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Survey on the prevalence of jasmine leaf web worm, *Nausinoe geometralis* and its natural enemies in Tamil Nadu

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Abstract

Jasmine leaf webworm (*Nausinoe geometralis*) was found to be the serious pest of jasmine posing severe threat to the plant. Roving surveys were conducted in 2014-15 in the major jasmine growing districts of Tamil Nadu, to study the incidence of jasmine leaf webworm and the natural enemies associated with it in managing the pest naturally. Field surveys indicated the presence of the pest incidence in the entire surveyed region in varying intensity with maximum incidence recorded in Madurai (28.75 %) and Coimbatore districts (27.65 %) respectively. Coccinellid predators like *Cheilomenes sexmaculata*, *Coccinella transversalis*, *Scymnus* sp., *Coccinella septempunctata*, *Brumus suturalis*, *Illeis cincta* and *Chilocorus* sp. were present in the jasmine ecosystem with a mean population of 3.04 coccinellids per plant. Neuropteran predators, *Chrysoperla zastrowi sillemi* and *Mallada boninensis* were found effectively managing the egg and early instars of leaf webworm with a mean population of 2.2 per plant. A wide range of preying mantises and spiders with a mean population of 3.8 and 4.3 per cent respectively was present. Larval parasitoids like *Bracon* sp., *Elasmus* sp., and *Apanteles* sp., played a vital role in natural suppression of the pest. Native weeds and flowering plants like *Parthenium hysterophorus*, *Rosa* sp., *Nerium oleander*, *Vernonia cinera*, *Datura metal*, *Lantana camara*, *Tagetes erceta*, *Ipomea carnea*, *Helianthus annus* and *Coriander sativum* were found to provide nectar to the adult stages of the parasitoid. The mean parasitism of the leaf webworm larva by these parasitoids was 1.74 per cent.

Keywords: Jasmine leaf webworm, webbing, *Bracon*, *Phanerotoma hendecasiella*, coccinellid, chrysopid, spider, preying mantises

Introduction

Jasmine is one of the leading traditional flowers of India. It has got importance in all religious, social and cultural ceremonies ^[1]. In India, the largest area under jasmine cultivation is in Tamil Nadu and Karnataka from where it is distributed to metropolitan cities. Jasmine is cultivated in an area of more than 8,000 ha with an annual production of flowers worth Rs. 80-100 million in India. 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 ^[2]. The production of jasmine is affected by various factors, among which, insect pests are the most devastating factor. The major pests affecting jasmine are jasmine budworm (*Hendecasis duplifasciatus* Hampson), blossom midge (*Contarinia maculipennis* Felt.), leaf webworm (*Nausinea geometralis* Guenee.), gallery worm (*Elasmopalpus jasminophagus* Hampson.), leaf roller, (*Glyphodes unionalis* Hubner.), and the two spotted mite (*Tetranychus urticae*. Koch.). Of these, leaf webworm gains major economic importance, as they cause excessive damage to silky foliage and hence the plant vitality. Jasmine leaf webworm, *Nausinoe geometralis* (Guenee) (Lepidoptera: Pyralidae) is a defoliator, reported as a serious pest in India ^[3]. 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 the production of flower buds/flowers reduction in the subsequent year.

Lady bird beetles and green lace wings were reported to feed on the egg and larval stages of the caterpillars ^[4]. Spiders as carnivorous arthropods, consume a large number of larvae present in jasmine ecosystem including leaf webworm ^[6]. Preying mantises play an important role in the environment as an efficient predator. Studying the identity, intensity of infestation of the pest and the natural enemies associated is a pre requisite to develop the management strategy.

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Classical biological control involving the utilization of host-specific parasitoids requires the passport information on the native natural enemies involved with them. The present study was aimed at studying the intensity of damage caused by jasmine leaf web worm and documenting the various natural enemies associated with them in different jasmine growing region of Tamil Nadu.

Materials and Methods

Roving survey: Roving surveys were conducted during June-August 2015 around ten major jasmine growing Southern districts of Tamil Nadu viz., Kanyakumari, Tirunelveli, Tuticorin, Virudhunagar, Madurai, Ramanathapuram, Theni Dindigul, Erode and Coimbatore districts to study the incidence of jasmine leaf webworm and the natural enemies associated with them, in checking the pest naturally.

