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Spiders in Jasmine Ecosystem and their Response to Biopesticides

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ABSTRACT

Jasmine, is a rising crop in Kerala with lot of commercial value with limited knowledge regarding their natural enemies. This study aims to document important spider predators of jasmine and evaluate effect of various biopesticides on them to develop an eco-friendly management. Nine spiders of four families were documented from Thiruvananthapuram, Kollam and Alappuzha districts of Kerala. *Oxyopes shweta* Tikader, *Camaricus* sp., *Plexippus paykulli* (Audonin), *Hyllus semicupreus* (Simon), *Telamonia dimidiate* (Simon), *Thomisus lobosus* Tikader, *Argiope catenulate* (Doleschall), *Tetragnatha maxillosa* Thorell and *Phintella vittata* (C. L Koch) were documented out of which *Camaricus* sp., *A. catenulate* and *T. maxillosa* were reported for first time from jasmine. In field experiment conducted at College of Agriculture, Vellayani microbials, oil based *Beauveria bassiana, Metarzhiium anisopliae* and talc based *Lecanicillium lecanii* and botanical formulations used were found safe to spiders.

Key Words: Biopesticide, *Beauveria bassiana,* Jasmine, *Metarzhiium anisopliae, Lecanicillium lecanii,* Spiders.

INTRODUCTION

The queen of fragrance, Jasmine (*Jasminum* spp.) encounters variety of pests that deteriorates quality and quantity while hampering their aesthetic value. Now a days, increase in rate of pest and disease incidence has become a major challenge in commercial jasmine cultivation. Reddy *et al* (2018) documented more than 20 insect and mite pests in jasmine. David (1958) reported jasmine budworm (*Hendecasis duplifascialis* Hampson), jasmine gallery worm (*Elasmopalpus jasminophagus* (Hampson)) and blossom midge (*Contarinama culipennis* Felt) as severe pests of jasmine which cause highest reduction in market value of flowers. Jasmine leaf webworm (*Nausinoe geometralis* (Guenee), Tingid bug (*Corythauma ayyari* Drake) and mites adversely affects the foliage of the plant. As jasmine is highly acknowledged for their scent and aesthetics, farmers often tend to avoid use of chemical controls. This increases the demand for the development of biological controls which are safe to natural enemies especially spiders.

Spiders are the most abundant terrestrial invertebrate predator and most ubiquitous predaceous group in the animal kingdom which plays major role as a natural enemy in agricultural ecosystem (Silwal and Molur, 2007). These non-insect arthropods belong to the class Arachnida and order Araenae. Presently more than 49,000 known species of spiders belonging to 120 families are found around the world (World spider Catalogue, 2021). The attributes like predatory potential, wide host range and good environmental tolerance makes them better candidate as predators for biological control of pests among cultivated crops (Rajeswaran *et al*, 2005). The population and species abundance of spiders can be similar in both cultivated and natural ecosystems when kept undisturbed (Shukla and Sandu, 1983). The spiders present in jasmine ecosystem consume large number of larvae of jasmine pests and play significant role in controlling them. Hence, the knowledge regarding spiders and other natural enemies is pre- requisite and to evolve

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Table 1. Spiders documented on Jasminum spp. from Kerala

Sl. No.	Common name	Scientific name	Family	Ecological guild	Incidence		
					Thiruvananthapuram	Kollam	Alappuzha
1	White lynx spider	O. shweta	Oxyopidae	Stalkers	+	+	+
2	Crab spiders	*Camaricus* sp.	Thomisidae	Ambushers	+	+	-
3	Pantropical jumping spider	P.paykulli	Salticidae	Stalkers	+	-	+
4	Heavy bodied jumper	H. semicupreus	Salticidae	Stalkers	+	+	+
5	Two striped jumper	T. dimidiate	Salticidae	Stalkers	+	-	+
6	Flower crab spider	T. lobosus	Thomisidae	Ambushers	+	-	-
7	Grass cross spider	A. catenulate	Araneidae	Orb weavers	+	+	+
8	Long jawed orb weaver	T.maxillosa	Tetragnathidae	Orb weavers	+	+	-
9	Banded phintella	P. vittata	Salticidae	Stalkers	+	-	-

integrated pest management strategy in jasmine has high worth and the present study is aimed to document the spiders from jasmine ecosystem in Kerala and to evaluate the safety of bio pesticides against spiders in jasmine ecosystem.

