International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 01-06-2021, Accepted: 16-06-2021, Published: 02-07-2021
Volume 6, Issue 4, 2021, Page No. 06-10

Spider diversity in mulberry cultivation in Kanchipuram district, Tamil Nadu, India

Azhagu Raj R[1, 2*], Cijomol PJ[2], Maruthirajan A[2], Stephenraj D[3], Muthukumar S[4]
[1] Department of Zoology, St. Xavier's College (Autonomous), Palayamkottai, Tamil Nadu, India
[2] Department of Zoology, Pachaiyappa's College for Men, Kanchipuram, Tamil Nadu, India
[3] Department of Zoology, St. John's College, Palayamkottai, Tamil Nadu, India
[4] Department of Zoology, Avvaiyar Government College for Women, Karaikal, Puducherry, India

Abstract
Mulberry leaves are the most preferable food for the silkworm. Spiders are arthropods called arachnids. Spiders are predaceous arachnids with insects constituting their primary prey. They are the abundant natural enemies in any agro-ecosystem and found in most terrestrial habitats and often present in high numbers. In the present study, spider diversity was assessed by using various sampling methods such as Semi-quantitative sampling, Ground collection, and Hand-picking methods. Species diversity indices were calculated. The results reveal that a totally nine families of spiders were recorded from the mulberry plantation in Kanchipuram District. The dominant families found during the study are Salticidae, and Araneidae. Eleven genera and fourteen species were recorded from the study area which accounts for 2.51% & 0.83%.Fourteen species of spiders were recorded during the study which is the highest number in Mulberry Cultivation. Shannon-Weiner index- H' of spider diversity in mulberry cultivation in the ranges (H') from 2.1510 to 2.3580 and Species evenness (J') in mulberry cultivation from 0.9789 to 0.9833. The spider diversity in mulberry cultivation in its varying due to various climatic conditions, mulberry varieties and availability of prey species etc.

Keywords: species diversity, arachnids**,** salticidae, mulberry, and *Neoscona* sp

Introduction
Spiders are arthropods called arachnids. They belong to the order Araneae is a large group of animals which is commonly called spiders. Spiders are the largest groups of arachnids comprising more than 30,000 species distributed over 60 families worldwide (Sebastin and Peter, 2009; Palem *et al*. 2017) [13, 7]. Mulberry leaves are the most preferable food for the silkworm *Bombyx mori*. Mulberry leaves contain a high amount of primary and secondary metabolites, macromolecules, high content of proteins and essential minerals for the growth of silkworm.
Mulberry fresh leaves harvested daily and directly feed to silkworms both morning and night-time for the length of thirty to forty-five days. In the mulberry plantation the small and medium scale farmers they are not using any pesticides or insecticides or fungicides in the study area. In the cultivated mulberry ecosystem the pest/ insect species, insect vectors efficiently controlled by mostly spiders followed by wasps and other predators.
Arachnids are carnivorous creatures feeding on insects and small arachnids which are most abundant and ecologically important in almost every terrestrial and semi- terrestrial habitat, cold from tundra and alpine ecosystem to tropical rain forests and deserts. Spiders occupy an important part of the overall predatory arthropod fauna in different terrestrial ecosystem/ Spiders are clearly an integral part of global biodiversity since they play many important roles in the ecosystem as predator's important role in the food chain of the ecosystem (Sebastin and Peter, 2009; Palem *et al*. 2017) [13, 7]. Arachnids are an important but generally poorly studied group of arthropods that play a significant role in the regulation of insect and other invertebrate populations in most ecosystems (Russell-Smith, 1999) [9]. Spiders, which globally include about 40, 700 described species (Platnick, 2008). Tikader (1987) [17] also published the first comprehensive list of Indian spiders, which included 1067 species belonging to 249 genera in 43 families. Palem *et al*. (2017) [7] reported the spider diversity in Sri Lankamala wildlife Sanctuary (19), Rapur Ghat forest (25), Pallakondalu (31), and, Seshachalam Biosphere Reserve forest (41) spider family. There is no hitherto report on spider diversity in Kanchipuram district. The present study is to document the spider's diversity, density, species richness and evenness in the Mulberry cultivation at Kanchipuram District, Tamil Nadu, India

Materials and Methods
Study area
Kanchipuram district is situated on the northern East Coast of Tamil Nadu and is adjacent by Bay of Bengal. It lies between 11° 00' to 12° 00' North latitudes and 77° 28' to 78° 50' East longitudes. In Kanchipuram district the small and medium scale farmers they cultivate the mulberry plantation. The following five villages (Purasi, Purasi (West), Leppaikhanpuram, Kaikatoor, Vengudi (A), and Vengudi (B) and eight sites were selected for this spider diversity study.

