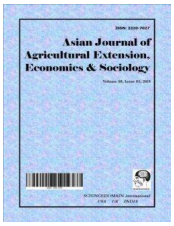

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Technology Gaps Analysis in Integrated Management of Jasmine's Leaf Webworm (*Nausinoe geometralis*) in Tamil Nadu

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Authors' contributions

This work was carried out in collaboration between all authors. Author IMK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author JSK is the mentor for author IMK and contributed in designing the study and managed the IPM strategies. Author IID managed the literature searches, interview schedule and analyses. All authors read and approved the final manuscript.

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ABSTRACT

Investigations were conducted during 2015-2016, in major jasmine growing districts of Tamil Nadu, for assessing the distribution, infestation level and the relative importance of leaf webworm of jasmine, *Nausinoe geometralis*. The incidence was more in Madurai (28.75%) followed by Coimbatore (27.65%), Virdhunagar (25.42%) and Tiruneveli (25.36%) districts. Forty nine % respondents were aware of leaf webworm as a pest, but only nine % respondents ranked it as the most important pest. The technological gap indices (TGI) were high in adopting right frequency in spraying of chemicals (91%), usage of biological control agents (87%) and effective cultural practices *viz.,* regular raking of soil to destroy pupa (85%) and collection and destruction of fallen

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and discolored buds and flowers (82%). A majority of respondents (52.94%) had high level of technological gap, whereas, only 11.76% were in low level of technology gap. Thus, efforts should be taken to create awareness among jasmine growers for the use of eco-friendly bio-control methods against jasmine leaf webworm as well as other pests of jasmine.

Keywords: Jasmine leaf webworm; webbings; IPM; Technological gap index; farmer.

1. INTRODUCTION

Jasmine (*Jasminum sambac*) is an important traditional plant belonging to the olive family (Oleaceae), 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 and hence used for the production of jasmine concrete which is used in cosmetic and perfume industries. Flowers and unopened buds are used for making garlands, bouquets, in religious and ceremonial functions, perfumed hair oils, attars, soaps, wine and drinks [1]. It is used for production of jasmine concrete, which is the base in cosmetic and perfumery industries and hence the phrase “no perfume without jasmine”. The dried flowers are used for making the famous ’jasmine tea’, scented with aroma from jasmine blossoms, which is a popular drink in South East Asian countries. An infusion of jasmine tea is beneficial in treating fever, relieving stress and anxiety. The flowers and other parts of the plant like leaf, stem, bark and root are also used for medicinal purposes [2]. Flower or essential oil, jasmine find a place in useful medicines as an aphrodisiac, sedative, antiseptic, antidepressant, antispasmodic, and analgesic relieving pains and relaxing the nervous system [3,4]. As the demand for high grade perfumes has greatly increased in recent times, there is tremendous scope for the production of concretes and oils from jasmine flowers. Also, the need for the mesmerizing jasmine flowers for diverse necessities like religious ceremonies, official and home decorations, weddings, funerals etc. is ever rising. This admirable commercial jasmine is attacked by a number of insect pests like leaf webworm, budworm, blossom midge, galleryworm, tingid bug, thrips, green plant hopper, jasmine bug, leaf roller, blossom midge and non insect pest like two spotted mite [5].

Jasmine leaf webworm, *Nausinoe geometralis* (Guenee) (Lepidoptera: Pyralidae) is a defoliator, reported as a serious pest in India [6]. The caterpillars web the leaves and nibble to make holes in the leaves which are quite often reduced to mere veins. The severely attacked bush present ‘burnt appearance’ because the damaged and dried leaves remain entrapped in the web. This results in reduced vitality of plant which affects the growth of the bush and consequently production of flower buds/flowers reduction in the subsequent year. The larva is which will severely affect flower production. Jasmine farmers were forced to undertake frequent sprays of pesticides to control the pests. Indiscriminate and injudicious uses of conventional insecticides for managing this pest have been causing different environmental hazards including resurgence, resistance and residue problems [7]. Disproportionate usage of chemicals caused health hazards, outbreaks of secondary pests, environmental pollution, objectionable pesticide residues, resources degradation and adverse effect on non-target organisms, and reduction in biodiversity of natural enemies [8]. Therefore, there is an urgent need to use safe but effective, biodegradable pesticides with no or less toxic effects on beneficial organisms.

