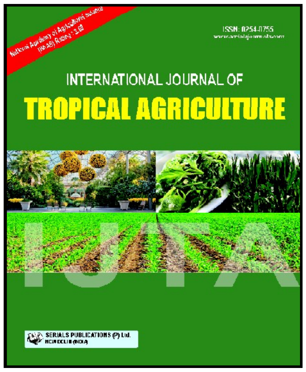

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Pesticidal Effect of Indigenous Plant Extracts Against Jasmine Bud Worm, *Hendecasis duplifascialis* Hampson. in Jasmine (*Jasminum sambac* L.)

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Abstract: The efficacy of botanicals against jasmine budworm (*Hendecasis duplifascialis*) was evaluated in two separate bioassays with plant extracts and plant oils under *invitro* and *invivo* conditions. *Invivo* bio-assay on plant extracts revealed that neem seed kernel extract 5 per cent recorded the maximum per cent mortality (71.69%), followed by sweetflag rhizome extract 5% (69.90), *Vitex* leaf extract 5% (68.38) and wild sage leaf extract 5% (65.97), whereas *invivo* bio-assay on plant oils revealed the superiority of neem oil in controlling budworm larvae with a maximum per cent mortality of 71.37%, followed by Horticultural mineral oil recording 69.58% mortality followed by pungam and lemon grass oil with 63.15% mortality. Further, field evaluation with the four best plant extracts and oils revealed that neem seed kernel extract 5% recorded maximum efficacy of 70.23 percent reduction in infestation over untreated control. Neem oil (3%), *Acorus calamus* rhizome extract (5%), horticultural mineral oil (3%) and *Vitex negundo* leaf extract (5%) were the next best treatments recording 68.41, 66.61, 64.98 and 58.88 percent respectively. Also, the tested plant extracts and oils did not cause any phytotoxic symptoms on the plants such as injury to leaf tips and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty.

Key words: Bio-efficacy, budworm, jasmine, plant extract, plant oil.

INTRODUCTION

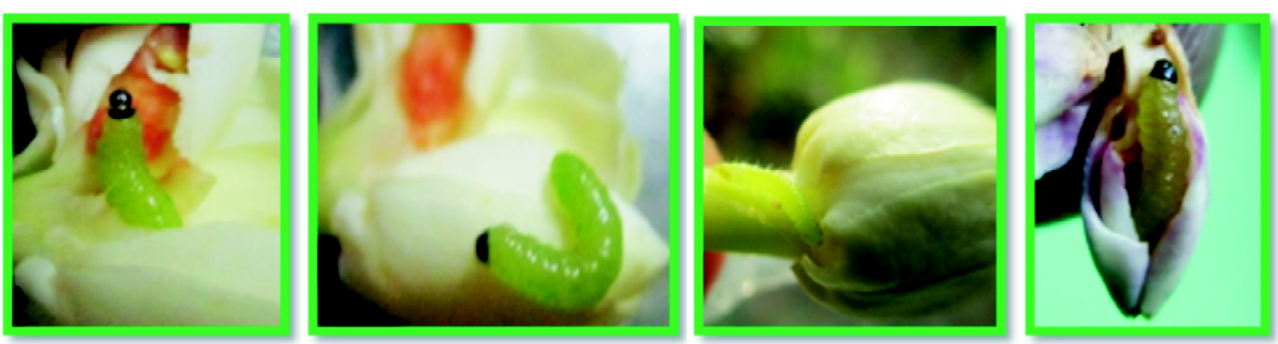
Jasmine (*Jasminum sambac*) is an important traditional flower, cultivated nearly throughout the tropical and subtropical parts of the world for its fragrant flowers. The plant is much valued for its exquisitely sweet-scented flowers, used for the production of jasmine concrete in cosmetic and perfume industries, to consecrate a sacred wedding ceremony, as a form of expressing love, affection, happiness and honouring the guests, religious offerings in temples and different plant parts like leaf, stem, bark and root are also used for medicinal purposes (Bose and Yadav, 1989).

As the demand for high grade perfumes has greatly increased in recent days, there is tremendous scope for the development of essential oil from jasmine flowers. In India, jasmine occupies an area of about 8,000 ha with an annual production of flowers worth Rs. 80-100 million. Tamil Nadu is the leading producer of jasmine in the country with an annual production of 77, 247 tonnes in an area of 9,360 ha (Prakash and Muniandi, 2014).

