Pest Management in Horticultural Ecosystems
Vol. 25, No.2 pp 178-185 (2019)

Bio-Efficacy of selected chemicals, bio-agents and botanical against the jasmine budworm, *Hendecasis duplifascialis* Hampson (Lepidoptera: Crambidae)

H. SAMATA[1], G. KESHAVAREDDY[1*], C. N. LAKSHMINARAYANA REDDY[2], K. S. JAGADISH[1] and K. H. NAGARAJ[3]

[1]Department of Agricultural Entomology, [2] Department of Plant Pathology, [3]Department of Agricultural Extension, University of Agricultural Sciences, GKVK, Bengaluru-560065, Karnataka, India

***E-mail:** keshavaa_reddy@rediffmail.com

ABSTRACT: The efficacy of different insecticides, botanical and bio-agents against jasmine bud worm, *Hendecasis duplifascialis* Hampson revealed that flubendiamide 39.35%SC @ 0.3ml/l, profenophos 50%EC @ 1.5ml/l and cypermethrin 5%EC @ 0.4ml/l emerged as most promising treatments in managing bud worm from three trials during July to September, 2018. Thiacloprid 21.7% SC @ 1.5 ml/lt and thiodicarb 75 WP @ 1g/l had moderate effect in bringing down bud worm infestation. Among bio-agents, *Beauveria bassiana* 1×10^8 spores/ml @ 1ml/l proved better than *Bacillus thuringenesis* 17,600IU/mg@1ml/l and also chemical insecticide treatments *viz.*, thiacloprid and thiodicarb in controlling bud worm and relatively safe to farmers and workers who were involved in buds harvesting on a daily basis. Azadirachtin 0.5% @3ml/lt did not give satisfactory reduction in bud worm damage

Keywords: Bio-efficacy, *Hendecasis duplifascialis, Jasminum multiflorum*

INTRODUCTION

Jasmine is a highly valued commercial flower crop, introduced to South Asia in the mid sixteenth century. Jasmine is an important flower crop in southern states of India where many farmers are commercially cultivating it. In Karnataka state, many small and marginal farmers grow jasmine for livelihood. Since from last one decade farmers are experiencing difficulty in cultivating jasmine due to few insect and mite pests, which were reported to cause considerable damage affecting flower production. The pests include budworm, *Hendecasis duplifascialis* Hampson, bud and shoot worm (gallery worm), *Elasmopalpus jasminophagus*, leaf webber, *Nausinoe geometralis* Guenee, leaf roller, *Glyphodes unionalis* Guenee, Flower thrips, *Thrips orientalis* Bagnall and the blossom midge, *Contarinia maculipennis* Felt. Among mites *Tetranychus urticae* and eriophyid mite, *Aceria jasmine* are prominent. Eriophyid mite damage is increasing due to prevailing hot weather conditions (Kamala and Kennedy, 2016).

In Ramanagara district where estimated area under jasmine cultivation is more than 250 hectares, many small and marginal farmers growing *J. multiflorum* are finding difficulty in getting profit due to many reasons. The survey to jasmine gardens during 2018 revealed that jasmine bud worm, *H. duplifascialis* is the major pest causing damage to the buds with an average infestation of 21.85% throughout the year. The bud worm, *H. duplifascialis* infestation appeared on jasmine during first fortnight of July and the population increased and reached peak during the month of August, 2018 with 54.96 per cent infestation. Thus the efficacy trials were conducted to know the relative bio- efficacy of different chemicals, a botanical and bio-agents against jasmine bud worm.

MATERIALS AND METHOD

The efficacy trials were conducted against jasmine bud worm in farmers fields at Chandurayanahalli village, Magadi taluk, Ramnagara district. Three trials were conducted during the months of July, August and September, 2018 with peak flowering and heavy infestation of jasmine bud worm. A Randomized Block Design (RBD) with ten treatments including control was used in the experiment. Each treatment had four replications in all the trials and each plant was considered as one replication. The experiments were conducted in well-established jasmine gardens.

The treatments included for the experiment were selected on the basis of earlier literature. Inclusion of thiodicarb was based on farmer's usage and feedback. The use of azadirachtin, *Bacillus thuringiensis* and *Beauveria bassiana* was attempted to explore as eco-friendly components. Since farmers and farm labourers are involved in flower harvesting on a daily basis, these environment friendly components could be included in the management of the jasmine bud worm.