Integrated Pest Management (IPM) techniques comprising physical, chemical and biological measures are essential for effective and eco-friendly management of pests. Biopesticides are inherently less toxic than conventional pesticides and often require in very small quantities, decompose quickly, resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides. An approach of using semiochemicals/ bio-control agents in pest management is to exploit ways to chemically augment, conserve or enhance the efficacy of natural enemies in a crop ecosystem. By promoting different methods of eco-friendly pest management in agriculture, global goal of sustainable agriculture can be achieved, thus improving the quality and quantity of food produced globally. This goal of sustainable agriculture can only be accomplished by creating awareness among farmers, community and society. As the farmers are end users and the final decision-makers for the adoption of any technology, it is essential to know their knowledge about the pests and practices recommended for pest management. However,

least attention has been paid to assess the farmer's perception. Hence, considering the economic losses caused by this pest, this study was undertaken to assess the incidence of jasmine leaf webworm in major jasmine growing districts of Tamil Nadu, to assess farmer's perception on the awareness about this pest and its prominence over other key pests of jasmine and to analyse the technology gaps in the integrated management of the pest.

2. MATERIALS AND METHODS

For assessing the awareness about the pests and their relative importance, face-to face interviews with jasmine growers were conducted during 2014-2015. From each selected village, 10 jasmine growing farmers were randomly selected and the data was collected by means of a structured questionnaire administered via personal interviews [9] and technology gap index was calculated (Plate 1). Thus, a total of 100 farmers spread over major jasmine growing districts of Tamil Nadu formed the sample of the study. The questionnaire composed of the farmer's demographic information, literacy rate, cultivation practices, list of different pests of jasmine and the pest which ranks first, months of severity of pest incidence, major pesticides applied, intervals of application, dosage, number of sprays, and knowledge on eco-friendly pest management practices. Even though the farmers of the study region did not maintain any farm records, they were able to furnish necessary information by memory reminiscence and by virtue of their experience.

Technological Gap Index (TGI) was computed to analyze the extent of adoption of various recommended practices related to pest management using the following formula [10].

$$\text{Technological Gap Index (TGI)} = \frac{R-A}{R} \times 100$$

Where,

R = No. of respondents who responded
A = No. of respondents who had adopted the recommended practice

On account of a wide range of technological gap, the jasmine growers were categorized as 'High' for those having TGI of 70 and above, 'Medium' having TGI between 40 and 70 and 'Low' below 40.

For assessing the pest incidence, the total number of leaves in a plant and the webbed and skeletonized leaves were counted and the % incidence was worked out. The data on incidence was transformed to $\sqrt{x+0.5}$ and analyzed by randomized block design. The treatment mean values of the experiment were compared using Latin Square Distribution (LSD).

3. RESULTS AND DISCUSSION

3.1 Incidence of Leaf Webworm of Jasmine in Different Districts of Tamil Nadu

The incidence of leaf webworm of jasmine was observed in all the ten districts of Tamil Nadu in varying proportion. However, the incidence was maximum in Madurai district recording 28.75% and Coimbatore district recording 27.65 percent, followed by Virdhunagar district (25.42%) and Tirunelveli districts (25.36%) and Erode district (23.14%). The lowest % incidence was recorded in Theni district (14.62), Tuticorin district (16.26) and Dindugal district (19.65) (Table 1). Kanyakumari district and Ramanathapuram district witnessed medium incidence of 21.65% and 21.45% respectively.

