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Diversity and Phytophagous - Predatory Relationship of Mites Associated With Papaya Plant (*Carica papaya* L. 1753)

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ABSTRACT

In the present study, the common species of mites, representing the phytophagous and predatory categories inhabiting the leaves of 12 Nos.of papaya plants (*Carica papaya* L.1753)grown in adjacent localities of the Calicut University Campus, Kerala were considered for studying their nature of interaction. Random samples of leaves (5 Nos.) were collected from each plant, and individually examined. The abundance of each mite species, either pest/ predatory category was recorded separately. A total of 892 mite specimens representing 12 species under 10 genera and 6 families were counted, of which 231 represented the phytophagous group while 661 represented the predators. Predatory mites constituted the largest proportion (74%) of acarine fauna than phytophagous group (26%). Shannon-Wiener index (H) of the predatory mite species was found higher (1.93) than that of the phytophagous species (0.52), results of correlation studies established a significant positive relationship (R=0.7614) between the phytophagous and predatory mite populations.

Keywords : Phytophagous Mites, Predatory Species, Papaya

I. INTRODUCTION

Papaya is cultivated as a major fruit crop extensively in the tropical countries and it is grown in large areas of India also. The plant supports varied groups of mites, representing the phytophagous and predatory categories, of which the former one often leads to significant yield loss.However, the predators generally afford protection to the plant from excessive pest attack, by actively devouring different kinds of prey and thereby maintaining the pest populations below the economic injurious levels.

Among the phytophagous mites, members of the family Tetranychidae have been reported in association with papaya plants and around 30 species have been reported to inhabit on the crop on a global level (Bolland et al. 1998). Spider mites of the Genus Tetranychus are considered as major pests, enjoying polyphagous habit worldwide, mainly distributed in semitropical and tropical areas (Jeppson et al., 1975). Mites belonging to other phytophagous families viz. Tenuipalpidae, Eriophyidae and Tarsonemidae are also reported to be associated with papaya (Mesa et al. 2009). Of the various groups of predatory mites harbouring on papaya plants, members of Phytoseiidae show dominance and these mites have gained much recognition owing to their increasing utility in the biological control programmes of pest mites (Moraes, 2002). During the present study, an attempt was made to record the diversity of mites associated with papaya plants growing in the adjacent areas of Calicut University Campus and also to establish the pest- predatory relationship of mites associated with the crop. Such a focus on the prey-predator relationship is thought to be vital in chartering pest management programmes.

II. METHODS AND MATERIAL

For screening the diversity of mites asociated with papaya, 12 Nos. of plants growing in the adjacent localities of Calicut University Campus, Kerala were selected. Random samples of leaves (5 Nos.) were collected from each plant, and kept individually in plastic bags and transferred to the laboratory. Each leaf

sample was examined under a stereozoom microscope and the number of each mite species, either the pest/ predatory category was recorded separately, excluding the immature stages.The number of individual species was noted and the specimens were slide mounted in Hoyer's medium and kept in an oven to attain proper drying and clearing. The cleared specimens were identified following relevant keys/literature. Repeated observations were made and the mean number of pest/ predatory mite population per plant was calculated.

III. RESULTS AND DISCUSSION

Result

Results of field sampling of papaya leaves enabled to recover a total of 892 mite specimens representing 12 species, 10 genera and 6 families. Of these, 231 specimens represented the phytophagous group while the remaining 661 represented the predators.Of the 6 families of mites recovered, 2 families viz. Tetranychidae and Tenuipalpidae constituted the phytophagous group (26%) while the remaining 4 families viz. Phytoseiidae, Tydeidae, Cunaxidae and Stigmaedae represented the predatory group (74%).Predatory mites were found to comprise 70% of the mite genera while the remaining 30% was represented by the phytophagous group.

Table: 1-Species diversity and relative abundance of mites associated with *Carica papaya*

Acarine Family	Phytophagous mites	Relative abundance (in %)
Tetranychidae	*Tetranychus urticae*	22
	Eutetranychus orientalis	2.60
Tenuipalpidae	*Dolichotetranychus* sp.	1.30
	Predatory mites	
Phytosiidae	*Amblyseius aerialis*	17.80
	Amblyseius channabasavannai	6.20
	Euseius papayensis	19.30
	Typhlodromus sp.	4.10
Tydeidae	*Tydeus interrruptus*	9.90
	Proctotydaeus sp.	10.40
Cunaxidae	*Cunaxa capreolus*	2.90
	Cunaxa womersleyi	2.30
Stigmaeidae	*Zetzellia* sp.	1.20

