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DIVERSITY OF PHYTOPHAGOUS AND PREDATORY MITES ON MANGROVE AND AGRI-HORTICULTURAL CROPS IN SUNDARBAN BIOSPHERE RESERVE, WEST BENGAL

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INTRODUCTION

Sundarban Biosphere Reserve (SBR) is very rich with at least 36 species of mangrove vegetation of the 55 species of mangrove plants that are known to occur in the world. Besides, during the past 2-3 decades, agricultural horticultural crops have been started growing in different re-claimed areas of SBR which have further added to the vegetational richness of this area. Expectedly, the plant mite fauna w.s.r. to those occurring on mangrove vegetation and diverse types of agri-horticultural crops are also likely to be diverse. Unfortunately, the knowledge about the plant mite faunal wealth of this region is very inadequately explored as appeared from the fact that only 6 species are so far known occurring on mangrove vegetation of that region (Gupta, 1992) and practically nothing is known about the phytophagous and predatory mite fauna occurring on agri-horticultural crops. Hence, with a view to exploring the plant mite faunal diversity of SBR and to study their bio-ecological aspects, this project was taken up and the present paper gives an idea about the Species Richness Index, Species Diversity Index, Index of Dominance, Relative Abundance, based on the observations made at Bamankhali, Sagar Island, during November, 2000 to October, 2001. This is the first such attempt to collect information of this kind on plant mite fauna from SBR and surprisingly such information is rather unavailable from most parts of India.

MATERIALS AND METHODS

The population data pertaining to phytophagous and predatory mites occurring on mangrove vegetation and agri-horticultural crops of SBR was collected from the experimentation station located at Bamankhali in Sagar Island about 100 kms. Southeast of Calcutta. Two species of Mangrove vegetation (*Avicennia alba & Rhizophora mucronata.*) and two types of horticultural crops (*Psidium guajava & Citrus* sp.) were selected. For *A. alba* and *Rhizophora,* 10 and 5 trees respectively were selected and tagged with labels. From each of the *A alba* tree, 10 leaves and from each of the *Rhizophora* tree, 8 leaves of same age and size were plucked and population of phytophagous and predatory mites was counted from the under surface of the whole leaf under stereo binocular microscope and number of each of the species present was recorded. Hence, for *Avicennia alba,* a total of 100 leaves and for *Rhizophora mucronata* 40 leaves were examined.

Likewise, for *Psidium guajava* and *Citrus* sp., 8 and 5 trees respectively were selected and tagged with labels and from each guava tree 10 leaves (total 8 × 10 = 80 leaves) and from each citrus tree 10 leaves (total 5 × 10 = 50 leaves) were plucked and population was counted from under surface of each of the entire leaf. The observation was recorded at monthly interval. The phytophagous and predatory mite fauna collected from each type of tree was identified and respective number of each species was counted.

The data thus collected was used to calculate Relative Abundance (RA) which was assessed following Tamura (1967) season wise for determining the nature and proportion of mite assemblage, Species Diversity Index ($\bar{H}$) was calculated following Shannon & Weaner (1949, 1949a), Index of Dominance(c) was calculated month wise to isolate the favourable and unfavourable months for diversity, Richness Index (d) was calculated following Menthnick (1964). The data towards abiotic factors like temperature, RH and rainfall were collected from Alipore Meteorological Department, Calcutta.

RESULTS AND DISCUSSION

The identification of mite species indicates the presence of 26 species (Table-1) collected during the study period, of those, 15 belonged to predatory group and 11 to phytophagous group.

Table-1. List of the Phytophagous and predatory mites.