Sampling technique
To measure the diversity spiders and abundance during the Month of January& February 2015 at different places by following the Semi-quantitative sampling, Ground collection, and Hand picking method (Sebastin and Peter 2009) [13].

Identification of spiders

The collected spiders were identified up to the species with the help of available literature (Tikader, 1987). All the spiders species were identified and confirmed by Dr. P. A. Sebastein, Sacard heart College, Cochin, Kerala, India.

Diversity Indices

The computer Programme PRIMER-E (ver. 6.1.7) (Plymouth Routines in Multivariate Ecological Research), was used for univariate and multivariate analyses of data (Clarke and Warwick, 2001) [2]. Shannon's diversity index, evenness index, and Margalef's richness index (program DIVERSE) and dominance curves were calculated. The similarity, using the Braye Curtis index, and an aggregation (program CLUSTER) and ordination analysis (program MDS) were made, using quantitative and qualitative data with transformation of square root (Clarke and Warwick, 2001) [2].

Results and Discussion

The present study is an attempt to identify the spider fauna commonly noticed in the mulberry cultivation in Kanchipuram District, Tamilnadu, India. During the study, species were recorded, belonging to 09 families that represent 15% of the total families reported from India spider diversity in mulberry cultivation in Kanchipuram is high compare to other places India (Figures1to8). In this study, spider family Araenidae and Salticidae was dominated.

The most abundant spider species was *Neoscona mukerjei*, followed by *Argiope pulchella*, *Oxyopes javanus*, *Hippasa* sp, and *Telamonia dimidiata etc*. In this field study, the total of 09 families, 11 genera and 14 species of spiders were recorded (Table 1.) The spider family diversity are Araenidae (02 species) and Salticidae (02 species) Tetragnathidae (01species), Oxypidae (01 species), Sparrasidae (1 species) Lycosidae (3 species), Uloboridae (1species), Clubionidae (1species) and Selenopidae (1species) were recorded (Table 1; Plate 1-3).

Table 1: Identified spider's species in mulberry cultivation in Kanchipuram district, Tamil Nadu

S. No	Family	Species	Natural History
1	Araneidae , Clerck, 1757	*Neoscona mukerjei* Tikader, 1980 *Argiope pulchella* Thorell, 1881	Orb web spider
2	Salticidae, Blackwall, 1841	*Telamonia dimidiata* (Simon, 1899) *Carrhotus viduus* (C. L. Koch, 1846)	Jumping spider
3	Tetragnathidae, Menge, 1866	*Tetragnatha* sp.	Orb Web Spider/ Long jawed spiders
4	Oxyopidae, Thorell, 1870	*Oxyopes javanus* Thorell, 1887 *Oxyopes birmanicus* Thorell, 1887	Plant Dwelling Spider
5	Sparassidae, Bertkau, 1872	*Olios milleti* (Pocock, 1901)	Wandering spiders / Plant Dwelling Spider
6	Lycosidae , Sundevall, 1833	*Hippasa* sp.	Bark Spider/ Ground Hunter
7	Uloboridae, Thorell, 1869	*Uloborus* sp.	Orb web spider
8	Clubionidae Wagner, 1887	*Clubiona drassodes* O.P.Cambridge, 1874	Orb web spider
9	Selenopidae Simon, 1897	*Selenops* sp.	Wall crab spider

In India, the total of 377 genera, 1520 spider species (Sebastian and Peter 2009) [13] from which 11 genera, 14 spider species were recorded in this study. This record is low compared with other ecosystems (Tikader, 1970, 1977; Tikader & Biswas, 1981) [15, 16, 41].