The production of Jasmine is affected by various factors, among them insect pests are the most important affecting the bud production. This major pests affecting jasmine are jasmine bud worm (*Hendecasis duplifascialus* Hampson), gallery worm (*Elasmopalpus jasminophagus* Hampson.), leaf web worm (*Nausinea geometralis* Guenee.), leaf roller, (*Glyphodes unionalis* Hubner.), blossom midge (*Contarinia maculipennis* Felt.) and red spider mite (*Tetranychus* spp. Koch.), of which, budworm gains major economic importance, as they cause excessive damage to buds. The tiny budworm, *H. duplifascialis* larva bores into closed immature buds and feed on the inner floral structures during initial stage. It makes a circular hole on the corolla tube, emerges and tunnels to move into other buds of the same shoot. Infested flowers turn pinkish violet in colour and fall off. In case of severe infestation, adjacent flower buds are webbed together by means of silken threads and feed on petals. As these tiny larvae feed on flower buds, which are the merchantable produce, the marketable quantity of the flowers are greatly reduced (Figure 1).

Information and research work on the management of jasmine budworm are scanty. The existing recommendation of insecticide application

Bore hole in the flower bud **Pink discoloured buds bud** **Web pattern among adjacent buds**



Larva in the flower bud

Figure 1: Damage symptoms of jasmine, bud worm, *Hendecasis duplifascialis*

is only a short term solution, as the pest population increases after a few months later disproportionately, requiring repeated application with high dosages, which finally become hazardous and uneconomical. Frequent application and large scale use of chemical insecticides for the control of these pests lead to the endangerment of ecosystem and reduction in biodiversity of natural enemies (Balasubramanian and Swamiappan, 1993). Besides, toxic effects of pesticides include emission of unpleasant odours from flowers leading to their rejection by consumers. Further, when exported to foreign countries, the importing countries impound the flowers in the ports if they detect pesticide residues above the MRL. It is pertinent that a change in the insect pest management strategy may form a meaningful solution to avoid the ill-effects caused by the synthetic chemical insecticides especially as environmental contaminants. Awareness of these environmental risks has encouraged interest in finding alternative pest control strategies and alternative products that are as effective as synthetics. In this context botanical extracts and oils are being explored extensively as a feasible alternative to synthetics in protecting Jasmine crop from insect pests.

Currently, great efforts are directed towards minimizing the use of conventional pesticides and increase in the use of Integrated Pest Management (IPM) strategies. Pesticides derived from plants are safer, specific in action, biodegradable and potentially suitable for use in integrated pest management programmes which have become part of leading research all over the world (Clemente *et al.,* 2003, Onnkum, 2012; Praveen *et al.,* 2012; Syahputra, 2013).). More than 2000 plant species including medicinal plants and spices are known to have insecticidal and acaricidal properties (Garcia *et al.,* 2004). Since plant extract compounds are found in nature, they donot release toxic substances into the environment besides suitable to use with natural enemies (El-Sharabasy, 2010). Keeping these in view, investigations were undertaken to evolve the botanical extract and plant oil which could be economically safer and effective against the budworm of jasmine.

MATERIALS AND METHODS

The study on bioefficacy of certain botanicals on the bud worm, *Hendecasis duplifacialis* was carried out *invivo* at the Department of Entomology, Agricultural College and Research Institute, Madurai under ambient conditions (Temperature, 28 ± 1°C and Relative Humidity 70 ± 5) during October-November 2015.

Laboratory Bioassay

Medicinal plants selected for the study

The plants used for the study were Neem, *Azadirachta indica* (leaf and seed kernel), Cashew, *Anacardium occidentale* (nut shell), Vitex, *Vitex negundo* (leaf), Citrullus, *Citrullus colocynthis*(fruit), Aloe, *Aloe vera* (leaf), Tulsi, *Ocimum sanctum*(leaf), Mint, *Mentha piperita* (leaf), Adathoda, *Adathoda vasica* (leaf), Sweet flag, *Acorus calamus* (rhizome), Custard apple, *Annona squamosa* (leaf and seed), Coleus, *Coleus aromaticus* (leaf), Wild sage, *Lantana camara* (leaf and flower) and Chrysanthemum, *Chrysanthemum cinerarifolium* (flower).