No.	Predatory Mites	No.	Phytophagous Mites
1	*Amblyseius largoensis*	16	*Tetranychus urticae*
2	*Amblyseius alstoniae*	17	*Tetranychus neocaledonicus*
3	*Amblyseius fallacis*	18	*Schizotetranychus* sp.
4	*Amblyseius multidentatus*	19	*Tetranychus* sp.
5	*Amblyseius pruni*	20	*Schizotetranychus hindustanicus*
6	*Amblyseius coccineae*	21	*Eutetranychus orientalis*
7	*Amblyseius ovalis*	22	*Eotetranychus hicoriae*
8	*Iphiseius andamanicus*	23	*Brevipalpus phoenicis*
9	*Phytoseius macropilis*	24	*Brevipalpus essigi*
10	*Phytoseius indicus*	25	*Tenuipalpus* sp.
11	*Typhlodromus communis*	26	*Phyllocoptruta oleirvora*
12	*Phytoseius kapuri*		
13	*Pronematus fleschneri*		
14	*Parapronematus* sp.		
15	*Tydeus* sp.		

The Relative Abundance (RA) : The Table 3, indicates that the most abundant species was *Amblyseius largoensis* (Muma) and *Amblyseius pruni* Gupta among predatory mites while among phytophagous mites, *Tetranychus* sp. *Schizotetranychus hindustanicus* (Hirst) and *Eotetranychus hicoriae* (McGregor), on all the plants in post monsoon period. During premonsoon period, the most dominant species were *Amblyseius largoensis, Amblyseius multidentatus* (Swirski & Shechter), *Amblyseius pruni, Amblyseius coccineae* Gupta, among predatory group and *Schizotetranychus hindustanicus* and *Eotetranychus hicoriae* among the phytophagous group. The dominant predatory and phytophagous species during monsoon months were *Amblyseius largoensis, Amblyseius alstoniae* Gupta, *Amblyseius pruni, Amblyseius coccineae* in the former group and *Schizotetranychus hindustanicus* and *Eotetranychus hicoriae* in the latter group. The remaining species, as per their frequency of occurrence, belonged to subdominant or rare category.

While studying the occurrence of different mite species in different groups of plants (Table–2), it was found that predatory mites like *Amblyseius largoensis, Amblyseius pruni, Pronematus fleschneri* Baker and phytophagous mites like *Tetranychus urticae* Koch, *Brevipalpus phoenicis* (Geijskes) were dominant on *Avicennia alba* during postmonsoon period, *Amblyseius alstoniae, Amblyseius fallacis* (Garman), *Amblyseius coccineae* and *Tetranychus neocaledonicus* Andre were sub dominant on the same host while the occurrence of other species was rare.

During premonsoon period, *Amblyseius largoensis, Amblyseius alstoniae, Amblyseius multidentatus, Amblyseius pruni, Amblyseius coccineae, Amblyseius fallacis* (among predatory mites) and *Tetranychus urticae, Tetranychus neocaledonicus* (among phytophagous group) were dominant. During monsoon period, the predatory mites like *Amblyseius pruni* and *Amblyseius coccineae,* were dominant and phytophagous species like *Tetranychus neocaledonicus, Tetranychus urticae* and *Schizotetranychus* sp. were subdominant.

In case of *Rhizophora mucronata, Amblyseius largoensis, Amblyseius pruni, Amblyseius coccineae* and *Pronematus flesehneri* among predatory group and *Brevipalpus phoenicis,* among phytophagous group were found dominant during post monsoon period; while during premonsoon period, predatory mites. *Amblyseius largoensis, Amblyseius pruni, Amblyseius coccineae,* and among phytophagous group, *Tetranychus urticae, Brevipalpus phoenicis, Brevipalpus essigi* Baker were dominant. The dominant species during monsoon period on the same host were *Amblyseius largoensis, Amblyseius multidentatus, Amblyseius pruni* and *Amblyseius coccineae.* The occurrence of phytophagous species during that period was rare.