The phytophagous mites were found to represent 3 species, 3 genera and 2 families while the predators could be categorized as 9 species under 7 genera and 4 families. The phytophagous species recovered from papaya leaves were *Tetranychus urticae* Koch, *Eutetranychus orientalis* Klein and *Dolichotetranychus* sp. While the predatory mites were *Amblyseius aerialis* Muma, *A.channabasavannai* Gupta and Daniel, *Euseius papayensis* Mary Anitha, *Typhlodromus* sp., *Cunaxa capreolus* Berlese, *C.womersleyi* Baker and Hoffmann, *Tydeus interruptus* Thor, *Proctotydeus* sp., and *Zetzellia* sp. The dominant species of phytophagous mite was recognized as *T.urticae* (22%) and less abundant species was *E.orientalis* (2.60%) and *Dolichotetranychus* sp. (1.30%). The dominant species of predatory mites were *E. papayensis* (19.30%) and *A. aerialis* (17.80%) and the percent of distribution was observed as: *Proctotydeus* sp. (10.40%), *T.interruptus* (9.90%), *A.channabasavannai* (6.20%), *Typhlodromus* sp. (4.10%),*C.capreolus* (2.90%), *C.womersleyi* (2.30%) and *Zetzellia* sp. (1.20%) (Table.1). Predatory mites constituted the largest proportion (74%) than that of phytophagous mites (26%) and the species diversity of predatory mites (75%) were also found be higher when compared to phytophagous species (25%).

Table: 2- Diversity index of the phytophagous and predatory mitesassociated with *Carica papaya*

Parameter	Absolute numbers			Proportions (%)	
	Pr	Ph	Total	Pr	Ph
Abundance	661	231	892	74	26
Number of species	9	3	12	75	25
Number of genera	7	3	10	70	30
Number of family	4	2	6	67	33
H	1.93	0.52	2.12	-	-
Hmax	2.19	1.1	2.39	-	-
J'	0.88	0.47	0.84	-	-

Pr: Predatory, Ph: Phytophagous, H: Shannon-Wiener diversity index, Hmax: maximum diversity
J':Uniformity index

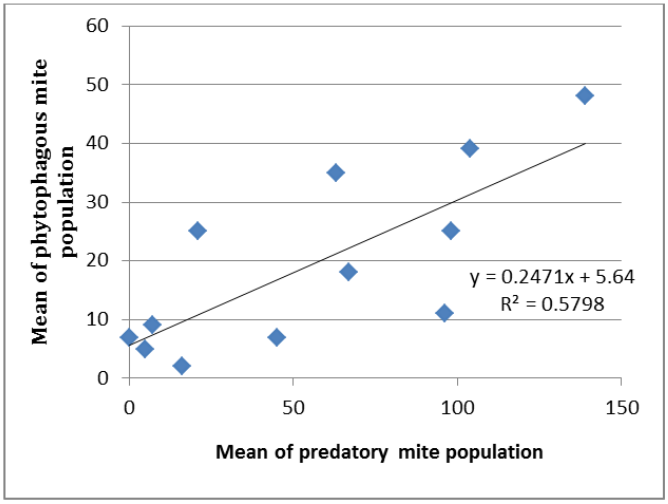

Figure 1.Trend line showing mean population of phytophagous and predatory miteon *Carica papaya*

Shannon-Wiener index (H) of predatory mite species was found higher (1.91) than that of the phytophagous species (0.52) and maximum diversity (Hmax) also was higher for predatory species of mites (2.19) when compared to that of the phytophagous group of mites (1.10). Thus the results of the study enabled to establish a higher diversity index (88%) for predatory mites when compared to that of the phytophagous mites (47%), corresponding to the estimated maximum theoretical diversities (uniformity indexes of 0.88 and 0.47 respectively) (Table.2). Results of correlation studies helped to establish a significant positive relationship (R=0.7614) between the phytophagous and predatory mite populations. The coefficient of determination (R^2=0.579) showed a 58% association between predatory and phytophagous mite population (Fig.1). The increase in pest mite population also resulted in an increase in predator mite population as observed during the present study.

Discussion

Association of diverse species of mites representing the phytophagous and predatory categories was recognized during the present study on papaya plants growing in the adjacent localities of Calicut University Campus. The predatory mites showed the maximum diversity and abundance with respect to families, genera and species, when compared to the respective taxa of phytophagous mites. Phytophagous mites have been reported as the common pests in gardens and orchards, feeding on many fruit trees and vegetable crops (Dreistadt et al., (1994). The three species of phytophagous mites recovered during the present study were *T.urticae*, *E.orientalis* and *Dolichotetranychus* sp., the former two represented the family Tetranychidae and the latter one represented the family Tenuipalpidae. Among these, the most dominant species was *T.urticae* and this finding is in agreement with the earlier observations (Van, 1985; Bolland et al.,1998) which established the species as a major polyphagous pest of many cultivated plants. The species was recorded to exhibit a wide host range in Mexico including papaya plants (García, 1981; Rodríguez-Navarro, 1999).