Similar trend was noticed in the number of larvae per plant in Madurai and Coimbatore district recording the maximum number of 6.3 and 6.10 larvae per plant followed by Virdhunagar and Tirunelveli district with 5.9 and 5.6 larvae per plant respectively. Hence, it is concluded that incidence of leaf webworm was high in Southern districts of Tamil Nadu and the hot weather in the region might be the probable reason for the pest buildup [11].

3.2 Relative Importance of Leaf Webworm of Jasmine and Perception among Jasmine Growers

Majority of respondents (49%) knew about leaf webworm of jasmine, but only 7% ranked as the most serious pest (Fig. 2). The respondents who ranked jasmine budworm as the most important pest were 94% and 16% perceived blossom midge and 9% recorded two spotted mite as a major problem.

Nearly half of the respondents (72%) felt that the incidence of leaf webworm is severe in Feb-April, medium (18%) in May to August, while in September-November it was 10% only (Fig. 3). Similar results were reported by [12] and [13] in Southern districts of Tamil Nadu.

3.3 Technology Gap Indices (TGI) on Management Practices of Leaf Webworm among Jasmine Growers

Jasmine leaf webworm is a major pest of jasmine. Cultural control measures like pruning of bushes (91%) and field sanitation (86%) were followed by majority of jasmine growers, thus recorded lower TGI (Table 2). This is due to the ease of the practice, which can be done while doing day to day field works. The TGI was found high in other cultural/mechanical practices *viz.,*

Table 1. Frequency distribution and incidence of leaf webworm of jasmine, *Nausinoe geometralis* by jasmine growers (n=100)

S. no.	Districts	Mean no. of larvae/plant	% Leaf webworm incidence
1	Kanyakumari	4.20^{cd}	21.65^{c}
2	Tirunelveli	5.60^{b}	25.36^{b}
3	Tuticorin	2.40^{f}	16.26^{e}
4	Virdhunagar	5.90^{ab}	25.42^{b}
5	Madurai	6.30^{a}	28.75^{a}
6	Ramanathapuram	4.70^{c}	21.45^{c}
7	Theni	2.60^{f}	14.62^{f}
8	Dindugal	3.50^{e}	19.65^{d}
9	Erode	4.70^{c}	23.14^{bc}
10	Coimbatore	6.10^{a}	27.65^{a}
	SEd	0.1482	0.2642
	CD(0.05)	0.2134	0.5478

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

Table 2. Technological gap at farmer's level in adopting recommended management practices for jasmine leaf webworm, *Nausinoe geometralis*

S. no.	Particulars of practices*	Respondents (%)	Technological gap Index (TGI)	Categorization of growers based on TGI
A.	**Cultural/mechanical practices**			
	1. Field sanitation	86.00	14.00	Low
	2. Collection and destruction of fallen leaves and flowers	18.00	82.00	High
	3. Light traps for monitoring the adult movement	27.00	73.00	High
	4. Regular mulching	53.00	47.00	Medium
	5. Regular weeding	41.00	59.00	Medium
	6. Regular tilling or raking of soil	15.00	85.00	High
	7. Planting inter/border crops	13.00	87.00	High
	8. Pruning the bushes in winter	91.00	9.00	Low
B.	**Biological control**			
	1. *Bacillus thuringiensis* @ 2 g/litre	16.00	84.00	High
	2. *Beauvaria bassiana* @ $1x10^{8}$cfu/ml	13.00	87.00	High
	3. Use of *Trichogramma* egg cards	14.00	86.00	High
	4. Use of *Chrysoperla* eggs	10.00	90.00	High
C.	**Chemical control**			
	1. Thiacloprid 240SC@1 ml/litre	47.00	53.00	Medium
	2. Profenophos 25EC @ 2 ml/lit	51.00	49.00	Medium
	3. Spray neem seed kernel extract or Azhadirachtin 5 % (5 ml /lit) at bimonthly intervals	48.00	52.00	Medium
	4. Basal application of carbofuran	43.00	57.00	Medium