In case of *Citrus* sp., as usually, the dominant species were *Amblyseius largoensis* among predatory species and *Schizotetranychus hindustanicus,* and *Eutetranychus orientalis* (Klein) among phytophagous mites were dominant in post monsoon period. During premonsoon period, the dominant species were *Amblyseius largoensis, Amblyseius pruni, Amblyseius coccineae,* among the predatory mites and *Schizoteranychus hindustanicus* and *Eutetranychus orientalis* among the phytophagous group were found dominant. Finally, during monsoon period, *Amblyseius largoensis, Amblyseius pruni, Amblyseius coccineae, Pronematus fleschneri,* and *Tydeus* sp. among the predatory

Table-2. Relative Abundance of mite fauna in different plants (RA).

	Post monsoon				Pre monsoon				Monsoon			
	A.. alba	*Rhizophora* Sp.	*Citrus* sp.	*Guava*	*A.. alba*	*Rhizophora* sp	*Citrus* sp.	*Guava*	*A.. alba*	*Rhizophora* sp	*Citrus* sp.	*Guava*
1	**44.36**	**37.5**	**7.37**	**5.29**	**35.50**	**33.75**	**12.16**	0	4.41	**44.77**	**6.80**	**19.64**
2	4.77	0	3.27	0	**11.01**	0	0	0	**29.04**	0	0	0
3	3.41	0	0	0	**12.80**	0	0	0	0	0.232	0	0
4	1.02	1.47	0	0	**6.29**	2.50	2.28	**12.5**	0	**9.28**	0	**7.54**
5	**10.23**	**20.58**	4.91	4.85	**6.51**	**14.58**	**18.25**	**20.90**	**6.01**	**16.93**	**7.14**	**16.84**
6	3.75	**16.91**	0.819	2.57	**7.86**	**18.75**	**15.58**	**31.46**	**6.43**	**19.25**	**8.84**	**20.17**
7	1.70	0	0	0	2.69	0	0	0	1.65	0	0	0
8	0	0	0	0	0.674	0	0	0	0	0	0	0
9	0	0	0	0	0.898	0	0	0	0	4.17	0	0
10	0	0	0	0	0.674	0.833	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0.207	0	0	0
12	0	0	0	0	0	0.416	0	0	0	0.696	0	0
13	**6.82**	**5.14**	2.04	0	0.674	1.66	0	0	0	1.16	**5.10**	0
14	0.682	4.41	0	0	0	0	2.66	0	0	1.16	0	0
15	0	0	0	0	0	0	0	0	0	0	**11.90**	0
16	**9.89**	3.67	0	0	**7.19**	**10.83**	0	0	4.14	0.696	0	0
17	3.75	2.94	0	0	**6.51**	2.50	0	0	4.14	0	0	0
18	0	0	0	0	0	0	0	0	**4.14**	0	0	0
19	0	0	0	**17.98**	0	0.416	0	**12.50**	0	0	0	**15.43**
20	0	0	**64.75**	0	0	0	**37.64**	0	0	0	**37.07**	0
21	0	0	**13.93**	0	0	0	**11.02**	0	0	0	**23.12**	0
22	0	0	0	**6.91**	0	0	0	**21.55**	0	0	0	**20.35**
23	**5.11**	**7.35**	2.86	0	0.674	**7.08**	0.380	0	0	1.62	0	0
24	2.73	0	0	0.151	0	**6.66**	0	1.07	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0		0	0	0	0	0

Species name 1 to 26 are listed in the Table-1. R. A. Value > 5 = Dominant species. O. A. Value 2 to 5 = Subdominant. R. A. Value > 2 = Rare.

Table-3. Showing Relative Abundance against total mite population in three different periods.