Preparation of botanical extracts

The different plant parts used for the assay were washed with water, then shade dried and ground separately from which 50 g of the well powdered material was soaked in 100 ml of solvent (ethanol) for 48 hrs at room temperature. The content was often stirred. After complete soaking, the extract was decanted. It was filtered through Whatman No. 1 filter paper. The filtrate was then made up to 100 ml by adding 5 ml of Triton × 100 (emulsifier) and the required quantity of solvent. Plant oils used for study: The different plant oils used for the study were ilupai oil (*Madhuca longifolia*), Pungam oil (*Pongamia pinnata*), Castor oil (*Ricinus communis*), Citrus peel oil (*Citrus maxima*), Lemon grass oil (*Cymbopogan citrates*), Neem oil (*Azadirachta indica*) Eucalyptus oil (*Eucalyptus globules*) and Horticultural Mineral Oil.

Preparation of ethanol based oil formulations: The botanical oils purchased from commercial venders were diluted in ethanol with water (70 + 30 by volume) mixtures and the solutions were made up to 100 ml by adding 5ml of Triton × 100 (emulsifier) and the required quantity of solvent. The final material was equivalent to 50 EC of the respective plant oil formulations. Emulsions of 3 per cent concentrations were prepared for conducting bio-efficacy studies.

Bio-assay Technique

Invitro bioassays were conducted to assess the efficacy of plant derivatives on the field collected third instar larvae of jasmine budworm by bud dip method. Screening of the botanicals/oils was carried out using aqueous suspension. Plant derived aqueous solutions/ oils were prepared at different concentrations each at 100 ml and placed in a 250 ml conical flask. Jasmine flower buds of equal size were immersed in 50 ml of the plant based suspensions for 30 seconds and the excess fluid was removed by uniform jerking and shade dried. Twenty buds treated with different concentrations were placed inside petridishes lined with moistened filter paper Ten third instar larvae were introduced to feed on the treated buds into each petriplate and observations on larval mortality were recorded at 24, 48, 72, 96, 120 and 144 hours after treatment.

Field experiment

A field trial was conducted at farmer's holding at Madurai district to evaluate the efficacy of botanicals against insect pests. Three rounds of foliar application were given at fortnight interval. The treatments used were four best treatments from the laboratory bioassay of plant extracts and four more from the best of plant oils along with standard check of Profenophos 50 EC and an untreated control. The experiment was conducted in RBD with three replications. The post treatment counts of the budworm infestation were recorded on 1, 3, 7 and 14 days interval after each spray, besides pre-treatment count. The total number of buds in a bush and the number of buds with bore holes were recorded and the percentage infestation was worked out.

Phytotoxicity

The phytotoxicity of plant extracts *viz.,* injury to leaftips and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty on the leaves were recorded. The observations on phytotoxicity were made on 1, 3, 7 and 14 days after each application.

Statsitical Analysis

For laboratory bio-assays, the data were transformed into $\sqrt{x}$ and analyzed by completely randomized design. The treatment mean values were compared using Latin Square Distribution (LSD). The corrected per cent mortality was worked out by using Abbott's correction. The percentage data obtained from the field experiment were subjected to arcsine transformation (Gomez and Gomez, 1984). Prior to analysis, the data were subjected to square root transformation and the mean values of treatments were then compared using Latin square distribution (LSD) and analysed by randomized block design to identify the most effective treatments.

RESULTS AND DISCUSSION

The plant extracts evaluated against *H. duplifascialis* under laboratory condition showed a varied response on their insecticidal activity (Table 1). Among the sixteen botanical extracts tested for their insecticidal property, neem (*Azadirachta indica*) seed kernel extract 5 per cent recorded the maximum per cent mortality (71.69 percent), followed by *Acorus calamus* rhizome extract 5 per cent (69.90), *Vitex negundo* leaf extract

Table 1
In-vitro* bio-assay of certain plant extracts against jasmine budworm, *Hendecasis duplifascialis
(Mean of three replications)

