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Biological Suppression of the White Spider Mite *Oligonychus iseilemae* (Hirst) on Coconut Foliage

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Abstract: *Oligonychus iseilemae* is one of the spider mite pests on the coconut palm foliage. This mite infests the ad-axial surface of the leaflets in colonies and the feeding results in the drying of the affected foliage. Natural predator complex of *O. iseilemae* comprised six species of spider. *A. (A.) paraaerialis, A. (T.) eucalypticus, Cunaxa setirostris* and *Agistemus* sp. are the major mite predators. Insect predators comprised Coccinellidae, Cecidomyiidae, Chrysopidae and Thripidae. Clubionid spiders are also dominant predators on this mite pest. The biology, predator-potential, seasonal occurrence and predator-prey ratio of the important predators were discussed.

Key words : Coconut, Spider mite, *Oligonychus iseilemae*, Mite predators, Phytoseiidae, Cunaxidae, Stigmaeidae, Predator-potential, Seasonal incidence

INTRODUCTION

Biological suppression of the spider mite pests of agricultural crops is possible by exploitation of the regulatory pressure exerted by the natural predators such as mites, insects and spiders. The phytophagous tetranychoid mites on the coconut palm comprised twelve species of spider mites and six species of false spider mites, infesting the foliage, inflorescence and nuts (Sathiamma, 1991). These mites usually occurred as occasional pests, but under favourable conditions their sporadic outbreaks could result in substantial crop losses.

Oligonychus iseilemae and *Tetranychus ludeni* are the two spider mite species infesting the coconut palm foliage (Sathiamma, 1985; 1988). The immature and adult stages of these mites sucked sap from the foliage. The affected parts get dried up. Sathiamma (1991, 1993) observed that weather parameters and the associated natural enemies governed the seasonal abundance of *O. iseilemae* under field conditions. Mite, insect and spider predators played an effective role in the natural biological suppression of these phytophagous species. Sathiamma (1992) discussed the role of the mite predators in the biological suppression of the mite pests of the coconut palm. Investigations were carried out in detail on the natural enemies of *O. iseilemae*, the prey consumption, biology, predator-prey ratio and seasonal incidence of the important predators and the results of these studies are discussed in this paper.

MATERIALS AND METHODS

Observations on the predators of *O. iseilemae* were recorded, every fortnight for two years (1985 and 1986), from two leaves each from ten sample coconut palms of the age group 3-4 years. The predators were counted on the basis of the actual observations on their feeding habits. A catalogue of the mite, insect and spider predators was prepared. The data were also used for studying the predator-prey ratio and seasonal intensity of the predators & prey in the field.

The prey consumption and the biology of the important predators were studied under laboratory conditions in Petri-plate cages. Fresh coconut leaflets were cut into bits (3.5 × 2.5 cm) and kept in petri-plate over water soaked cotton pads and the predators were released on these bits of leaflets for egg laying. *O. iseilemae* nymphs and adults were also released on these leaflets as prey for the predators. Data on the number of eggs laid and the period taken to complete the egg to adult stages were recorded daily at regular intervals (9.30 hrs and 16.30 hrs). Observations were recorded in the laboratory at a mean temperature 28 ± 1°C and relative humidity of 68 ± 2%. The predators as

Table 1. Natural predator complex of *Oligonychus iseilemae* (Hirst) on coconut palm foliage

Class/Subclass	Order	Family	Name of predator
Acarina	Mesostigmata	Ascidae Phytoseiidae	*Lasioseius sp.* *Amblyseius (Amblyseius) paraaerialis* Muma *A. (Typhlodromalus) eucalypticus* Gupta
	Prostigmata	Cheyletidae Cunaxidae Eupodidae Stigmaeidae	Unidentified *Cunaxa setrostris* (Hermann) *Eupodes sp.* *Agistemus sp.*
Arachnida	Araneae	Clubionidae	*Cheiracanthium sp.*
Insecta	Coleoptera Diptera	Coccinellidae Cecidomyiidae	*Stethorus keralicus* Kapur Unidentified

soon as they hatch from the egg were provided with 30-50 numbers of the prey containing the egg, larva nymph and adult stages. The number of prey and the stage of the prey consumed at each stage of the predator was separately recorded at 24 h interval. Mean prey consumption was worked out from the data collected. Separate cages were maintained for the different species of predator under this experiment.