Sp. Name	Post monsoon		Premonsoon		Monsson	
	total mite population	Relative Abundance (%)	Total mite population	Relative Abundance (%)	Total mite population	Relative Abundance (%)
1	268	**15.56**	271	**19.19**	538	**30.27**
2	**22**	1.11	49	3.47	140	**7.87**
3	10	0.506	57	4.03	1	0.056
4	5	0.253	98	**6.94**	83	4.67
5	134	**6.78**	209	**14.80**	219	**12.32**
6	70	3.54	267	**18.90**	255	**14.35**
7	5	0.253	12	0.849	8	4.50
8	0	0	3	0.212	0	0
9	0	0	4	0.283	18	1.01
10	0	0	5	0.354	0	0
11	0	0	0	0	1	0.056
12	0	0	1	0.070	3	0.168
13	**32**	1.61	7	0.495	20	1.12
14	8	0.404	7	0.495	5	0.281
15	0	0	0	0	35	1.96
16	34	1.72	58	4.10	23	1.29
17	15	0.759	35	2.47	20	1.12
18	0	0	0	0	20	1.12
19	237	**11.99**	59	4.17	88	4.95
20	158	**7.99**	99	**7.01**	109	**6.13**
21	34	1.72	29	2.05	68	3.82
22	912	**46.15**	100	**7.08**	116	**6.52**
23	22	1.11	21	1.48	7	0.393
24	10	0.506	21	1.48	0	0
25	0	0	0	0	0	0
26	0	0	0	0	0	0

Species name 1 to 26 are listed in the Table-1.

R. A. Vaue > 5 = Dominant species.

R. A. Value 2 to 5 = Sub dominant.

R. A. Value > 2 = Rare species.

mites and *Schizotetranychus hindustanicus* and *Eutetranychus orientalis* among the phytophagous group were found dominant. The other species were sub dominant or rare (Table 3).

In case of Guava (*Psidium guajava*), the most abundant species were *Amblyseius largoensis* and *Tetranychus* sp., during post monsoon period. In premonsoon period, *Amblyseius pruni, Amblyseius coccineae, Amblyseius multidentatus* among the predatory mites and *Tetranychus* sp. and *Eotetranychus hicoriae* among phytophagous mites were dominant. Almost the similar trend in population prevailed during monsoon period excepting the addition of *Amblyseius largoensis* as one of the dominant predatory species.

Species Diversity Index (H) : Table-4 indicates that in *Avicennia alba,* the maximum species diversity index (1.826) was found in March, 2001 and minimum (1.127) was in October, 2001. In case of *Citrus* sp and guava, the highest values 1.491 on *Citrus* and 1.637 on guava were found in April, 2001 and their respective lowest values were 0.470 and 0.582 were during January, 2001. In *Rhizophora,* the highest diversity value (1.972) and lowest (1.072) were seen during March, 2001 and January, 2001 respectively.

The Index of dominance (c) : Table-5 indicates that the index of dominance values were different in four different plants chosen for this study. In *Avicennia alba,* the maximum (c) value (0.388) was found in January, 2001 and minimum (0.173) was in March, 2001. In *Rhizophora mucronata,* the highest (c) value (0.407) was seen in October, 2001 and lowest (0.145) seen in February, 2001. In *Citrus,* the highest was in January, 2001 (0.764) and lowest (0.120) was in February, 2001. Finally, on guava, the highest (0.663) and lowest (0.211) were found in January and April, 2001 respectively.

Species Richness Index (d) : Table-6 gives the values of species richness index in four species of plants studied. In *Avicennia alba,* the highest value (1.152) was in November, 2000 and lowest (0.363) was in August and September, 2001. In *Rhizophora,* the highest value (1.077) was in December, 2000 and lowest (0.383) was in October, 2001. In *Citrus,* highest (0.639) and lowest (0.384) were seen in April and in September, 2001, respectively while on guava, the highest (0.532) and lowest (0.011) were found in April, 2001 and December, 2000 respectively.

DISCUSSION

From the data presented in Tables 2-6, it is evident that the species diversity is not uniform in all the four plants on which study was conducted. It also appeared that the dominant pest species on guava were *Tetranychus* sp. and *Eotetranychus hicoriae* and on *Citrus* the dominant pests were *Eutetranychus orientalis* and *Schizotetranychus hindustanicus*. Surprisingly, both the mangrove plants were relatively free from phytophagous species though harboured a reasonably good number of predatory species. The overall predatory species which were found dominant during the entire study period on all the four types of plants were *Amblyseius largoensis, Amblyseius pruni, Amblyseius coccineae* and *Amblyseius multidentatus.* This pioneer study attempted to find out the incidence of

Table-4. Species Diversity Index ($\bar{H}$).