				Larval count (hours after treatment)							
Treatments	*Common name*	*Tissue Used*	*Concentration*	*24 hrs*	*48 hrs*	*72 hrs*	*96 hrs*	*120 hrs*	*144 hrs*	*Mean*	*Per cent reduction over untreated control*
T_1	Neem	Leaf	5%	11.00 (3.31)^{de}	9.33 (3.05)^{cde}	8.66 (2.94)^{de}	7.00 (2.64)^{cd}	6.33 (2.51)^{c}	5.00 (2.23)^{c}	7.89 (2.80)^{de}	57.21
T_2	Neem	Kernel	5%	7.00 (2.64)^{ab}	6.66 (2.57)^{ab}	5.33 (2.30)^{ab}	5.0 (2.23)^{b}	4.33 (2.07)^{b}	3.00 (1.73)^{b}	5.22 (2.28)^{b}	71.69
T_3	Cashew	Nut Shell	5%	15.33 (3.91)^{hi}	14.00 (3.74)^{h}	12.33 (3.50)^{gh}	9.66 (3.10)^{fg}	8.00 (2.82)^{de}	6.33 (2.51)^{de}	10.64 (3.26)^{fgh}	40.67
T_4	Vitex	Leaf	5%	8.00 (2.82)^{abc}	7.66 (2.76)^{bc}	6.00 (2.44)^{bc}	5.66 (2.37)^{bc}	4.33 (2.07)^{b}	3.33 (1.82)^{b}	5.83 (2.41)^{bc}	68.38
T_5	Adathoda	Leaf	5%	14.33 (3.78)^{ghi}	13.00 (3.60)^{gh}	11.66 (3.41)^{fgh}	9.00 (2.99)^{efg}	7.33 (2.70)^{cde}	6.00 (2.45)^{cde}	10.22 (3.19)^{fg}	44.57
T_6	Citrullus	Fruit	5%	12.33 (3.50)^{efg}	11.00 (3.31)^{efg}	9.66 (3.10)^{ef}	8.00 (2.82)^{def}	6.66 (2.58)^{cd}	5.00 (2.23)^{c}	8.775 (2.96)^{ef}	52.41
T_7	Aloe	Leaf	5%	11.66 (3.41)^{ef}	10.00 (3.16)^{def}	9.66 (3.10)^{ef}	8.33 (2.88)^{defg}	7.00 (2.64)^{cd}	6.00 (2.45)^{cd}	8.775 (2.96)^{ef}	52.41
T_8	Tulsi	Leaf	5%	9.33 (3.05)^{cd}	9.00 (2.99)^{cde}	8.33 (2.88)^{de}	7.66 (2.76)^{de}	6.00 (2.44)^{c}	5.33 (2.30)^{cd}	7.44 (2.72)^{cde}	59.65
T_9	Mint	Leaf	5%	11.00 (3.31)^{de}	9.33 (3.05)^{cde}	8.66 (2.94)^{de}	7.00 (2.64)^{cd}	6.33 (2.51)^{c}	5.00 (2.23)^{c}	7.89 (2.80)^{de}	57.21
T_{10}	Coleus	Leaf	5%	15.00 (3.87)^{hi}	14.00 (3.73)^{h}	12.33 (3.50)^{gh}	10.00 (3.15)^{gh}	8.66 (2.94)^{ef}	6.33 (2.51)^{d}	11.05 (3.31)^{cgh}	40.07
T_{11}	Sweet Flag	Rhizome	5%	7.66 (2.76)^{abc}	7.00 (2.64)^{abd}	6.33 (2.51)^{bc}	5.00 (2.23)^{b}	4.33 (2.08)^{b}	3.00 (1.73)^{b}	5.55 (2.35)^{b}	69.90
T_{12}	Custard apple	Leaf	5%	14.66 (3.83)^{h}	13.33 (3.64)^{gh}	11.00 (3.31)^{f}	9.00 (2.99)^{ef}	6.33 (2.51)^{c}	5.00 (2.23)^{c}	9.89 (3.14)^{f}	46.36
T_{13}	Custard apple	Seed	5%	15.66 (3.95)^{ghi}	14.00 (3.74)^{h}	13.33 (3.65)$^{g h}$	12.00 (3.46)^{gh}	10.33 (3.21)^{f}	9.00 (2.99)^{f}	12.38 (3.52)^{gh}	33.86
T_{14}	Wild sage	Leaf	5%	8.66 (2.94)^{bci}	8.00 (2.82)^{bc}	7.33 (2.70)^{d}	6.00 (2.44)^{bcd}	4.66 (2.16)^{b}	3.00 (1.73)^{b}	6.27 (2.50)^{bcd}	65.97
T_{15}	Wild sage	Flower	5%	13.00 (3.60)^{efg}	12.00 (3.46)^{fgh}	10.66 (3.26)^{fg}	9.00 (2.99)^{egf}	8.66 (2.94)^{ef}	7.33 (2.70)^{e}	10.10 (3.17)^{efg}	45.22
T_{16}	Chrysanthe-mum	Flower	5%	13.66 (3.69)^{fghi}	12.66 (3.55)^{gh}	11.00 (3.30)^{fg}	9.33 (3.04)^{efg}	8.00 (2.82)^{e}	6.33 (2.51)^{d}	10.16 (3.18)^{efg}	44.98
T_{17}	Profenofos 50 EC	–	2 ml/lit	6.66 (2.58)^{a}	5.33 (2.30)^{a}	4.00 (1.99)^{a}	3.33 (1.82)^{a}	1.66 (1.28)^{a}	0.33 (0.57)^{a}	3.55 (1.88)^{a}	80.74
T_{18}	Untreated check	–	–	20.0 (4.47)^{j}	19.33 (4.39)^{i}	18.66 (4.31)^{i}	18.0 (4.23)^{i}	17.66 (4.19)^{g}	17.0 (4.11)^{g}	18.44 (4.28)^{i}	–
SE			NS	0.1726	0.1727	0.1563	0.1514	0.1401	0.1267	0.1566	
CD(0.05)				0.3500	0.3503	0.3170	0.3072	0.2842	0.2570	0.3176	
CV%				6.19	6.50	6.24	6.56	6.64	6.80	6.54	