Table 1: Efficacy of chemicals, bio-agents and botanical against jasmine bud worm, *H. duplifascialis* (Trial- I)

Treatment	Pre-treatment larval population	Per-cent reduction		
		3 DAS	7 DAS	14 DAS
Flubendiamide39.35% SC @ 0.3 ml/lt	20.16	75.23 (60.15)[ab]	90.88 (72.42)[a]	100.00 (90.00)[a]
*Beauveria bassiana*1*10^8 spores/ml @1ml/lt	20.58	49.71 (44.83)[de]	73.89 (59.27)[bc]	84.55 (66.85)[cd]
Thiacloprid 21.7% SC @ 1.5 ml/lt	25.08	56.26 (48.60)[cd]	69.30 (56.36)[c]	80.60 (63.87)[cde]
Profenophos 50% EC @ 1.5 ml/lt	21.66	78.89 (62.65)[a]	90.99 (72.53)[a]	98.72 (83.50)[a]
Bacillus thuringiensis 17,600 IU/mg @1ml/lt	14.58	46.96 (43.26)[de]	46.64 (43.07)[d]	67.18 (55.05)[ef]
Azadirachtin 0.5% @ 3 ml/lt	17.58	45.96 (42.67)[de]	49.33 (44.61)[d]	62.51 (52.24)[f]
Cypermethrin 5% EC @ 0.4 ml/lt	18.00	33.04 (35.09)[e]	82.41 (65.20)[ab]	96.04 (78.52)[ab]
Thiodicarb75% WP @1 g/lt	19.25	71.81 (57.93)[abc]	83.08 (65.71)[ab]	90.99 (72.53)[bc]
Monocrotophos 36% SL @ 1.5 ml/lt	18.50	59.93 (50.73)[bcd]	65.42 (53.98)[c]	70.97 (57.40)[def]
Untreated	23.50	9.76 (18.20)[f]	5.98 (14.15)[e]	9.13 (17.59)[g]
C.D		**(8.55)**	**(7.93)**	**(9.28)**
SEm ±	**NS**	**(2.95)**	**(2.73)**	**(3.20)**
CV		**12.72**	**9.95**	**9.93**

*All the values are mean of four replications. *Values in the parantheses are Arc sine transformed. *DAS-days after spraying

The details of the treatments used for the experiment are given in the Table 1. Before treatments imposition, the selected plants for the experiment were labelled. From each labelled plant, three branches were randomly selected and tagged. Later infested buds count was recorded as pre-count. The treatments were imposed by using high volume knapsack sprayer. The observations on the bud worm infestation were recorded prior to treatment imposition as pre-count data and at three days, seven days and fourteen days after treatment imposition. The per cent reduction in bud worm infestation was worked out for each treatment. The per cent bud worm control data were analysed using ANOVA given by Gomez and Gomez (1984) to determine the efficacy of different chemicals and bioagents in the control of jasmine budworm.

The mean per cent reduction in damaged buds of budworm *H. duplifascialis* were worked out and values were Arc sin transformed and then subjected to single factor analysis of variance (ANOVA). The critical difference (CD) at 5% probability level was used as the test criterion.

RESULTS AND DISCUSSION

To evaluate the efficacy of the insecticides, a botanical and bio-agents three field trials were conducted. The spraying was done using high volume knapsack sprayer.

Trial –I

The data on the efficacy of selected insecticides, botanical and bio-agents against *Hendecasis duplifascialis* infesting jasmine are presented in Table 1. The pre- treatment population count of bud worm larvae in the selected cymoses were taken one day prior to the imposition of the treatments and the number of damaged buds with larvae ranged from 14.58-25.08 damaged buds/plant. The change in the colour of the buds, holes on the buds and the excreta deposition in the buds were considered as the index to categorise the buds as damaged buds during counting. These pre-count values were used to work out the per cent reduction in the bud worm damage after imposition of treatments. The observations were recorded at three, seven and fourteen days after spraying.