The species, *E. orientalis* showed a very close association with papaya and this finding supports the polyphagous habit of the species. The wide host range of *E. orientalis* enable the species to inhabit on more than 85 species of plants belonging to 28 families (Lal and Mukherji, 1979). Like spider mites, false spider mites also have been reported to induce serious crop losses, including fruit crops like papaya (Haramoto, 1969). Results of the present study seems to support the earlier findings by recording the presence of *Dolichotetranychus* sp. on papaya plants and the species is known to exhibit worldwide distribution pattern.

Plant inhabiting predatory mites, especially members of the family Phytoseiidae effectively suppress the populations of pest mites as well as soft bodied insects like thrips, scale insects, mealy bugs, aphids etc. These mites have been recognized as important regulators of high densities of phytophagous mites (McMurtry and Croft, 1997). In the present study, the association of various phytoseiid species like *A. aerialis*, *A.channabasavannai*, *E.papayensis* and *Typhlodromus sp.* could be recorded on papaya plants. Of these, *A. aerialis* and *E.papayensis* were the dominant species, seen in association with the spider mites on papaya. These species were already recorded from plants like Kachnar and citrus in various districts of India like Arunachal Pradesh, Bihar and Karnataka (Gupta, 2003). The association of these species with tenuipalpid mites on betelvine was also on record from West Bengal (Karmakar and Gupta, 2011). Another phytoseiid member viz. *E.papayensis* also was recovered during the study as a dominant species. The species was first described as a new taxon from the leaves of papaya plants of North Kerala (Mary Anitha, 2006) and its

association was usually observed along with spider mite infestation.

Apart from phytoseiid mites, predatory mites belonging to other families like Cunaxidae, Stigmaeidae and Tydeidae were also collected during the study. Cunaxids are known to occupy both in soil as well as on plants and are recognized as predators in natural and agricultural ecosystems (Muma,1960; Walter, 1988) feeding on varied types of pests. The two species of cunaxids recovered during the study were *C. capreolus* and *C.womersleyi* and these species were seen in association with the pest mites on papaya plants. Further studies are warranted on the feeding habits of the above species to exploit their predatory potential on pest mites infesting papaya plants.

Among the predatory mites, members of the family Tydeidae constitute a dominant group, generally distributed in the arid, semiarid and temperate ecosystems (Andre´ et al., 1997; Noble et al., 1996). During the present study, two species of Tydeid mites viz. *T.interruptus* and *Proctotydaeus* sp. could be collected from the leaves of papaya plant. The presence of tydeids in association with the pest mites on cassava pants as observed during the present study seems to be encouraging as it would help in suppressing the pest mite population under natural condition. The study also helped to encounter a member of the family Stigmaeidae, viz. *Zetzellia* sp. Members of *Zetzellia* have already been recorded as one of the most important groups of predatory mites, after Phytoseiidae (Santos and Laing, 1985).

The prey-predator relationship observed during the current study when subjected to statistical revealed a higher Shannon-Wiener index (H) value for the predatory mites (1.93) when compared to that of the phytophagous mites (0.52). The correlation coefficient (0.7614) showed a significant positive relationship between the phytophagous and predatory mite population, suggesting that the increase in pest mite population would lead to a corresponding increase in predator mite population also on the papaya plants studied. The predatory mite population showed an abundance when the pest mite population flourished in the field, as it ensured ready supply of food. The predator population might be influenced by the biotic and abiotic factors operating in the natural habitat (Sathe and Bhosale, 2001) and it is dependent on various factors like abundance of prey and their hosts, season, climate and ethology of the predator cum prey (David, 1993). When all the above conditions operate in an optimum level, the predatory mite population also would show a tremendous increase. Probably, this would be the reason for the per cent increase observed during the present study in the predatory mite population on the papaya plants examined.

Maximum species diversity was recorded for the predatory mites during the present study when compared to that of the phytophagous species. Although phytophagous mites displayed an increasing trend in population density on papaya plants, a corresponding increase was enjoyed by the predatory mite population also. This suggests that increasing population of pest mites normally would serve to make a ready and abundant supply of food for the predatory mites which in turn would lead to build up their population in a rapid rate. This seems to be encouraging as far as the biocontrol programmes are concerned as it would promote natural suppression of pest mites and maintenance of their general equilibrium position always below the economic injury levels, by the increasing predatory mite population in the field conditions. This definitely would ensure protection to fruit crops like the papaya plants from mite pests under natural conditions.

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