MATERIALS AND METHODS

Documentation of spiders from jasmine was conducted in Thiruvananthapuram, Kollam and Alappuzha districts of Kerala during the period of 2019-2021. The districts were selected based on availability of jasmine farmers with help of Agricultural Officers in Kerala. In each district, five random jasmine growing areas were selected for collection of spiders. The specimens were labeled and preserved in alcohol (70%) for identification. Later pot study was conducted at College of Agriculture, Vellayani to evaluate effect of various treatments against spiders present in *Jasminum sambac* (L.) Ait. The design adopted was CRD with four replications. The treatments used were,

T_1: Oil based formulation of *B. bassiana* NBAIR Bb 5 @ 10 ml/L

T_2: Talc formulation of *L. lecanii* NBAIR Vl 8 @ 20 g/ L

T_3: Oil based formulation of *M. anisopliae* NBAIR Ma 4 @ 10 ml/L

T_4: *A. paniculata* formulation @ 50 ml/L

T_5: Azadirachtin 1% @ 2 ml/L

T_6: Cashew Nut shell Liquid (CNSL) 20 EC @ 5 ml/L

T_7: Horticultural mineral oil (HMO) @ 25 ml/L

T_8: Chlorantraniliprole 8.8% w/w+Thiamethoxam 17.5 % w/w SC @150g a.i/ ha

T_9: Untreated

Before spraying pre count of spiders were taken. The data were subjected to statistical analysis using the software- GRAPES (Gopinath *et al*, 2021).

Table 2: Effect of different treatments on the population of spiders

Treatments	Mean population of spider per plant						Reduction over control (%)
	Pre-count	4 DAS	6 DAS	8 DAS	10 DAS	12 DAS	
$T_{1:}$ Oil based formulation of *B. bassiana* NBAIR Bb 5 @ 10 mL L^{-1}	1.25 (1.31)	0.50 $(0.97)^{bc}$	0.50 $(0.97)^{bc}$	0.50 $(0.97)^{bc}$	0.75 $(1.10)^{b}$	1.00 $(1.23)^{b}$	50.00
$T_{2:}$ Talc based formulation of *L. lecanii* NBAIR Vl 8 @ 20g L^{-1}	1.25 (1.27)	0.75 $(1.10)^{b}$	0.75 $(1.10)^{b}$	0.75 $(1.10)^{bc}$	0.75 $(1.10)^{b}$	1.00 $(1.23)^{b}$	50.00
$T_{3:}$ Oil based formulation of *M. anisopliae* NBAIR Ma 4 @ 10 mL L^{-1}	0.5 (0.97)	0.75 $(1.06)^{bc}$	1.00 $(1.23)^{b}$	1.00 $(1.23)^{ab}$	0.75 $(1.10)^{b}$	0.75 $(1.10)^{b}$	62.50
$T_{4:}$ *A. paniculata* formulation @ 50 mL L^{-1}	1.25 (1.27)	0.75 $(1.10)^{b}$	0.75 $(1.10)^{b}$	0.75 $(1.10)^{bc}$	0.75 $(1.10)^{b}$	0.75 $(1.10)^{b}$	62.50
$T_{5:}$ Azadirachtin 1% @ 2 mL L^{-1}	1.5 (1.40)	0.75 $(1.10)^{b}$	1.00 $(1.18)^{b}$	0.50 $(0.97)^{bc}$	0.5 $(0.97)^{bc}$	0.75 $(1.10)^{b}$	62.50
$T_{6:}$ Cashew Nut Shell Liquid (CNSL) 20 EC @ 5mL L^{-1}	1.25 (1.27)	1.25 $(1.31)^{ab}$	1.00 $(1.23)^{b}$	0.75 $(1.10)^{bc}$	0.50 $(0.97)^{bc}$	0.50 $(0.97)^{b}$	75.00
$T_{7:}$ Horticultural Mineral Oil (HMO) @ 25 mL L^{-1}	0.5 (0.97)	0.00 $(0.71)^{c}$	0.00 $(0.71)^{c}$	0.25 $(0.84)^{cd}$	0.50 $(0.97)^{bc}$	0.75 $(1.10)^{b}$	62.50
$T_{8:}$ Chlorantraniliprole 8.8% w/w + Thiamethoxam 17.5 % w/w SC @ 50g a.iha^{-1}	1.00 (1.18)	0.00 $(0.71)^{c}$	0.00 $(0.71)^{c}$	0.00 $(0.71)^{d}$	0.00 $(0.71)^{c}$	0.00 $(0.71)^{c}$	100.00
$T_{9:}$ Untreated	1.00 (1.18)	2.00 $(1.56)^{a}$	2.00 $(1.56)^{a}$	2.00 $(1.56)^{a}$	1.75 $(1.49)^{a}$	2.00 $(1.58)^{a}$	-
CD (0.05)	(NS)	(0.37)	(0.31)	(0.35)	(0.36)	(0.29)	-