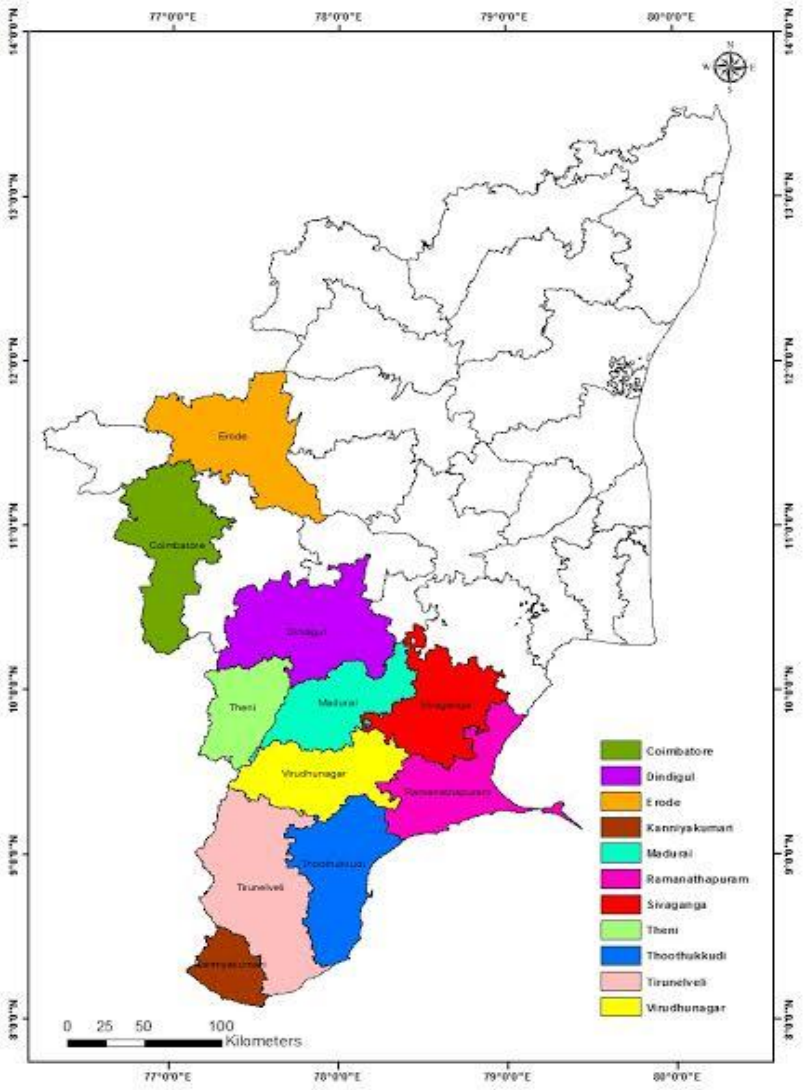

Fig. 1. Map showing the study site

setting traps, regular weeding and raking of soil, as these operations are labour intensive, thus not commonly followed by the growers. Rising of intercrops/border crops and their role in attracting beneficial organisms to naturally check the pest by providing pollen and nectar to the natural enemies and in turn getting additional income were unaware to the jasmine growers with a widened technology gap of 87%. Regarding the usage of bio-control agents, growers were less educative and only an average of 10% respondents use *Bt, Beauvaria bassiana* and *Chrysoperla* eggs with a TGI of 86%. Similar trend of less knowledge on biopesticides was noticed by banana growers [14]. The main reason was the lack of awareness about biological control, less and slow relief of bio-control agents and their unavailability [15]. Knowledge about use of botanical pesticides *i.e.,* neem seed kernel extract or Azhadirachtin 5% (5 ml per liter) at bimonthly intervals and their usage were adopted by 48% of growers, lessening the technology gap. In case of chemical control, comparatively medium TGI was observed, which is due to the ease of application and availability of chemicals. Jasmine growers chiefly rely on synthetic chemicals due to the quick recovery of pink discolouration and lack of awareness about environmentally safe bio control strategies. Regarding the frequency of application of chemicals, there is a long technology gap (91%), as the lack of patience and swift reaction by the grower's on finding even a pink bud by spraying indiscriminately without any proper interval.