The species diversity (Shannon-Weiner index- H'), Species richness (d) and species evenness (Pielous evenness-J) were calculated (Table.2&3). Shannon-Weiner index- H' of spider diversity in mulberry cultivation (total 8 sites) in the month of January ranges(H') from 2.1510 to 2.3580; in the month of February (H') ranges from 2.0222 to 2.4671. The Fisher- α diversity in the month of January and February varied from 10.9388 to 24.5450; 9.4810 to 50.0585 respectively; species richness(D) in the month of January and February varied from 3.0784 to 3.8018; 3.2442 to 4.2191 respectively. Species evenness (J') in mulberry cultivation (total 8 sites) in the month of January and February from 0.9789 to 0.9833; 0.9726 to 0.9918 respectively (Table 2&3).

Table 2: Univariate Diversity indices for Spiders Diversity in mulberry ecosystem Kanchipuram (January)

Sampling Sites	N	d	J'	Brillouin	Fisher	H'(loge)	1-Lambda'
Site 1	13.87832	3.801808	0.983368	1.650841	24.54505	2.358012	0.971344
Site 2	13.44683	3.078411	0.978966	1.574825	11.90989	2.151007	0.948897
Site 3	15.97809	3.247669	0.978924	1.700383	11.44153	2.254056	0.949767
Site 4	14.93828	3.328492	0.975339	1.601871	13.23871	2.245802	0.951676
Site 5	12.5286	3.16454	0.980449	1.574825	14.31427	2.154267	0.955196
Site 6	11.87832	3.232696	0.981488	1.492314	16.93338	2.156549	0.960363
Site 7	15.69213	3.268972	0.979153	1.743704	11.87137	2.254583	0.950953
Site 8	16.35045	3.220894	0.980734	1.657061	10.93881	2.258222	0.949601

Table 3: Univariate Diversity indices for Spiders Diversity in mulberry ecosystem Kanchipuram (February)

Sampling sites	N	d	J'	Brillouin	Fisher	H'(loge)	1-Lambda'	N21'
S1	13.56048	4.219151	0.991872	1.749862	50.05855	2.46471	0.985677	0.975171
S2	15.21076	4.041142	0.983734	1.767532	26.26788	2.444488	0.973217	0.951812
S3	12.56387	2.765896	0.972605	1.521506	9.48109	2.022476	0.935052	0.941746
S4	16.08907	3.59953	0.987133	1.743704	15.32581	2.367042	0.963295	0.967777
S5	14.43879	3.745433	0.988534	1.650841	21.09545	2.370401	0.97134	0.971371

S6	14.29253	3.75977	0.984622	1.650841	21.8831	2.361021	0.969958	0.959596
S7	16.02458	3.244268	0.988151	1.657061	11.37543	2.275301	0.954414	0.974777
S8	16.26722	3.585319	0.991628	1.743704	14.91721	2.377821	0.964838	0.979913

The K- dominance plot drawn clearly demonstrated the diversity pattern of spiders in mulberry cultivation at eight sites. Conforming to the trend observed in diversity indices, curves of sites 1, 2, 3 and 7 which lies on the lower side extends further and rises slowly due to the presence of more number of species. As the percentage contribution of each species is added, the curve extends horizontally (species number is evident in the X- axis) before reaching the cumulative 100%. As the curve for the site 8 had to accommodate less number of species, it rises quickly. This plot also amply proved the rich diversity in the stations 1, 2, 3 and 7 compared to station 6&8 **(**Figure 1&2).