NS-Non significant
Each value is the mean of three replications.
Figures in parentheses are square root transformed values.
In a column, means followed by common letter (s) is / are not significantly different by LSD at P=0.05

5 per cent (68.38) and *Lantana camara* leaf extract 5 per cent (65.97), *Mentha piperita* 5 percent (59.65). The results are in line with the findings of Ogah *et al.*, (2011), who confirmed the effect of neem seed kernel extract 5 per cent against rice yellow stem borer. *Azadirachta indica* leaf extract 5 per cent (57.21) and *Ocimum sanctum* leaf extract 5 per cent ranks next in the order of efficacy which are on par recording 57.21 per cent mortality over untreated control, followed by the fruit extracts of *Citrullus colocynthis* 5 per cent and the leaf extracts of *Aloe vera* 5 per cent expressed similar effect recording 52.41 per cent larval mortality. Similarly, the flower extracts of *L. camara* 5 per cent and *C.cinerarifolium* 5 per cent were on par in their efficacy recording 45.22 and 44.98 per cent larval mortality respectively. However, profenophos 50 EC (standard check) @ 2 ml/l was significantly superior over all plant extracts with the highest larval mortality of 80.74 per cent.

The plant oil formulations evaluated for their efficacy against *H. duplifascialis* under *invitro* conditions revealed that (Table 2) neem oil has better efficacy in controlling budworm larvae of 71.37 percent mortality, which is in line with the findings of

Table 2
In-vitro* bio-assay of certain plant oil formulations against jasmine budworm, *Hendecasis duplifascialis
(Mean of three replications)