Jasmine leaf webworm incidence: In each district, 10 jasmine gardens were randomly selected and the per cent incidence of leaf webworm was recorded by counting the webbed and skeletonized leaves and total number of leaves per plant. The number of larvae present per plant was also recorded.

Natural enemies associated with leaf webworm

The population of predators that were seen actively moving near the infested leaves from ten randomly selected plants were observed and recorded. The population of parasitoids stuck in yellow sticky cup trap, placed per plant in ten plants were recorded. Larvae showing mummified appearance were considered as parasitized and such parasitized larvae were collected in small vials and brought to the laboratory and observed for adult emergence. The collected predators/parasitoids from ten randomly selected plants were reared still adult stage to confirm the identity of the natural enemies. The flowering plants and weeds in and around the jasmine gardens were observed and recorded for the activity of parasitoids.

Taxonomic identification of natural enemies of jasmine leaf webworm

Field collected predators were killed using ethyl acetate, preserved as dry mounts and identified using standard taxonomic keys. The identity was confirmed by the repository collection of natural enemies maintained at Insect Systematic Laboratory, Department of Entomology, Faculty of Agriculture, and Tamil Nadu Agricultural University Coimbatore. The emerged parasitoids from parasitized larvae were collected and preserved in 70% ethanol and sent to Division of Systematics, National Bureau of Agriculturally important insects (NBAIL), Bengaluru.

Results

In the surveys the incidence of jasmine leaf webworm was noticed in all the ten districts of Tamil Nadu. However, the incidence was maximum in Madurai district recording 28.75 per cent, followed by Coimbatore district with 27.65 per cent, Virudhunagar district with 25.42 per cent and Tirunelveli district recording 25.36 percent, followed by Erode districts (23.14). The lowest per cent incidence was recorded in Theni (14.62 per cent) and Thootukudi District (12.43 per cent). A similar trend was noticed in the number of larvae/ plant with Madurai district recording the maximum number of 6.30 larvae/plant followed by Coimbatore district with 6.1 larvae/plant.

The extent of parasitization of leaf webworm larva is observed throughout Tamil Nadu. The movement of the larval parasitoids, *Bracon* sp., *Elasmus* sp., *Apanteles* sp., was noticed in all the jasmine gardens. The blackened mummified larvae were considered parasitized by the active parasitoids. The extent of parasitization was highest in Madurai district (3.1 %), Tirunelveli district (1.6%) and Coimbatore district (2.2 %).

The mean number of coccinellids observed was 3.04/plant. The different coccinellids observed in jasmine ecosystem were *Cheilomenes sexmaculata* (Fabricius), *Scymnus coccivora* (Fabricius), *Coccinella transversalis* (Fabricius), *Coccinella septempunctata* (Linnaeus), *Brumus suturalis* (Fabricius), *Illeis cincta* (Fabricius), *Chilocorus* sp., *Epilachna vigintioctopunctata* (Fabricius), *Propylea dissecta* (Mulsant) and *Coccinella repanda* (Fabricius). Chrysopid predators identified during the survey included *Chrysoperla zastrowii sillemi* and *Mallada bonensis* with a mean number of 2.2/plant. Preying mantis predators recorded were *Mantis religiosa* (Linnaeus), *Creobroter urbana* (Fabricius), *Euantisa pulchra* (Fabricius), *Empusca pennata* (Thunberg), *Gongylus gongylodes* (Linnaeus), *Creobroter urbana* (Fabricius), *Creobroter pictipennis* (Wood-Mason), *Odontomantis micans* (Saussure), *Hestiasula brunneriana* (Saussure), *Amorphoscelis* sp., and *Thesprotia* sp. with the mean number being 3.8/ plant.