Geometric class plots are essentially frequency polygons, plotted for each sites. It has been recommended that impact on assemblages tends to transform the form of this division, lengthening the right tail. The geometric classes (1.0, 2.0 and 3.0) for sites 1-8 were represented in the figures (3&4).Besides this, to study the similarity/dissimilarity, (D1 Euclidean Distance) the data (Squre root) of spiders composition was also approached to cluster analysis. Among the spider species, *Hippasa* sp1; *Hippasa* sp2*;* and *Hippasa* sp3 at the highest level of similarity followed by *Oxyopes javanus; Oxypes birmani; Neoscana mukerjei* and *Argiope pulchella*. Further, cluster of *Oxyopes javanus; Oxypes birmani; Neoscana mukerjei* and *Argiope pulchella* were formed a single cluster at the next level of similarity and cluster of *Hippasa* sp1*; Hippasa* sp2 and *Hippasa* sp3 grouped successively to this at the next level similarity. Cluster analysis (or classification) is helpful in finding natural groupings of samples, such that samples within a group are more similar to each other than the samples in different groups. The K- dominance plot drawn clearly demonstrated the diversity pattern in eight site. Conforming to the trend observed in diversity indices, curves of site 1,2,3,6 and 7 which lies on the lower side extends further and rises slowly due to the presence of more number of species. As the percentage contribution of each species is added, the curve extends horizontally (species number is evident in the X- axis) before reaching the cumulative 100%. Study on spiders is completely untouched in Kanchipuram, Tamilnadu, India. Thus the study is the baseline information over the checklist of spider species. Structurally more complex herbs and shrubs can support a more diverse spider community (Uetz, 1991) [18]. The study will also help to work for the Integrated pest management (IPM), biodiversity assessments and conservation of the species and specify the hidden benefits in them. Araenidas, Oxyopids, Salticides, Uloborids, Tetragnathids etc., are some of expert silent predators in the tea and paddy ecosystems that are seen feeding on small insects like moths, butterflies, beetles, aphids, hoppers etc**.** (Rypstra and Carter 1995) [10]. They are maintaining ecological equilibrium by suppressing insect pest (Hazarika, and Chakraborti, 1998).

The list of spiders observed in the mulberry cultivation at eight different locations during the present survey is given in table 1. The predatory efficiency of these spiders on insects and their possible role in the insect pest management in mulberry cultivation are highlighted here under. Predatory spiders, *Oxyopes satrae* Tikader, *O. shweta* Tikader, *Neoscona* sp. and *Plexippus paykulli* in pigeon pea ecosystem kept control over the common insect pest, *Helicoverpa armigera* (Hubner) (Borah and Dutta, 2003) [1]. Dharmaraj *et al*. (2017) [5] reported that, the diversity and distribution of spiders in the forest area of the Nigiris. A total of 40 species of spiders belonging to 36 genera and 11 families were recorded in Tamilnadu. In rice ecosystem spider population exhibited positive correlation with that of insect pests and limited the exponential growth of the pest population (Jeyakumar and Sankari, 2010) [12]. Similarly, in brinjal and snake gourd fields' spiders were effective in stabilizing insect pest population and their population showed slightly higher density in pesticide free area than in frequently pesticide used area (Sankari and Thiyagesan, 2010 and Isaiarasu *et al*., 2011) [12, 4]. As mulberry is perennial producing luxuriant foliage, it attracts various insect and non-insect pests. It has been observed that the population dynamics of some of these pests on mulberry show a positive correlation with its natural enemies including spiders (Samuthiravelu *et al*., 2010) [11].

Conclusion

In this study, nine families of spiders were recorded from mulberry fields in Kanchipuram District; this represents 15% of the total families recorded so far from India. The dominant families found during the study are Salticidae, and Araneidae. Eleven genera and fourteen species were recorded from the study area which accounts for 2.51% & 0.83% of the total genera and species found in India. Fourteen species of spiders were recorded during the study which is the highest number in Mulberry Cultivation. This represents 0.83 % of the total spider species in the country. Five species are found to be probably new but were identified only up to genus level.

Acknowledgment

We sincerely, thank Dr. P.A. Sebastin, Professor, Department of Zoology, Sacred Heart College, Cochin, Kerala, India, for his consent support for identification of Spiders.

Conflict of interest

The authors declare that they have no conflict of interest.

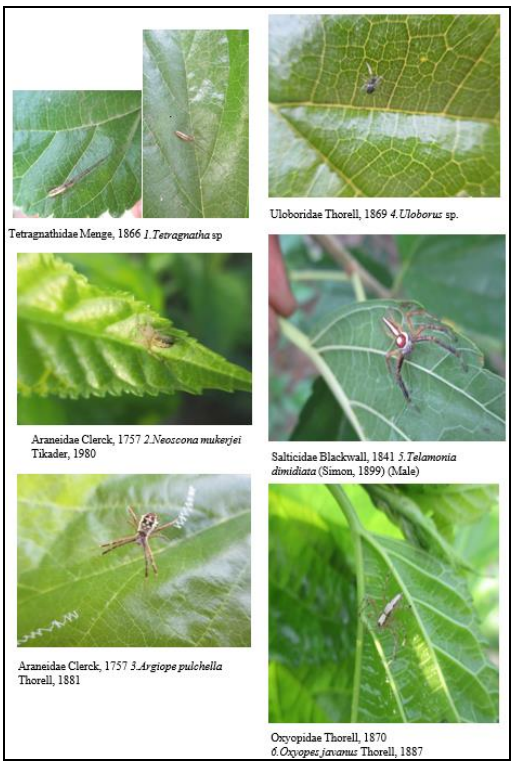

Plate 1: Identified Spiders species in mulberry cultivation in Kanchipuram district, Tamil Nadu