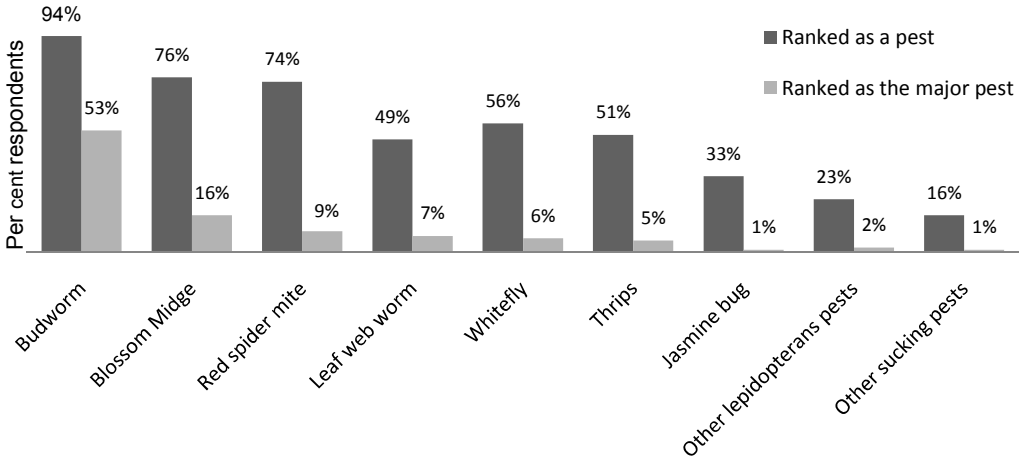

Fig. 2. Frequency distribution and ranking of jasmine pests by jasmine farmers

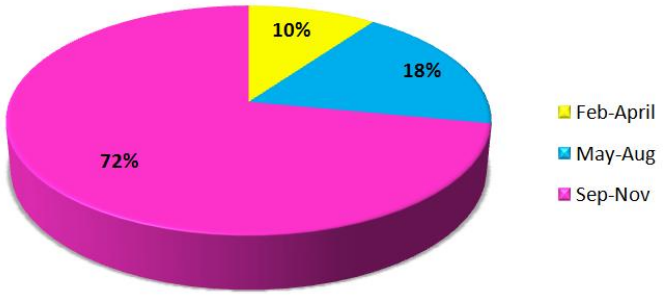

Fig. 3. Perception of respondents on temporal incidence of jasmine leaf webworm

Plate 1. Survey with jasmine growers

3.3.1 Distribution of respondents

Majority of the respondents (51%) belonged to the high technological gap category, whereas, 30% under medium technology gap category. Only 19% of the respondents were found in low level of technology gap. The adoption gap clearly indicates that among the various practices recommended for the management of jasmine leaf webworm like application of chemicals and

few cultural/mechanical practices with less complexity were more feasible and adopted. Several constraints *viz.,* unavailability of labours for carrying out cultural practices, lack of awareness about the use of bio-pesticides etc. leads to widening of technology gap among the usage of environmentally safe pest management strategies. More or less similar findings were reported by [16,17] in wheat and groundnut.

4. CONCLUSION

It is therefore suggested that extension agencies should intensify their efforts to organize extension educational programs like trainings, demonstrations, field days, etc., to motivate the farmers to accept and adopt the IPM practices. In the extension programs, a special emphasis should be given to promote eco-friendly bio-control methods against leaf webworm as well as other pests of jasmine by conducting skilled demonstrations and specialized participatory trainings. As the world is moving towards "Go green" slogan, encouraging and educating the farming community to improved integrated/bio-intensive and eco-friendly pest management strategies to pause environment being polluted by synthetic insecticides is a need of the hour to mend Indian farming.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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