Results and Discussion

Natural predator complex of the coconut white spider mite *O. iseilemae* comprised six species of mites, two insects and one spider. They belonged to nine genera (including two unidentified ones) of nine families and five Orders (Table 1). These predators occupied the same habitat and co-existed with the colonies of prey mites or remained scattered on the mite infested coconut foliage.

Species of *Amblyseius* (Phytoseiidae) were the major predators of *O. iseilemae*. There were two species, *Amblyseius (Amblyseius) paraaerialis* Muma and *A. (Typhlodromalus) eucalypticus* Gupta. *Cunaxa setirostris* (Cunaxidae), *Agistemus* sp. (Stigmaeidae), *Lasioseius* sp. (Ascidae) and an unidentified species of Cheyletidae were the other mite predators recorded. These predators are new records on the prey and the host palm.

A. (A.) paraaerialis

Adults and immature stages of *A. (A.) paraaerialis* fed on the eggs and motile stages of the prey. These dominant predators occurred in abundance during the peak period of incidence of *O. iseilemae*. The larvae and protonymphal stages of the predator consumed the immature stages of the prey; the deutonymphal predator fed on the immature and adult stages of the prey and the adult predator preferred the eggs rather than the motile stages of the prey.

The prey consumption per larva was 2.8 ± 0.2, protonymph 3.1 ± 0.4, deutonymph 3.4 ± 0.3 and adult female 5.4 ± 0.9 prey during its developmental period. As compared to the females, the adult male predator consumed less, the average feeding was 1.3 ± 0.2, 2.0 ± 0.3, 2.3 ± 0.2 and 2.7 ± 0.3, respectively, for larvae, protonymph, deutonymph and adult stages (Table 2).

The female predator laid 15-35 eggs during its life period of 10-20 days. It completed the egg to adult period in 4.5 ± 0.1 days, with an egg period of 1.2 ± 0.1, larval 1.0 ± 0.0, protonymphal 1.2 ± 0.1 and deutonymphal 1.1 ± 0.1 days. Whereas, the male predator took only 4.2 ± 0.1 days to complete the development from egg to adult stage (Table 3). *A. (A.) paraaerialis* is also a predator on the coconut

Table 2. Prey consumption by *Amblyseius (A.) paraaerialis*, *A. (T.) eucalypticus* and *Cunaxa setirostris* predacious on *Oligonychus iseilemae* in the laboratory*

Predator stage	Prey consumed			
	A. (A.) paraaerialis		*A. (T.) eucalypticus*	*C. setirostris*
	Male	Female	Female	Female
Larva	1.3 ± 0.2	2.8 ± 0.2	2.8 ± 0.3	8.3 ± 1.1
Protonymph	2.0 ± 0.3	3.1 ± 0.4	3.7 ± 0.7	11.8 ± 1.4 **
Deutonymph	2.3 ± 0.2	3.4 ± 0.3	5.8 ± 0.6	
Adult	2.7 ± 0.3	5.4 ± 0.9	9.0 ± 0.5	14.9 ± 1.7

* Mean of 10 observations

** Protonymph and deutonymph stages combined

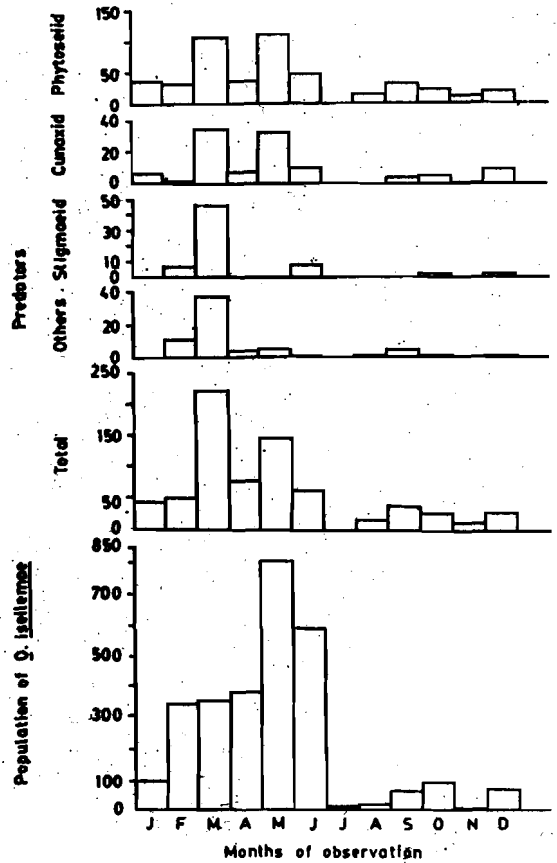

Fig. 1. Fluctuations in population density of Oligonychus iseilemae and the associated predators (Mean of 1985 and 1986).