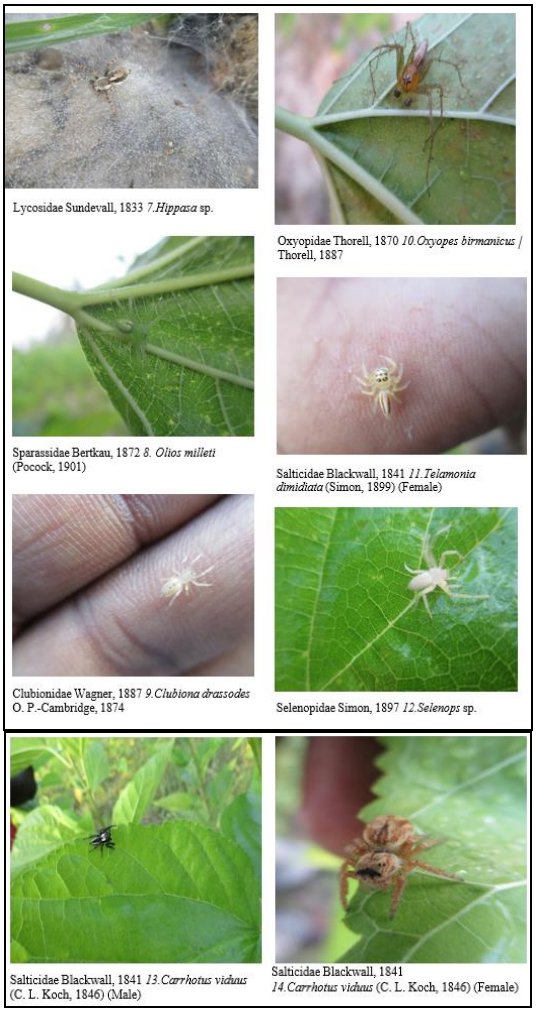

Plate 2: Identified spiders species in mulberry cultivation in Kanchipuram district, Tamil Nadu