A variety of spiders were found in jasmine plant leaves, twigs, trunk as well as flower and buds, preying on the adult moths of the lepidopteran pests including jasmine leaf webworm. Spiders belonging to different families viz., araneidae, clubionidae, theridiidae, linyphiidae, miturgidae, oxyopidae, salticidae, sparassidae, tetragnathidae, thomisidae, ulaboridae etc. were encountered in different districts. The predominant spiders observed being *Argiope anasuja* (Thorell), *Neoscona theisi* (Walkckenaer), *Neoscona Mukherjee* (Tikader), *Olios millet* (Pocock), *Chikunia nigra* (O. Pickward-Cambridge), *Pisaura putiana* (Barion and Litsinger), *Peutica viridana* (Stoliczka), *Oxyopes javanus* (Thorell), *Oxyopes birmanicus* (Thorell), *Oxyopes shweta* (Tikader), *Phintella vitata* (C.L.Koch), *Myrmaplata platalaeoides* (O. Pickard-Cambridge), *Plexippus paykulli* (Audouin), *Telamonia dimidiata* (Simon), *Telamonia dimidiata* (Simon), *Rhene danieli* (Tikader), *Carrhotus viduus* (C.L.Koch), *Thyene imperialis* (Rossi), *Hyllus semicupreus* (Simon), *Thomisus projectus* (Tikader), *Araneus* sp., *Heteropoda* sp., *Theridion* sp., *Uthina* sp., *Clubiona* sp., *Cheiracanthium* sp., *Bavia* sp., and *Misumena* sp. The mean number of spiders observed was 4.3/plant. Field collected *Bracon* pupa maintained in the laboratory recorded a mean of 1 parasitoid/plant. Field trapped *Apanteles* sp. and *Elasmus* sp. recorded a mean of 3.2 and 1.3 parasitoid/yellow sticky trap.

Discussion

The jasmine growing regions of Tamil Nadu showed slight to heavier infestation of leaf webworm with the maximum incidence in Madurai district followed by Tirunelveli district and the least incidence is noticed in Theni district. The variations in leaf webworm incidence in the study locations may be due to the interplay of various biotic and abiotic factors that influence the pest population.

The larval parasitoids, *Bracon* sp., *Elasmus* sp. and *Apanteles* sp. were the common parasitoids recorded in the study area that caused parasitization of leaf webworm. Both the parasitoids were found to coexist in some study area and in such places high parasitization of leaf webworm was recorded.

The larval parasitoid, *Bracon brevicornis* parasitizing lepidopteran larva was reported by earlier workers [6]. The jasmine leaf webworm being parasitized by *Bracon* parasitoids were reported by several workers [7, 8]. *Bracon* sp. were found emerging from the parasitized third instar larva. The presence of *Apanteles* sp. as a larval parasitoid of leafwebworm was previously reported [9].

There is increasing need to use compatible safer insecticides for management of leaf webworm to preserve the native natural enemies in jasmine gardens. The highest activity of the parasitoids in the adjacent nectariferous crops may be due to the ample supply of nectar to the adult stages of the parasitoids. The positive influence in increasing the population of beneficials in the jasmine gardens by growing nectariferous crops is reported by many workers [9-11]. Coccinellid predators observed during the survey included, *Cheilomenes sexmaculata*, *Scymnus coccivora*, *Coccinella transversalis*, *Coccinella septumpunctata*, *Brumus suturalis*, *Illeis cincta*, *Chilocorus* sp., *Epilachna vigintioctopunctata* and *Coccinella repanda*. *Cheilomenes sexmaculata* is found to be abundant in jasmine gardens and is known to predate upon the various lifestages of the eggs and young larva of leaf webworm and found to be a key predator of leaf webworm infesting jasmine. The prevalence of this coccinellid in jasmine gardens was previously reported [8, 12].

The various lifestages of chrysopids were invariably observed in many jasmine gardens with the eggs oviposited in the undersurface of leaves. The grubs were found sucking sap from the early instar leaf webworm larva and hence makes an efficient predator in managing leaf webworm. Chrysopids as voracious feeders of sucking pests with the inherent potential to tolerate pesticides [13, 14]. Chrysopids are well known biocontrol agents meant for inundative releases against cotton aphids (Iqbal *et al.*, 2008). The widespread occurrence of chrysopid predator in habiting diverse habits can be

utilized for pest management in jasmine.

A wide array of preying mantises, were noticed in jasmine garden actively predated the larva of the jasmine pests. Their predatory role can be utilized in effective management of jasmine leaf webworm.

Spiders rank as one of the best candidate for biological pest control. Different species of spiders belonging to different families were seen actively preying larva and moths of the most lepidopteran pests of jasmine including jasmine leaf webworm. Spiders are carnivorous arthropods, consume a large number of preys and cause no damage to plants. They have exclusive habitats and they live in almost all the environments. Their prey searching ability, wide host range, ease in multiplication and polyphagous in nature make them as a potential predator in biological pest suppression (Rajeshwaran *et al.*, 2005). The positive response of spiders in naturally managing pests can be utilized in biological control and care should be taken to use safer and compatible insecticides that may not harm them.