RESULTS AND DISCUSSION

Documentation

Nine different species of spiders were documented from three districts - Thiruvanathapuram, Kollam and Alappuzha. The spiders were white lynx spider (*O. shweta*), crab spiders (*Camaricus* sp.), pantropical jumping spider (*P. paykulli*), heavy bodied jumper (*H. semicupreus*), two striped jumper (*T. dimidiate*), flower crab spider (*T. lobosus*), grass cross spider (*A. catenulate*), long jawed orb-weaver (*T. maxillosa*) and banded phintella (*P. vittata*) (Fig.1) out of which *Camaricus* sp., *A. catenulate* and *T. maxillosa* were reported for the first time. The spiders were found preying on the adult moths and larvae of jasmine pests. Rajeswaran *et al* (2005) reported *Phidippus punjabensis* Tikader, *Paradosa* sp., *Cheiracanthium* sp. and *Theridion* sp. as important predatory spiders found in jasmine ecosystem. Similarly, Kamala and Kennedy (2017) also referred *Argiope anasuja* (Thorell), *Neoscona theisi* (Walkckenaeur), *Neoscona mukherjee* (Tikader), *Olios millet* (Pocock), *Chikunianigra* (O. Pickward-Cambridge), *Pisaura putiana* (Barion and Litsinger), *Peutica viridana* (Stoliczka), *Oxyopesjavanus* (Thorell), *Oxyopes birmanicus* (Thorell), *O. shweta*, *P. vitata*, *Myrmaplata plataleoides* (O. Pickard-Cambridge), *P. paykulli*, *T. dimidiata*, *Rhenedanieli* (Tikader), *Carrhotus viduus* (C. L Koch), *Thyeneim perialis* (Rossi), *H. semicupreus*, *Thomisus projectus* (Tikader) as prominent spiders observed on jasmine twigs, trunk,

leaves, flowers and buds preying on the larvae and adult of jasmine leaf webworm. Heiling *et al* (2005) reported the ability of crab spiders to manipulate the flower signals through UV- reflecting body coloration as deceptive signaling and to catch its prey.

Field evaluation

An investigation was conducted to evaluate the effect of different treatments against predatory spiders *of J. sambac* at College of Agriculture, Vellayani. Pre-treatment counts of spiders had no significant difference in population. However, after spraying. mean number of two spiders per plant was the highest population recorded and it was the in untreated plot (Table 2). Spiders avoided the plants sprayed with Chlorantraniliprole 8.8% w/w +Thiamethoxam 17.5 % w/w SC @ 50g a.i/ ha throughout 4, 6, 8 and 12th day after spraying. But this was contradictory to findings of Baehaki *et al* (2017) who found that Chlorantraniliprole + Thiamethoxam 300 SC was safe with less than 25 per cent mortality of *Lycosa pseudoannulata* in pre-treated paddy hills inside a nylon cage. However, Pekar (2012) opined that spiders sometimes tends to show more sublethal effects than lethal effects in normal field conditions where they actively avoid the treated plants and recolonize to untreated plants. Similar finding was also reported by Riechert and Lockley (1984) who studied the effect of spiders as biocontrol agents. This could have been one of the reasons for absence of spiders in the chemical treated plants in the field throughout spraying periods.

After four days of spraying the untreated control with highest spider population (2.00) was on par with Cashew Nut Shell Liquid (CNSL) 20 EC @ 5 ml/L (1.25). It was also found on par with the oil based formulation of *B. bassiana* NBAIR Bb 5 @ 10 ml/L (0.50), oil based formulation of *M. anisopliae* NBAIR Ma 4 @ 10 ml/L (0.75), talc based formulation of *L. lecanii* NBAIR Vl 8 @ 20g/L (0.75), Azadirachtin 1% @ 2 ml/L (0.75) and *A. paniculata* formulation @ 50 ml/L (0.75). By the end of twelfth day of spraying, among the biocontrol treatments, the highest mean population of spiders was recorded on oil based formulations of *B. bassiana* NBAIR Bb 5 @ 10 ml/L and *M. anisopliae* NBAIR Ma 4 @ 10 ml/L (1.00). It can be concluded from the results that the microbials and botanicals used in experiment were safe to spiders. These findings were in tune with Manu (2005) who reported that *M. anisopliae, B. bassiana* and *L. lecanii* as safe to spiders in vegetable ecosystem. Nanda *et al* (1996) also found population of natural enemies, *Tetragnatha* sp. and *Oxyopes* sp. in cucurbits remained similar even after application of neem-based pesticide. But, Raguraman and Kanan (2014) found that plant derived insecticides in crude formulations may have some ill effects against predators and other beneficial insects in laboratory condition however their risk is highly reduced after application in the fields which synchronized with the findings of Vijayasree *et al* (2012) who reported botanicals neem oil, neem oil garlic emulsion and azadirachtin as safe to spiders.