At three days post treatment, all the treatments were significantly superior over control. However, profenophos (78.89%) was found to be superior among all the treatments, followed by flubendiamide (75.23%) and thiodicarb (71.81%) were on par with each other. These were followed by monocrotophos (59.93%) and thiacloprid (56.26%) in mean per cent reduction in bud worm infestation and on par with each other. The treatments *Beauveria bassiana* (49.71%), *B. thuringiensis* (46.96%) and azadirachtin (45.96%) were found to be superior over the control but were on par with each other. Cypermethrin with 33.04% mean reduction in bud worm infestation was least effective as compared to other treatments, three days after treatments imposition.

The observations recorded at seven days post treatment, revealed that all the treatments were significantly superior over the control. The highest mean per cent reduction in bud worm damage was observed in profenophos (90.99%) followed by flubendiamide (90.88%) on par with each other. These were followed by thiodicarb (83.08%), cypermethrin (82.41%) and *B. bassiana* (73.89%) which were all on par with each other. Thiacloprid (73.89%) and monocrotophos (65.42%) were found to be next best treatments in controlling bud worm. Azadirachtin with 49.33% and *B. thuringiensis* with 46.64% mean per cent reduction in bud worm infestation was least effective as compared to other treatments.

At fourteen days post treatment, flubendiamide recorded highest mean per cent reduction in bud worm infestation (100%), followed by profenophos (98.72%) and cypermethrin (96.04%) which were on par with each other. This was followed by thiodicarb (90.99%), *B. bassiana* (84.55%) and thiacloprid (80.60%) which were next best treatments for the suppression of bud worm infestation. Monocrotophos (70.97%), *B. thuringiensis* (67.18%) and azadirachtin (52.49%) were the least effective when compared to other treatments, but all these treatments were significantly superior over the control.

Trial –II

The pre-treatment population count of mean number of bud worm larvae from selected and tagged branches ranged between 17.58 to 29.83 and are presented in Table 2. Three days after the treatment application, it was found that all the treatments were found significantly superior over the control. Flubendiamide (72.90%) recorded the highest control, followed by cypermethrin (67.89%) and profenophos (47.90%) which were on par with each other. The next treatments monocrotophos (54.30%), azadirachtin (49.94%), thiacloprid (49.50%), *Beauveria bassiana* (49.22%) and thiodicarb (47.90%) were all on par with each other and significantly superior over control. *B. thuringiensis* with 45.43% mean per cent reduction of bud worm infestation was the least effective, but it is significantly superior over control.

The observations revealed that seven days after post treatment, flubendiamide (91.13%) recorded the highest

Table 2: Efficacy of chemicals, bio-agents and botanical against bud worm, *H. duplifascialis* (Trial- II)

Treatment	Pre-treatment larval population	Per cent reduction		
		3 DAS	7 DAS	14 DAS
Flubendiamide 39.35% SC @ 0.3 ml/lt	24.66	72.90 (58.63)^{a}	91.13 (72.67)^{a}	99.31 (85.24)^{a}
Beauveria bassiana 1*10^{8} spores/ml @ 1ml/lt	21.91	49.22 (44.55)^{cd}	67.35 (55.15)^{b}	78.48 (62.36)^{bc}
Thiacloprid 21.7% SC @ 1.5 ml/lt	27.41	49.50 (44.71)^{cd}	68.44 (55.83)^{b}	85.12 (67.31)^{b}
Profenophos 50% EC @ 1.5 ml/lt	29.83	60.04 (50.79)^{bc}	89.42 (71.02)^{a}	97.60 (81.09)^{a}
Bacillus thuringiensis 17,600 IU/mg @ 1ml/lt	28.08	45.43 (42.37)^{d}	62.05 (51.97)^{b}	79.43 (63.03)^{bc}
Azadirachtin 0.5% @ 3 ml/lt	28.25	49.94 (44.96)^{cd}	67.03 (54.96)^{b}	81.28 (64.36)^{bc}
Cypermethrin 5% EC @ 0.4 ml/lt	17.58	67.89 (55.48)^{ab}	86.53 (68.47)^{a}	97.77 (81.41)^{a}
Thiodicarb 75% WP @1 g/lt	21.00	47.90 (43.80)^{cd}	66.30 (54.51)^{b}	82.49 (65.26)^{bc}
Monocrotophos 36% SL @ 1.5 ml/lt	21.08	54.30 (47.47)^{cd}	68.50 (55.86)^{b}	70.35 (57.01)^{c}
Untreated	23.75	6.01 (14.19)^{e}	2.96 (9.91)^{c}	6.28 (14.51)^{d}
CD		**(6.99)**	**(8.20)**	**(7.79)**
Sem±	**NS**	**(2.41)**	**(2.83)**	**(2.69)**
CV		**10.77**	**10.23**	**8.26**