Moreover, the activity of the hemipteran predators viz., *Geocoris pallens* (Stal.) and *Orius* sp. sucking the sap of sucking pests as well as young instar lepidopteran larvae was observed in jasmine ecosystem. The predation of *Geocoris* sp. on the lepidopteran larva, *Helicoverpa virescens* larva was previously reported [15].

The present survey projected the incidence of jasmine leaf webworm, *N. geometralis* as the major pest infesting jasmine in all the major jasmine growing tracks of Tamil Nadu. The pest was found to be associated with a rich pool of natural enemies that provide natural suppression of jasmine leaf webworm. These natural enemies need to be conserved by raising flowering plants in and around jasmine gardens to support adult parasitoids as a source of nectar during the period of scarce availability of target hosts.

Table 1: Incidence of jasmine leaf webworm in different districts of Tamil Nadu and the extent of parasitization by larval parasitoids

S. No	Districts	Mean no.of larvae/plant	Mean percent leaf webworm incidence	% Parasitization
1	Kanyakumari	4.20 ^{cd}	21.65 ^c	4.23 ^a
2	Tirunelveli	5.60 ^b	25.36 ^b	3.14 ^b
3	Thootukudi	2.40 ^f	16.26 ^e	2.36 ^c
4	Virdhunagar	5.90 ^{ab}	25.42 ^b	3.25 ^b
5	Madurai	6.30 ^a	28.75 ^a	1.25 ^d
6	Ramanathapuram	4.70 ^c	21.45 ^c	3.62 ^b
7	Theni	2.60 ^f	14.62 ^f	4.58 ^a
8	Dindugal	3.50 ^e	19.65 ^d	2.69 ^c
9	Erode	4.70 ^c	23.14 ^{bc}	3.54 ^b
10	Coimbatore	6.10 ^a	27.65 ^a	2.35 ^c
SEd CD(0.05)		0.1482 0.2134	0.2642 0.5478	0.1134 0.1856

Mean of three replications.

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

Table 2: Natural enemies associated with jasmine leafworm in different districts of Tamil Nadu

S. No	Districts	Predators recorded			Parasitoids recorded	Flowering plants observed near the jasmine gardens
		Coccinellids	Chrysopids	Others		
1	Kanyakumari	<i>Coccinella septumpunctata</i> <i>Brumus suturalis</i>	<i>Chrysoperla</i> <i>zastrowi sillemi</i>	Preying mantises, Spiders	<i>Phaneratoma</i> <i>hendecasiella</i> , <i>Bracon</i> sp	<i>Parthenium</i> <i>hysterophorus</i> <i>Rosa</i> sp. <i>Nerium oleander</i>
2	Tirunelveli	<i>Cheilomenes sexmaculata</i> <i>Propylea dissecta</i>	<i>C. z. sillemi</i>	Preying mantises, Spiders	<i>P.</i> <i>hendecasiella</i> <i>Bracon</i> sp	<i>Vernonia cinera</i>
3	Thootukudi	<i>Coccinella transversalis</i> , <i>C.</i> <i>septumpunctata</i>	<i>C. z. sillemi</i>	Preying mantises, Spiders	<i>P.</i> <i>hendecasiella</i> , <i>Bracon</i> sp	<i>Datura metal</i>
4	Virdhunagar	<i>B. suturalis</i> <i>Scymnus</i> sp.	<i>C. z. sillemi</i>	Preying mantises,	<i>P.</i>	<i>Lantana camara</i>

				Spiders	<i>hendecasiella</i>	
5	Madurai	<i>C. sexmaculata B. suturalis Illeis cincta C. transversalis,</i>	<i>C. z. sillemi Mallada boninensis</i>	Preying mantises, Spiders	<i>P. hendecasiella Bracon sp</i>	<i>Tagetus erceta Ipomea carnea</i>
6	Ramanathapuram	<i>Coccinella transversalis P. dissecta</i>	-	Preying mantises, Spiders	<i>P. hendecasiella</i>	<i>Helianthus annus</i>
7	Theni	<i>C.transversalis, C. septumpunctata</i>	<i>C. z. sillemi</i>	Preying mantises, Spiders	<i>P. hendecasiella</i>	<i>Lantana camara</i>
8	Dindugal	<i>Scymnus sp. C transversalis</i>	<i>C. z. sillemi</i>	Preying mantises, Spiders	<i>P. hendecasiella</i>	<i>Coriander sativum</i>
9	Erode	<i>B. suturalis Scymnus sp.</i>	-	Preying mantises, Spiders	<i>P. hendecasiella</i>	<i>Lantana camara</i>
10	Coimbatore	<i>C. sexmaculata, C. septumpunctata L. cincta, B. suturalis C. transversalis Chilocorus sp.,</i>	<i>C. z. sillemi Mallada boninensis</i>	Preying mantises, Spiders	<i>P. hendecasiella, Bracon sp.</i>	<i>Tagetus erceta Ipomea carnea</i>