Table 3. Duration of Life stages (Mean ± SE) of *Amblyseius (A.) paraaerialis*, *A. (T.) eucalypticus* and *Cunaxa setirostris* in the laboratory *

Life stage	Duration (days)			
	A. (A.) paraaerialis		*A. (T.) eucalypticus*	*C. setirostris*
	Male	Female	Female	Female
Egg	1.0 ± 0.0	1.2 ± 0.1	1.0 ± 0.0	2.1 ± 0.2
Larva	1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	1.9 ± 0.1
Protonymph	1.0 ± 0.0	1.2 ± 0.1	1.2 ± 0.1	2.4 ± 0.1 **
Deutonymph	1.2 ± 0.1	1.1 ± 0.1	1.1 ± 0.1	

* Mean of 10 observations
** Protonymph and deutonymph stages combined

red spider mite *T. ludeni* and the rate of consumption was 1-4 prey per day. This predator also fed on *A. eucalypticus*, another phytoseiid predator on *O. iseilemae*.

A. (T.) eucalypticus

A. (T.) eucalypticus inhabits the coconut leaflets amidst colonies of *O. iseilemae*. They fed on all stages of the prey. The predator larvae consumed 2.8 ± 0.3, protonymph 3.7 ± 0.7 and deutonymph 5.8 ± 0.6 prey per predator during its life period. Adult female predator consumed 9.0 ± 0.5 and the male 2.5 ± 0.2 prey per day (Table 2). But, the predator larva consumed only the egg and larval stages of the prey and the protonymph consumed the immature prey stages and the deutonymph and the adult predator on all stages of the prey.

The adult female laid only 5-8 eggs and completed the egg to adult period in 4.3 ± 0.2 days which comprised an egg and larval period of one day each, protonymphal 1.2 ± 0.1 and deutonymphal 1.1 ± 0.1 days (Table 3).

Cunaxa setirostris

The cunaxid mite *C. setirostris* is a very active and efficient predator on all the motile stages of *O. iseilemae*. The predator larva preferred the larval prey; the nymphal predator preferred the larvae and early nymphs of the prey and the adult preferred the prey nymphs and adults. Total prey consumption during its larval stage was 8.8 ± 1.1 and nymphal 11.8 ± 1.4 prey (Table 2).

The female predator lived on an average for 15.8 ± 0.7 days and laid 6.3 ± 0.7 eggs. The egg to adult period was completed in 6.3 ± 0.2 days. The egg period comprised 2.1 ± 0.2, larval 1.9 ± 0.1 and nymphal (inclusive of protonymphal and deutonymphal stages) 2.4 ± 0.1 days (Table 3).

Agistemus sp.

Species of *Agistemus* occurred at a low level in the field and it fed on all developmental stages of *O. iseilemae*. The predator larva fed on the larval prey, nymph fed on all immature stages of the prey and the adult fed on all life stages. The prey consumption ranged from 20.0 to 20.5 by larva, 3.7 to 30.0 by nymph and 3.3 to 31.0 by the adult.

Predator- prey ratio

Phytoseiidae and Cunaxidae are the dominant predators of *O. iseilemae*. In the field, the overall predator-prey ratio was 1 : 4.7, which varied from 1 : 0.5 during Novmber to 1 : 11.2 during June. High population of the prey occurred during March, when the predator-prey ratio was 1 : 2.6 and during May, the peak period of the prey, the ratio was 1 : 5.7.

Considering the phytoseiid predators, the predator-prey ratio varied from 1 : 0.5 to 1 : 13.6, with a peak population ratio of 1 : 7.4, during May. As compared to the Phytoseiidae, the cunaxid predators were comparatively low, with a peak during March, the predator-prey ratio being 1 : 10.7.

Seasonal abundance

The predators occurred in the field during all months of the year, except July (Fig. 1).