*All the values are mean of four replications. *Values in the parantheses are Arc sine transformed. *DAS-days after spray

reduction in pest and its damage and also was on par with profenophos (89.42%) and cypermethrin (86.53%). These were followed by monocrotophos (68.50%), thiacloprid (68.44%), *B. bassiana* (67.35%), azadirachtin (67.03%), thiodicarb (66.30%) and *B. thuringiensis* (62.05%) which were on par with each other, but superior over control (9.66%).

At fourteen days after treatment, all the treatments were significantly superior over control. Flubendiamide (99.31%), cypermethrin (97.77%) and profenophos (97.60%) were equally effective in reducing bud worm larva and its damage. Further all other treatments like thiacloprid (85.12%), thiodicarb (82.49%), azadirachtin (81.28%), *B. thuringiensis* (79.43%), *B. bassiana* (78.48%) were on par with each other. Monocrotophos (70.35%) recorded the least reduction in bud worm larva and its damage but was significantly superior over the control (14.29%).

Trial –III

The data on the efficacy of selected insecticides, botanical and bio-agents against *H. duplifascialis* infesting jasmine are presented in Table 3. The pre-treatment population count of bud worm larvae in the

Table 3: Efficacy of chemicals, bio-agents and botanical against bud worm, *H. duplifascialis* (Trial-III)

Treatment	Pre-treatment larval population	Per cent reduction		
		3 DAS	7 DAS	14 DAS
Flubendiamide 39.35% SC @ 0.3 ml/lt	21.41	67.76 (55.40)[ab]	93.97 (75.79)[a]	100.00 (90.00)[a]
Beauveria bassiana 1*10^{8} spores/ml @1ml/lt	24.66	55.97 (48.43)[abc]	75.83 (60.55)[b]	89.24 (70.85)[b]
Thiacloprid 21.7% SC @ 1.5 ml/lt	21.50	51.65 (45.95)[bc]	70.20 (56.91)[bc]	84.19 (66.57)[bc]
Profenophos 50% EC @ 1.5 ml/lt	20.25	72.39 (58.30)[a]	88.80 (70.45)[a]	98.02 (81.91)[a]
Bacillus thuringiensis 17,600 IU/mg @1ml/lt	21.25	49.36 (44.63)[c]	67.33 (55.14)[bc]	80.36 (63.69)[c]
Azadirachtin 0.5% @ 3 ml/lt	23.00	47.45 (43.53)[c]	64.11 (53.20)[bc]	80.11 (63.51)[c]
Cypermethrin 5% EC @ 0.4 ml/lt	21.91	68.90 (56.10)[a]	90.25 (71.81)[a]	99.38 (85.48)[a]
Thiodicarb 75% WP @1g/lt	21.66	45.32 (42.31)[c]	60.77 (51.22)[c]	75.74 (60.49)[cd]
Monocrotophos 36% SL @ 1.5 ml/lt	23.50	49.22 (44.56)[c]	61.80 (51.83)[bc]	66.41 (54.58)[d]
Untreated	18.00	7.04 (15.39)[d]	5.50 (13.56)[d]	5.24 (13.23)[e]
CD		**(9.00)**	**(8.56)**	**(6.76)**
Sem±	**NS**	**(3.10)**	**(2.95)**	**(2.33)**
CV		**13.66**	**10.49**	**7.11**

*All the values are mean of four replications. *Values in the parantheses are Arc sine transformed. *DAS-days after spray

selected cymoses were taken one day prior to imposition of treatment and the number of damaged buds with larva ranged from 18.00 to 24.66. At three days after treatment imposition, all the treatments were found to be significantly superior over control. Profenophos (72.39%) and cypermethrin (68.90%) were equally effective in controlling bud worm and also on par with flubendiamide (67.76%). These were followed by *Beauveria bassiana* (55.97%), thiacloprid (51.65%), *B. thuringiensis* (49.36%), monocrotophos (49.22%), azadirachtin (47.45%) and thiodicarb (45.32%) which were all on par with each other and were significantly superior over the control.