			Larval count (hours after treatment)							
Treatments	*Common name*	*Concentration (per cent)*	*24 hrs*	*48 hrs*	*72 hrs*	*96 hrs*	*120 hrs*	*144 hrs*	*Mean*	*Per cent reduction over untreated control*
T_1	Ilupai oil	3	6.66 (2.23)^{de}	6.00 (2.45)^{de}	5.00 (2.23)^{cd}	4.33 (2.08)^{ef}	3.66 (1.91)^{de}	3.00 (1.73)^{d}	4.78 (2.19)^{de}	49.68
T_2	Pungam oil	3	4.66 (1.99)^{bc}	4.33 (2.08)^{bc}	4.00 (1.99)^{c}	3.33 (1.83)^{cd}	2.66 (1.63)^{c}	2.00 (1.41)^{c}	3.50 (1.88)^{c}	63.16
T_3	Castor oil	3	8.00 (2.58)^{f}	7.00 (2.64)^{de}	6.66 (2.58)^{e}	5.00 (2.24)^{ef}	4.00 (1.99)^{e}	3.66 (1.91)^{d}	5.71 (2.39)^{e}	39.89
T_4	Citrus peel oil	3	5.66 (2.15)^{cd}	5.33 (2.30)^{cd}	4.66 (2.15)^{bc}	4.00 (1.99)^{de}	3.00 (1.73)^{d}	2.00 (1.41)^{c}	4.10 (2.02)^{d}	56.84
T_5	Lemon grass oil	3	5.00 (1.91)^{bc}	4.66 (2.08)^{c}	3.66 (1.91)^{ab}	3.00 (1.73)^{bc}	2.66 (1.63)^{c}	2.00 (1.41)^{c}	3.50 (1.85)^{c}	63.15
T_6	Neem oil	3	4.33 (1.73)^{b}	4.00 (1.99)^{b}	3.00 (1.73)^{a}	2.33 (1.52)^{b}	1.66 (1.29)^{b}	1.00 (0.99)^{ab}	2.72 (1.65)^{b}	71.37
T_7	Eucalyptus oil	3	7.33 (2.45)^{ef}	7.00 (2.64)^{e}	6.00 (2.45)^{e}	5.33 (2.31)^{ef}	4.33 (2.08)^{e}	3.33 (1.82)^{d}	5.53 (2.35)^{e}	41.79
T_8	Horticultural Mineral Oil	3	4.33 (1.73)^{b}	4.00 (1.99)^{b}	3.00 (1.73)^{a}	2.66 (1.63)^{bc}	2.00 (1.41)^{b}	1.33 (1.15)^{b}	2.89 (1.69)^{b}	69.58
T_9	Profenophos 50 EC	2 ml/lit	3.00 (1.82)^{a}	2.66 (1.62)^{a}	1.66 (1.73)^{a}	1.33 (1.15)^{a}	1.00 (0.99)^{a}	0.66 (0.811)^{a}	1.72 (1.33)^{a}	81.37
T_{10}	T_{13}-Untreated check	–	10.00 (3.10)^{g}	10.00 (2.08)^{f}	9.66 (3.10)^{f}	9.33 (3.05)^{g}	9.00 (2.99)^{f}	9.00 (2.99)^{e}	9.50 (3.07)^{f}	
	S. Ed.		0.1185	0.1178	0.1188	0.1106	0.1003	0.0922	0.1144	
	CD (P = 0.05)		0.2471	0.2458	0.2478	0.2307	0.2093	0.1923	0.2368	
	CV per cent		6.04	6.28	6.73	6.94	6.96	7.21	6.81	

NS - Non significant;
Each value is the mean of three replications.
Figures in parentheses are square root transformed values.
In a column, means followed by common letter (s) is/are not significantly different by LSD at P = 0.05

Gunasekaran (1989), followed by Horticultural mineral oil (69.58% mortality), pungam and lemon grass oil (63.15% mortality), followed by citrus peel oil (56.84% mortality), followed by illupai oil recording 49.68% mortality. Nevertheless, profenophos 50 EC (standard check) @ 2 ml/l registered the highest mortality of 81.37 per cent.

Field experiment conducted to evaluate the bio-efficacy of certain promising plant extracts (each @ 10% concentration) and plant essential oils (each @ 3% concentration)(Table 3) revealed that pre-treatment infestation of the jasmine bud worm, ranged between 34.52 to 46.38 percent infestation, which were statistically non significant. The post

Table 3
Field evaluation of botanicals against jasmine bud worm, *Hendecasis duplifascialis*