CONCLUSION

Presently, about nine spiders are documented from jasmine ecosystem from Kerala. White lynx spider (*O. shweta*), crab spiders (*Camaricus* sp.), pantropical jumping spider (*P. paykulli*), heavy bodied jumper (*H. semicupreus*), two striped jumper (*T. dimidiate*), flower crab spider (*T. lobosus*), grass cross spider (*A. catenulata*), long jawed orb-weaver (*T. maxillosa*) and banded phintella, (*P. vittata*) were documented. Spiders *Camaricus* sp., *A. catenulate* and *T. maxillosa* were reported for the first time from Kerala on jasmine. From the field experiments, it was found that spiders avoided plants treated with Chlorantraniliprole 8.8% w/w +Thiamethoxam 17.5 % w/w SC @ 50g a.i/ha whereas treatments, oil based *B. bassiana* NBAIR Bb 5@ 10 ml/L, talc based *L. lecanii* NBAIR Vl 8 @ 20g/ L, oil based *M. Anisopliae* NBAIR Ma 4 @ 10 ml/L, *A. paniculata* formulation @ 50 ml/L, azadirachtin 1%@ 2 ml/L, Cashew Nut Shell Liquid 20 EC @ 5 ml/L and Horticultural Mineral Oil @ 25 ml/L population of spiders were significantly high.

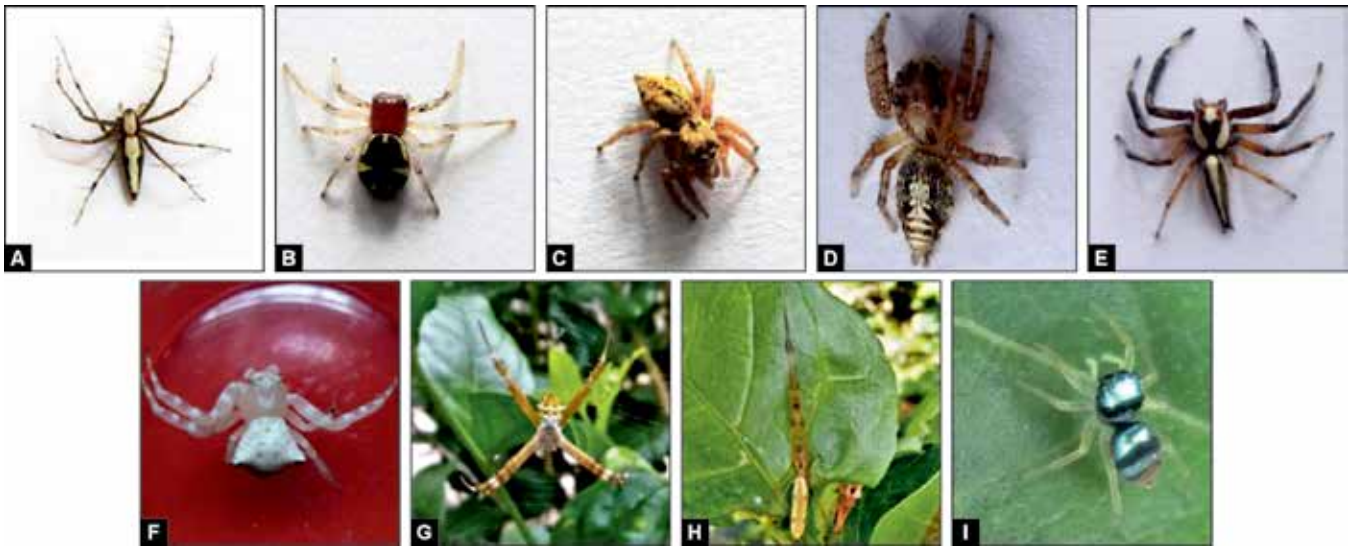

Fig.1: A. *Oxyopesshweta* Tikader, B. *Camaricus* sp., C. *Plexippuspay kulli* (Audouin), D. *Hyllus semicupreus* (Simon), E. *Telamonia dimidiate* (Simon), F. *Thomisus lobosus* Tikader, G. *Argiope catenulata* (Doleschall), H. *Tetragnatha maxillosa* Thorell, I. *Phintella vittata* (C. L Koch)).

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Mean of four replications;* DAS – Days After Spraying; Value in the parenthesis – Square root transformed values

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