At seven days after treatment, the observations revealed that all the treatments were significantly superior over control. Flubendiamide (93.97%), cypermethrin (90.25%) and profenophos (88.80%) gave highest pest damage reduction and were equally effective in reducing mean per cent bud worm infestation. These were followed by *B. bassiana* (75.83%), thiacloprid (70.20%), *B. thuringiensis* (67.33%), azadirachtin (64.11%), monocrotophos (61.80%) and thiodicarb (60.77%) which were on par with each other but was significantly superior over the control. The observations revealed that at fourteen days after treatment, flubendiamide (100.00%), cypermethrin (99.38%) and profenophos

(98.02%) recorded the highest mean per cent reduction in bud worm infestation and were on par with each other.

These were followed by *B. bassiana* (89.24%) and thiacloprid (84.19%) which were on par with each other. *B. thuringiensis* (80.36%), azadirachtin (80.11%) and thiodicarb (75.74%) were next best treatments and were on par with each other. Monocrotophos with 66.41% was least effective but significantly superior over the control.

Pooled data

The pooled data on the efficacy of selected insecticides, botanical and bio-agents against *H. duplifascialis* infesting jasmine are presented in the Table 4. The pre-treatment population count of damaged buds with larva were ranged from 19.16 to 24.66. It was observed that even the pooled data after analyzing showed the similar control pattern as observed in three independent trials.

At three days after treatment, all the treatments were significantly found to be superior over control but highest reduction in mean per cent bud worm infestation was observed in flubendiamide (71.96%). This was followed by profenophos (70.44%), cypermethrin (56.61%) and thiodicarb (55.01%) which were on par with each other. These were followed by monocrotophos (54.48%), thiacloprid (52.47%), *B. bassiana* (51.63%), azadirachtin (47.78%) and *B. thuringiensis* (47.25%) which were on par with each other, but significantly superior over the control.

At fourteen days after treatment, flubendiamide (99.77%), profenophos (98.11%) and cypermethrin (97.73%) were found to be best treatments in reducing mean per cent bud worm infestation and were on par with each other. These were followed by *B. bassiana* (84.09%), thiacloprid (83.30%), thiodicarb (83.07%), *B. thuringiensis* (75.66%), azadirachtin (74.63%) and which were on par with each other. Monocrotophos (56.77%) was significantly superior over the control but least effective in reducing mean per cent bud worm infestation.

From the pooled data it was found that flubendiamide, profenophos and cypermethrin were highly effective in reducing mean per cent bud worm infestation even at 15 days after treatment. Among bio-agents tested, *B. bassiana* was more effective compared to *B. thuringiensis* against bud worm infestation. *Beauveria bassiana* is even more effective than many chemical treatments except flubendiamide, profenophos, cypermethrin 15 days after treatment imposition. Thiacloprid and thiodicarb were moderately effective, whereas monocrotophos and azadirachtin were inferior to the above said treatments.

As bud worm is one of the major pest in jasmine causing huge economic loss by damaging the flower buds, it is very essential to take up management practices to control the pest. Sometimes it is so severe that it cannot be controlled through traditional management practices. In the present study, among the ten treatments evaluated, flubendiamide 39.35% SC@ 0.3ml/l was found to be superior over all other treatments recording 99.77 per cent reduction in the bud worm damage. This is supported by Kiran *et al*. (2017) and Harini *et al*. (2018) who reported that flubendimide 39.35%SC@ 0.75ml/l was effective in managing bud worm on *Jasminum sambac*.

The next best treatments against the bud worm were profenophos 50%EC@1.5ml/lt and cypermethrin 5%EC@0.4ml/lt. The effectiveness of cypermethrin in the present study is in confirmation with the findings of Dandapani (1989) who reported that cypermethrin 150g a.i/ha caused 90.2 per cent and 87.9 per cent reduction in infestation during subsequent spraying. David *et al*. (1990) also made similar report on the efficacy of cypermethrin against bud worm. Thiodicarb 75%WP @1g/l and thiacloprid 21.7% SC@1.5ml/l was also effective in managing the bud worm population as reported by Kamala and Kennedy (2018). They reported that thiacloprid 21.7%SC @ 0.6ml/l was effective in managing major pests, bud worm and midges.