Table 4. Seasonal occurrence and mean population of the predators of *Oligonychus iseilemae* (Hirst) during the years 1985 and 1986 (Total palms observed - 10)

Month	Mites				Insects		Spiders
	Phytos-eiidae	Cuna-xidae	Stigm-aeidae	Cheyl-etidae	Coccin-ellidae	Cecido-myiidae	Clubion-idae
January	70	11	0	1	2	2	40
February	64	23	14	1	3	6	17
March	208	66	92	1	4	0	20
April	136	11	0	0	5	0	6
May	218	63	0	1	4	2	13
June	86	18	14	1	0	5	5
July	0	0	0	0	0	0	0
August	32	0	0	0	1	0	23
September	55	6	4	1	4	0	21
October	40	9	2	0	2	0	22
November	19	1	0	0	0	1	18
December	36	15	2	0	0	2	25

High population was recorded from January to May and very low to zero from June to December. Maximum predator population occurred from March to May. The seasonal occurrence of the predators followed a similar pattern as that of the prey. With increase in the population of *O. iseilemae* from January, the predator population gradually built up and reached the peak level in March. But, with the decrease in prey population the number of predators also became less and reached either a very low level or were totally absent. Predators influenced a decrease in the spider mite population and their beneficial role was observed when the population reached severe proportions.

The phytoseiid predators *A. (A.) paraaerialis* and *A. (T.) eucalypticus* were abundantly present as compared to the cunaxid, stigmae and cheyletid predators. High population of these mites occurred from March and May. A similar trend was noted in the cunaxid mites. Stigmaeid predators occurred in abundance during March. Population of cheyletid mites was extremely low and was present during January, March, May, June and September. Among the insect predators, Coccinellidae and Cecidomyiidae were the dominant ones. Clubionid spiders, particularly species of *Cheiracanthium* occurred throughout the year, except July (Table 4).

Increase in spider mite population on coconut was regulated by a number of factors including climate and natural enemies (Sathiamma, 1993). The present observations also revealed that the predators were capable of multiplying in large numbers and maintaining the spider mite population at a low level. This method of biological suppression of pests was successfully employed on a number of agricultural crops. According to Helle and Sabelis (1985), Huffaker *et al.*, (1970), Mc Murtry (1982) and Pickett and Gilstrap (1986) phytoseiid mites play an important role in the biological suppression of mite pests. *A. (A.) paraaerialis* and *A. (T.) eucalypticus* (Phytoseiidae) were the most dominant predators checking the population or *O. iseilemae* and *T. ludeni* in the field. These active predators occurred in abundance corresponding to the increase in prey mite population. They have a short life cycle, a high potential for multiplication and consumed all stages of the prey.

A. (Euseius) alstoniae (Gupta and Gupta, 1978), *A. (A.) nuciferae* (Gupta, 1986), *A. largoensis* (Schicha and Gutierrez, 1985) and an unidentified species of phytoseiid (Cayme

and Gapasin, 1987) were the other species of phytoseiid mites recorded on coconut. The economic importance of these species is not known, but for *A. (E.) alstoniae* feeding on *Raoiella indica*, the false spider mite on coconut.

C. setirostris is one of the potential predators of *O. iseilemae*. It is world wide in distribution and known to be an efficient predator of tetranychid mites. It has all the essential prerequisites of an efficient predator with a good searching ability, shorter life span, prolonged longevity and high rate of prey consumption.

Species of *Agistemus* are potential predators of tetranychoid mites (Gupta, 1985; Gupta *et al.*, 1971). The present observations clearly indicated that combined with the phytoseiid and cunaxid predators, *Agistemus* sp. effected successful natural suppression of the spider mite population during the period of mite abundance.

The insects, particularly Coccinellidae are well known predators on spider mite pests. *Stethorus fijiensis, S. expectatus* and *S. exsultabilis* on coconut spider mites (Cayme and Gapasin, 1987; Chazeau, 1983) and *S. Keralicus* on the arecanut false spider mite (Daniel, 1979) are some of the recorded predators.

The spiders are quite abundant in the coconut ecosystem. *Cheiracanthium* sp. is one of the most efficient predators of *Opisina arenosella*, the leaf eating caterpillar pest of coconut (Sathiamma *et al.*, 1987) and this species consumed the spider mites to the coconut foliage.

Along with the mite predators, the insect and spider predators effected significant suppression of the spider mite population on coconut foliage. Some of these predators are individually insignificant, but collectively their abundance coincided with prey abundance and effected biological suppression of the tetranychid mite *O. iseilemae* infesting coconut palm.

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