{a}	0.94 (0.97)^{a}
Azadirachtin 10000 ppm	2.50ml	9.29 (3.04)	8.52 (2.92)^{cd}	8.28 (2.87)^{d}	8.32 (2.88)^{d}	8.23 (2.87)	7.60 (2.76)^{b}	7.29 (2.70)^{d}	7.29 (2.70)^{d}
Dicofol 18.5% EC	2.50ml	8.66 (2.94)	8.68 (2.95)^{cd}	7.91 (2.81)^{d}	7.38 (2.72)^{d}	7.61 (2.76)	7.41 (2.72)^{b}	6.72 (2.59)^{cd}	5.99 (2.45)^{c}
Water spray (Control)	--	10.48 (3.24)	10.70 (3.27)^{e}	11.30 (3.36)^{e}	11.73 (3.42)^{e}	9.78 (3.13)	10.12 (3.18)^{c}	10.47 (3.23)^{e}	10.69 (3.27)^{e}
F 7, 14		NS	*	*	*	NS	*	*	*
SEm±		0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.02
CD @ 5%		-	0.19	0.20	0.19	-	0.16	0.17	0.25
CV%		5.26	3.89	4.40	4.55	4.67	3.34	3.97	6.56

DBS - Days before spray; DAS - Days after spray; * Significant @ 5%; NS: Non significant; Values in the parenthesis are square root transformed values; Values with same alphabetical superscript within a column are not significantly different.

Conclusion

In summary, the study evaluated various insecticides and acaricides for their efficacy in managing bud borer, leaf web worm, and red spider mite populations in jasmine fields. Chlorantraniliprole 18.5% SC emerged as highly effective against bud borer and leaf web worm, with consistent performance after multiple spray applications. Its novel mode of action and low mammalian toxicity profile make it a promising option for pest management in jasmine cultivation. Additionally, etoxazole 10% SC proved to be the most effective acaricide against red spider mites, followed by Spiromesifen 22.9% SC. These findings underscore the importance of selecting less toxic insecticides and acaricides to minimize harm to non-target organisms and enhance flower yield in jasmine cultivation. Further research is needed to optimize pest management strategies and promote sustainable practices in jasmine production.

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