Among the bio-agents *B. bassiana* 1x10^8 spores/ml @1ml/l was more effective in managing bud worm than *B. thuringeinsis*17,600IU/mg@1ml/l. The effectiveness of *B. bassiana* in managing bud worm is in confirmation with findings of Kiran *et al.* (2017). But the present findings with respect to *B. bassiana* were contrary to the finding of Kamala and Kennedy (2016), who reported that the mean per cent reduction in bud worm infestation over control was maximum in *B. thuringiensis* treated plots (77.60 %) followed by *B. bassiana* (74.45 %) but both these treatments were on par with each other. This may be due to weather parameters prevailing in this particular region during evaluation of bio-agents. During July to September months in 2018, in and around Bengaluru/ Ramanagara districts the average relative humidity was more than 90 per cent. This may be the one reason *B. bassiana* was more effective against bud worm as fungal pathogens were more virulent when relative humidity is more.

In the present study azadirachtin was not effective enough in managing bud worm when compared to other treatments. Though Ponsekha and Muthusamy (2016) reported that neem oil at 0.02% was found to be more effective than pungam oil (0.03%), many studies

Table 4: Efficacy of chemicals, bio-agents and botanical against bud worm, *H. duplifascialis* (Pooled data)

Treatment	Pre-treatment larval population	Per cent reduction		
		3 DAS	7 DAS	14 DAS
Flubendiamide 39.35% SC @ 0.3 ml/lt	22.08	71.96 (58.03)[a]	91.99 (73.56)[a]	99.77 (87.25)[a]
Beauveria bassiana 1*10^{8} spores/ml @ 1ml/lt	23.38	51.63 (45.93)[c]	72.36 (58.28)[b]	84.09 (66.49)[b]
Thiacloprid 21.7% SC @ 1.5 ml/lt	24.66	52.47 (46.43)[c]	69.31 (56.36)[bc]	83.30 (65.88)[b]
Profenophos 50% EC @ 1.5 ml/lt	23.91	70.44 (57.06)[ab]	89.74 (71.32)[a]	98.11 (82.10)[a]
Bacillus thuringiensis 17,600 IU/mg @ 1ml/lt	21.30	47.25 (43.42)[c]	58.67 (49.99)[c]	75.66 (60.44)[bc]
Azadirachtin 0.5% @ 3 ml/lt	22.94	47.78 (43.72)[c]	60.16 (50.86)[bc]	74.63 (59.76)[bc]
Cypermethrin 5% EC @ 0.4 ml/lt	19.16	56.61 (48.80)[abc]	86.39 (68.35)[a]	97.73 (81.33)[a]
Thiodicarb 75% WP @ 1g/lt	20.64	55.01 (47.88)[abc]	70.05 (56.82)[bc]	83.07 (65.70)[b]
Monocrotophos 36% SL @ 1.5 ml/lt	21.02	54.48 (47.57)[bc]	68.09 (55.61)[bc]	66.39 (54.57)[c]
Untreated	21.75	7.60 (16.00)[d]	4.81 (12.67)[d]	6.88 (15.21)[d]
CD		**(9.91)**	**(7.16)**	**(6.88)**
Sem±	**NS**	**(3.34)**	**(2.41)**	**(2.30)**
CV		**12.70**	**7.52**	**15.14**

*All the values are mean of four replications. *Values in the parantheses are Arc sine transformed. *DAS-days after spray

reported that rather than the neem formulations, NSKE (neem seed kernel extract) @ 5% recorded maximum per cent larval mortality. Kamala *et al*. (2017) reported that NSKE @ 5% recorded the maximum per cent larval mortality (71.69%) than neem oil (71.37%). The field studies conducted by Neelima (2005) also reported that NSKE (5%) was superior to azadirachtin @1500ppm.

Further, the monocrotophos 36% SL @1.5ml/lt used as standard check was found to be the least effective in reducing mean per cent bud worm infestation than other treatments. These findings from the present study is contrary to the findings of Ponsekha and Muthusamy (2016), who reported that monocrotophos (0.005%) caused 100% mortality. Similar findings by Gunasekaran (1989) who reported that monocrotophos @ 360g a.i/ha was superior to all other treatments in managing the bud worm effectively. This may be due to the influence of host plant on the efficacy of particular chemical against the insect control. Since monocrotophos in the present study was evaluated on *Jasminum multiflorum* against bud worm whereas all the previous reports were on *Jasminum sambac*.