Table 3: Incidence and species complex of predators during the study

Predators observed	Species of predators in decreasing trend	Mean number of predator/plant
Cocinellids	<i>Cheilomenes sexmaculata > Cocinella transversalis > Scymnus sp > Coccinella septumpunctata > Brumus suturali > Illeis cincta > Chilocorus sp.</i>	3.04
Chrysopids	<i>Chrysoperla zastrowi. Sillemi > Mallada boninensis</i>	2.2
Preying mantises	<i>Mantis religiosa > Odontomantis micans > Creobroter pictipennis > Creobroter urbana > Euantisa pulchra > Hestiasula sp.</i>	3.8
Spiders	<i>Oxyopes javanus > Plexippus paykulli > Thyene imperialis > Telamonia dimidiata > Hyllus semicupreus > Thomisus projectus Neoscona mukherjee > Olios millet > Peucetia viridana</i>	4.3
Parasitoids	<i>Bracon brevicornis > Bracon sp.</i>	1.00
	<i>Phanerotoma hendecasiella</i>	1.80

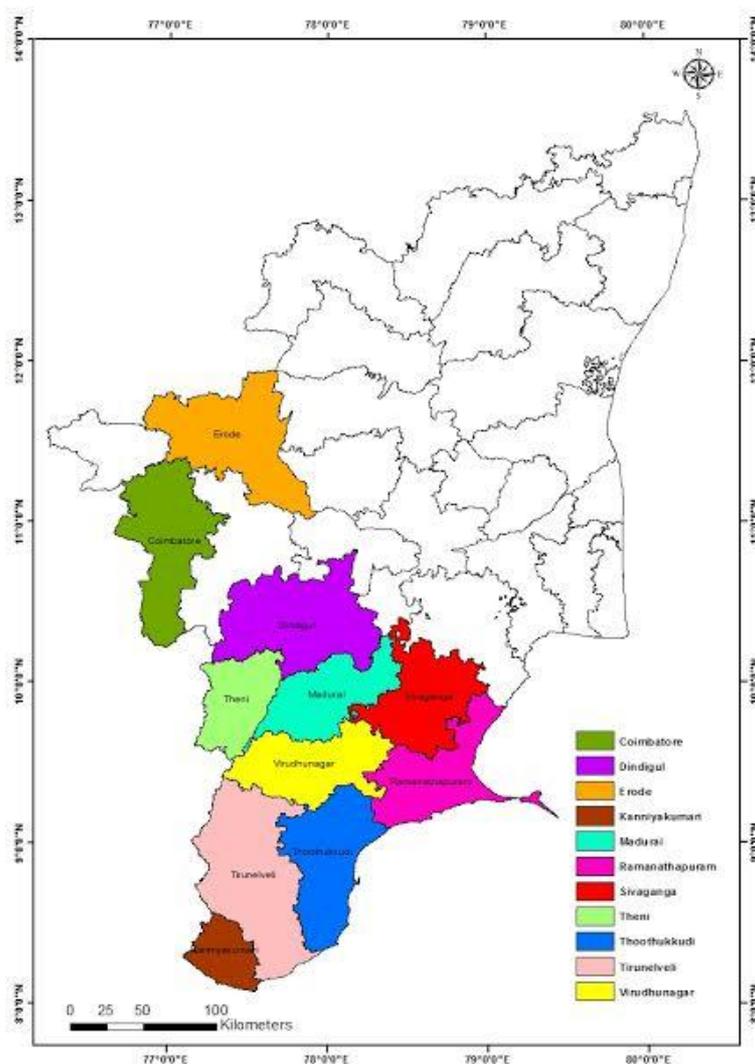


Fig 1: Jasmine growing region surveyed in Tamil Nadu

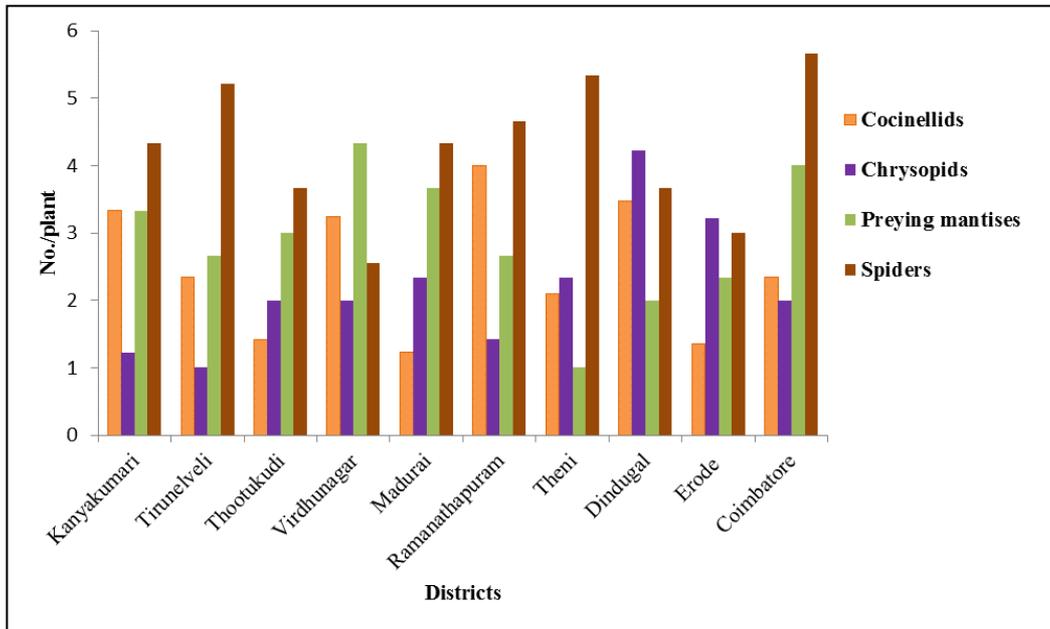


Fig 2: Predators encountered in jasmine growing region of Tamil Nadu

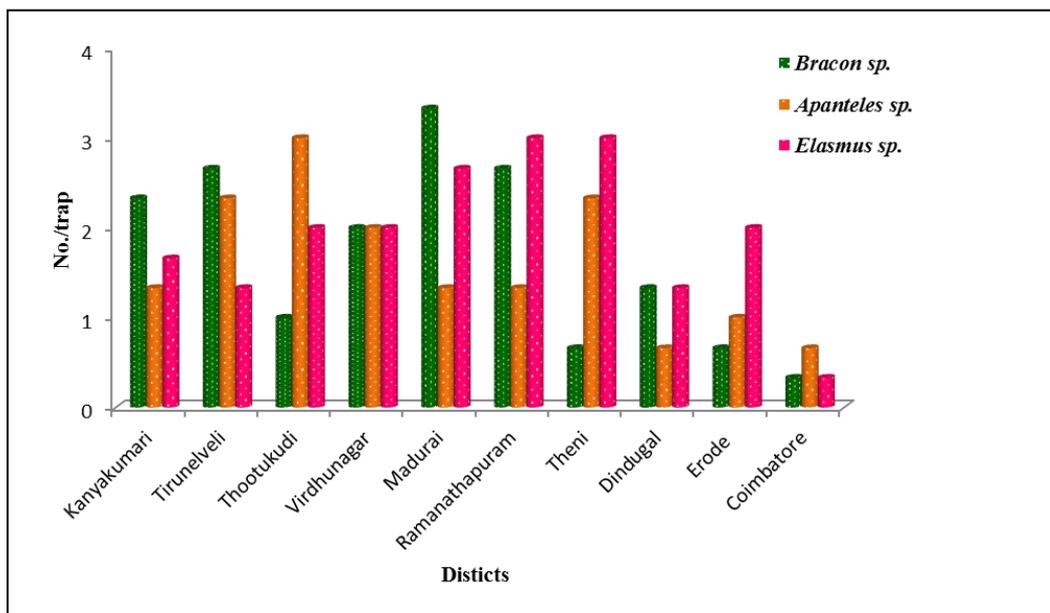


Fig 3: Parasitoids encountered in jasmine growing region of Tamil Nadu

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