				Percentage of infestation					
Treatments	*Common name*	*Concentration (per cent)*	*Pre-treatment infestation*	*1 DAT*	*3 DAT*	*7 DAT*	*14 DAT*	*Mean*	*Per cent reduction over untreated control*
T_1	Neem (*Azadirachta indica*) kernel extract	5	43.85	9.68 (3.11)^{b}	10.65 (3.26)^{b}	13.93 (3.73)^{a}	17.53 (4.18)^{b}	12.95 (3.59)^{b}	70.23
T_2	Sweet flag (*Acorus calamus*) rhizome extract	5	38.65	10.96 (3.30)^{b}	12.14 (3.48)^{b}	15.36 (3.91)^{a}	19.63 (4.42)^{b}	14.52 (3.80)^{bc}	66.61
T_3	Notchi (*Vitex negundo*) leaf extract	5	46.38	14.32 (3.78)^{cd}	16.17 (4.02)^{cd}	19.62 (4.42)^{cd}	21.43 (4.62)^{bc}	17.88 (4.22)^{cd}	58.88
T_4	Wild sage (*Lantana camara*) leaf extract	5	40.42	15.87 (3.97)^{de}	16.83 (4.09)^{d}	20.85 (4.56)^{d}	24.63 (4.95)^{c}	19.54 (4.41)^{d}	55.07
T_5	Neem Oil	3	41.58	10.36 (3.22)^{bd}	11.45 (3.38)^{b}	14.84 (3.85)^{a}	18.35 (4.28)^{b}	13.74 (3.70)^{b}	68.41
T_6	Horticultural Mineral Oil	3	40.85	11.38 (3.37)c	13.04 (3.61)^{bc}	16.14 (4.01)^{ac}	20.36 (4.51)^{bc}	15.23 (3.89)^{bc}	64.98
T_7	Pungam Oil	3	37.56	16.29 (4.03)^{e}	18.42 (4.29)^{d}	21.47 (4.63)^{d}	24.69 (4.96)^{c}	20.22 (4.49)^{d}	53.51
T_8	Lemon grass Oil	3	34.52	18.31 (4.27)^{e}	19.73 (4.43)^{d}	22.45 (4.73)^{d}	24.68 (4.96)^{c}	21.29 (4.60)^{d}	51.05
T_9	Profenophos 50 EC	2 ml/lit	38.36	5.69 (2.38)^{a}	6.36 (2.52)^{a}	7.91 (2.81)^{a}	12.31 (3.50)^{a}	8.07 (2.84)^{a}	81.44
T_{10}	Untreated check	–	39.65	40.21 (6.33)^{f}	44.25 (6.64)^{e}	42.65 (6.51)^{e}	46.87 (2.99)^{d}	43.49 (6.58)^{e}	
S. Ed.			NS	0.2006	0.2100	0.2210	0.2381	0.2179	
CD (P = 0.05)				0.4214	0.4412	0.4644	0.5003	0.4577	
CV per cent				6.50	6.48	6.27	6.18	6.33	

NS-Non significant

Each value is the mean of three sprayings in three replications.

Figures in parentheses are square root transformed values.

In a column, means followed by common letter (s) is / are not significantly different by LSD at P = 0.05

treatment observations were recorded on 1, 3, 7 and 14 days after each spraying. The data revealed that, among the eight plant products tested, Neem (*Azadirachta indica*) kernel extract (5%) recorded maximum efficacy of 70.23% reduction over untreated control, followed by neem oil (3%), *Acorus calamus* rhizome extract (5%), horticultural mineral oil (3%) and *Vitex negundo* leaf extract (10%) recording 68.41, 66.61, 64.98 and 58.88 per cent reduced infestation. The results are in accordance with Nisha Isabel (1996) and Vanitha (2001) confirming the efficacy of neem products in managing jasmine bud worm. However, propenophos 50 EC (standard check) @ 2.0 ml / lit. was superior to all other treatments tested (81.44% reduction).

Observations were recorded on 1, 3, 7 and 15 days for phytotoxic symptoms like necrosis, epinasty, hyponasty, leaf tip injury, leaf surface injury, wilting and vein clearing. Plant botanicals *i.e.* plant extracts as well as oils did not cause any phytotoxic symptoms to the plants such as injury to leaf tips and leaf surface, wilting, vein clearing, necrosis, epinasty and hyponasty (Table 4).

Jasmine is an important commercial flower crop as well as exportable commodity. For sustainable jasmine cultivation, integrated pest management system is the vital component. Traditional pest control methods, especially the use of indigenous pesticide plants if improved, offer a safer, low cost and more dependable method of crop protection.