Further, for low level of bud worm infestation during first fortnight of July month, if detected early, any of the treatments evaluated in the present study is sufficient to manage the bud worm since all the treatments were found to be effective in reducing the pest damage by more than 50 per cent. However, farmers should be advised to keep a close watch on bud worm re-infestation. If there is re-infestation or severe infestation, then jasmine growers are suggested to go with flubendiamide or cypermethrin or profenophos treatment for effective control of bud worm.

Based on the present study results, it can be concluded that flubendiamide 39.35%SC @ 0.3ml/l, profenophos 50%EC @ 1.5ml/l and cypermethrin 5%EC @ 0.4ml/l are most promising treatments in managing jasmine bud worm. The spray of azadirachtin or any neem based insecticides were not appreciated much by the farming community as it reduced the quality of flower buds with an off odour for at least one or two days.

ACKNOWLEDGEMENT

We are thankful to Department of Agriculture, Ramanagara, Government of Karnataka for providing financial support to carry out present investigations.

REFERENCES

David, P. M. M., Hanifa, A. M. and Natarajan, S., 1990. Biology and control of blossom midge *Contarinia* sp. (Diptera: Cecidomyiidae) on *Jasminum sambac* in Tamil Nadu. *Entomon*, **15** (3-4): 193-196.

Dhandapani, N., Gopal, N., M. and Sundarababu, P. C., 1989. Evaluation of insecticides for the control of jasmine bud worm. *Madras Agricultural Journal,* **76**: 50-52.

Gomez, K. A. and Gomez, A. A., 1984. *Statistical Procedures for Agricultural Research,* John Wiley & Sons Publications, New York, pp. 562-628.

Gunasekaran, V., 1989. Studies on the bio-ecology of jasmine pest complex. *M. Sc. Thesis*, Tamil Nadu Agricultural University, Coimbatore.

Harini, K., Elanchezhyan, K., Murugesan, N., Allwin, L. and Prabhu, T., 2018. Seasonal incidence and management of budworm, *Hendecasis duplifascialis* (Hampson) in *Jasminum sambac* L. *International Journal of Advances in Agricultural Science and Technology*, **5** (7): 42-51.

Kamala, I. M. and Kennedy, J. S., 2016. Evaluation of microbial agents against Jasmine budworm, *Hendecasis duplifascialis* Hampson in jasmine (*Jasminum sambac* L.), *Current Biotica*, **10** (3):230-240.

Kamala, I. M., Kennedy, J. S. and Kumar, B. V., 2018. Dissipation Dynamics and Risk Assessment of Thiacloprid 240 SC in Jasmine (*Jasminum sambac* L.) Buds. *Pesticide Research Journal*, **30** (2): 147-152.

Kamala, I. M., Chinniah, C., Kennedy, J. S., Kalyanasundaram, M. and Suganthy, M., 2017. Pesticidal effect of indigenous plant extracts against jasmine bud worm, *Hendecasis duplifascialis* Hampson in jasmine (*Jasminum sambac* L.). *International Journal of Tropical Agriculture*, **35** (2): 315-323.

Kiran, C. M., Jayalaxmi, N. H., Chakravarthy, A. K., Thippesha, D. and Kalleshwarswamy, C. M., 2017. Efficacy of certain insectides against jasmine gallery worm, *Elasmopalpus jasminophagus* (Hampson) (Lepidoptera: Pyralidae). *Pest Management in Horticulture Ecosystem,* **23** (1): 97-100.

Neelima, Y., 2005. Bio-ecology and management of jasmine pests. *Ph. D. Thesis*, Acharya NG Ranga Agricultural University, Rajendranagar, Hyderabad).

Ponsekha, C. P. and Muthusamy, M., 2016. Effect of Neem oil, Pungam oil and Monocrotophos against the larvae of Jasmine Budworm *Hendecases duplifacialis* (Pyraustidae: Lepidoptera). *International Journal Advanced Life Sciences*, **9**(2): 185-189.

MS Received 25 August 2019
MS Accepted 10 November 2019