Plant species	Nov. 2000	Dec. 2000	Jan. 2001	Feb. 2001	Mar. 2001	Apr. 2001	May 2001	June 2001	Jul. 2001	Aug. 2001	Sept. 2001	Oct. 2001
Avicennia alba.	1.428	1.760	1.146	1.489	**1.826 (H)**	1.761	1.578	1.330	1.129	1.277	1.355	**1.127 (L)**
Rhizophora mucronata	1.492	1.627	**1.072 (L)**	1.557	**1.972 (H)**	1.452	1.502	1.566	1.448	1.445	1.245	1.207
Citrus sp.	0.797	0.815	**0.470 (L)**	1.346	0.792	**1.491 (H)**	0.885	1.189	1.079	1.237	1.049	1.290
Guava	0.894	0.934	**0.582 (L)**	0.951	1.354	**1.637 (H)**	1.067	1.277	1.355	1.091	**1.446**	1.193

H = highest value and **L** = lowest value.

Table-5. Index of Dominance (c).

Plant species	Nov. 2000	Dec. 2000	Jan. 2001	Feb. 2001	Mar. 2001	Apr. 2001	May 2001	June 2001	Jul. 2001	Aug. 2001	Sept. 2001	Oct. 2001
Avicennia alba.	0.178	0.206	**0.388 (H)**	0.338	**0.173 (L)**	0.211	0.192	0.334	0.378	0.254	0.262	0.370
Rhizophora mucronata	0.271	0.222	0.345	**0.145 (L)**	0.147	0.267	0.497	0.250	0.286	0.263	0.328	**0.407 (H)**
Citrus sp.	0.637	0.461	**0.764 (H)**	**0.120 (L)**	0.474	0.260	0.449	0.340	0.345	0.332	0.394	0.345
Guava	0.484	0.456	**0.663 (H)**	0.438	0.262	**0.211 (L)**	0.352	0.410	0.262	0.336	0.268	0.339

H = Highest value and **L** = Lowest value.

Table-6. Species Richness Index (d).

Plant species	Nov. 2000	Dec. 2000	Jan. 2001	Feb. 2001	Mar. 2001	Apr. 2001	May 2001	June 2001	Jul. 2001	Aug. 2001	Sept. 2001	Oct. 2001
Avicennia alba.	**1.152 (H)**	0.773	0.676	0.858	0.721	0.769	0.514	0.679	0.458	**0.363 (L)**	**0.363 (L)**	0.454
Rhizophora mucronata	0.832	**1.077 (H)**	1.133	0.935	0.878	0.848	0.927	0.848	0.635	0.689	0.601	**0.383 (L)**
Citrus sp.	0.485	0.547	0.625	0.650	0.600	**0.639 (H)**	0.462	0.384	0.437	0.488	**0.384 (L)**	0.589
Guava	0.021	**0.011 (L)**	0.159	0.232	0.436	**0.532 (H)**	0.279	0.340	0.428	0.325	0.338	0.298

H = Highest value and **L** = Lowest value.

different mites on mangrove and agri-horticultural crops. Unless this study is carried out for a longer period and the indication in population trend is confirmed, no definite conclusion can be arrived at this stage. The role of abiotic factors on the mite population will be dealt with in a separate paper.

SUMMARY

The present paper discusses the Relative Abundance (RA) of phytophagous and predatory mite species on two each of mangrove plants, viz. *Avicennia alba* and *Rhizophora mucronata* and two each of fruit trees, viz. guava and citrus in Sundarban Biosphere Reserve during November, 2000-October, 2001 (post monsoon, premonsoon and monsoon periods) along with discussing their Richness Index (d), Species Diversity Index ($\bar{H}$) and Index of Dominance (c).

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