Since there is a need for environmentally safe insecticides, the use of botanicals as pesticide can be a better remedy due to their abundance, cheaper and easy availability. Studies revealed that the neem

Table 4
Phytotoxic effect of botanicals on jasmine (Visual phytotoxicity 0-10% Grade)

			Visual rating in 1-10 scale									
Treat-ments	*Common name*	*Concentration (per cent)*	*1 0-10%*	*2 11-20%*	*3 21-30%*	*4 31-40%*	*5 41-50%*	*6 51-60%*	*7 61-70%*	*8 71-80%*	*9 81-90%*	*10 91-100%*
T_1	Neem Seed Kernel Extract	5	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_2	Sweet flag rhizome extract	5	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_3	Notchi leaf extract	5	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_4	Wild sage leaf extract	5	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_5	Neem Oil	3	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_6	Horticultural Mineral Oil	3	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_7	Pungam Oil	3	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_8	Lemon grass Oil	3	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_9	Profenophos 50 EC	2 ml/lit	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T_{10}	Untreated check	–	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

NP-No phytotoxicity.

products *viz.,* neem seed kernel extract as well as neem oil can be effectively utilized in managing jasmine bud worm.

REFERENCES

Balasubramanian, V. and M. Swamiappan. (1993), Screening of insecticides used in cotton ecosystem for their effect on the green lacewing, *Chrysoperla carnea* Stephens (Neuroptera: Chrysopidae) In: *National Symposium on Advances in biological control of insect pests*, 2-4, Oct, 1993. Uttar Pradesh Zoological Society, SantamDharam College, Muzuffarnagar, Uttar Pradesh, India. pp. 30.

Bose, T.K. and L.P. Yadav. (1989), Commerical Flowers. Naya prakash, Calcutta, India, 487-544 pp.

Clemente, S., G. Mareggiani, A. Broussalis, V. Martino and G. Ferraro. (2003), Insecticidal effects of Lamiaceae species against stored products insects. *Boletín de Sanidad Vegetal. Plagas,* **29**: 1-8.

El-Sharabasy, H. M. (2010), Acaricidal activities of *Artemisia judaica* L. extracts against *Tetranychus urticae* Koch. and its predator *Phytoseiulus persimilis* Athias Henriot (Acari: Phytoseiidae). *J. of Biopestic.,* **3**(2): 514-551.

Gomez, K.A and A.A. Gomez. (1984). Statistical procedures for Agricultural research. Wiley International Science Publications. John Wiley and sons, New Delhi.

Gunasekaran.V. (1989), Studies on bio-ecology of Jasmine pest complex. M.Sc. Thesis submitted to Agricultural College and Research Institute, Madurai.

Larry, P. P. and Marlin, E.R. (2009), Entomology and Pest Management (Sixth Edition). Pearson Prentice Hall. 534-56.

Nisha Isabel. J. (1996), Studies on the management of major pests of jasmine (*Jasminum sambac* Ait.) Cv. Gundumalli with special reference to *Nausinoe geometralis* Guenee. (Pyralidae: Lepidoptera). M.Sc. Thesis submitted to Agricultural College and Research Institute, Madurai.

Ogah, E.O., A.A. Moloye, F.E. Nwilene and A.C. Nwogbaga. (2011), Effect of Neem Seed Kernel Extracts in the Management of Rice Stem Borers in the Field in Nigeria. *Nig J. Biotech.,* **23**: 13-21.

Onnkum, O. (2012), Evaluation of aqueous extracts of five plants in control of flea beetles on okra (*Abelmoschus esculentus* (L.) Moench). *Jouranal of Biopesticides*, **5**: 62-67.

Prakash, K and B. Muniyandi. (2014), Application of ARIMA Model for Forecasting Production of Jasmine Flower in Madurai District of Tamil Nadu, India. *American International Journal of Research in Humanities, Arts and Social Sciences.*, **14**: 279-285.

Praveen, R., V. Devanand and M. Jagadeesan. (2012), Antifeedent activity of selected medicinal plants on *Earias vittella*. *Journal of Biopesticides.*, **5**(2): 96-97.

Syahputra, E. and Endarto. O. (2013), Acaricidal activity of tropical plant extracts against citrus mites and their effect on predator and citrus plants. *International Research Journal of Agricultural Science and Soil Science.*, **3**(4): 99-106.

Vanitha, J. (2001), Management of major pests of Jasmine (*Jasminum* spp.) with special reference to botanicals and biological control. M.Sc. Thesis submitted to Tamilnadu Agricultural College and Research Institute, Madurai.