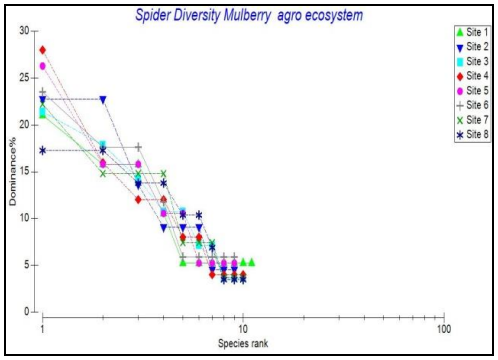

Fig 1: Dominance Plot (k-dominance) for Spiders Diversity in mulberry ecosystem

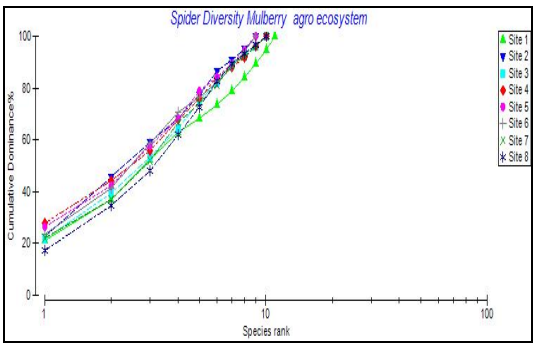

Fig 2: Spiders Diversity Cumulative Dominance (%) in mulberry ecosystem

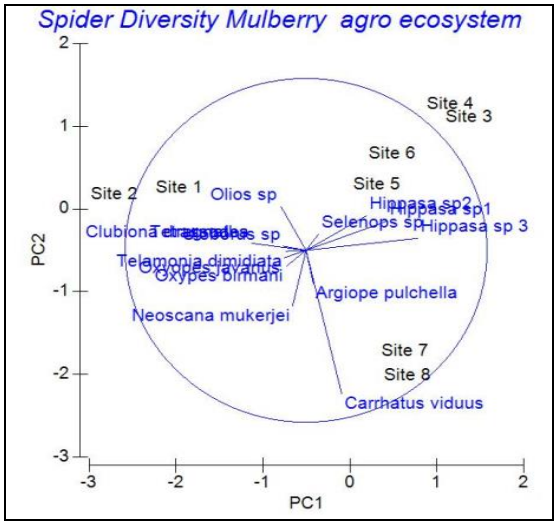

Fig 3: Spiders Diversity principal component analysis (Between sites and Spiders) in mulberry ecosystem.

Reference

1. Borah SR, Dutta SK. Predatory spiders of *Helicoverpa armigera* in pigeon pea. *Insect Environment*,2003:9(1):18-20.
2. Clarke KR, Warwick RM. Change in Marine Communities: An Approach to Statistical Analysis and Interpretation. Plymouth Marine Laboratory, Plymouth, UK, 2nd edition: PRIMER-E, Plymouth, UK, 2001, 172pp.
3. Hazarika LK, Chakrabarti SK. Spider complex of tea ecosystem in Assam, Res. Bull. AAU/DA/EI. Assam Agriculture University, Jor-hat. Hazarika, R. and Gupta, A. K. Resource Sharing by Hoolock Gibbon (Bunopithecus hoolock) with two primate species in Gibbon Wildlife Sanctuary, Assam, India, 1998.
4. Isaiarasu L, Sakthivel1 N, Ravi kumar J, Jeyaparvathi S. A preliminary report on spiders in mulberry cultivations near Srivilli Puthur, Tamil Nadu, India. Insect Pest Management, A Current Scenario (ed.), Dunston P. Ambrose, Entomology Research Unit, St. Xavier's College, Palayamkottai, India, 2011, 111-113.
5. Jayaraman Dharmaraj, Chinnappan Gunasekaran, Vallavan Rajkumar, Panneerselvam Chinnaraj. Diversity of spiders (Arachnida: Araneae) in Nilgiris, Tamil Nadu. Int. J. Adv. Res. Biol. Sci,2017:4(5):143-147. DOI:http://dx.doi.org/10.22192/ijarbs.2017.04.05.015
6. Jeya kumar S, Sankari A. Spider population and their predatory efficiency in different rice establishment techniques in Aduthurai, Tamilnadu. *Journal of Biopesticides*,2010:3(1):20-27.
7. Palem H, Kanike S, Purushottam VRS Diversity of spider fauna (Arachnida: Araneae) in different ecosystems, Eastern Ghats, Southern Andhra Pradesh, India. S. Asian J. Life Sci,2017:4(2):51-60. DOI | http://dx.doi.org/10.14737/journal.sajls/2016/4.2.51.60
8. Platnick NI. The World Spider Catalog, version 12.0. American Museum of Natural History, 2011. http://research.amnh.org/entomology/spiders/catalog/index.html
9. Russell-Smith A. The spiders of Mkomazi Game reserve. In: Mkomazi: The ecology, biodiversity and conservation of a Tanzanian savanna. Royal

Geographical Society, London, 1999.
10. Rypstra AL, Carter RE. The web spider community of soybean agroecosystems in south-western Ohio. J. Arachnol,1995:23:135-144.
11. Samuthiravelu P, Ravikumar J, Quadri SMH, Hemanthkumar L, Jeyaraj S. Influence of abiotic factors on population dynamics of leaf weber *Diaphania pulverulentalis* and its natural enemies in mulberry. *Journal of Biopesticides*,2010:3(1):37-42.
12. Sankari A, Thiyagesan K. Population and predatory potency of spiders in brinjal and snake guard. *Journal of Biopesticides*,2010:3(1):28-32.
13. Sebestian PA, Peters KV. Spiders of India. University Press Publication, Hyderabad, 2009, 691.
14. Tikader BK, Biswas B. Spider fauna of Calcutta and vicinity: Part I. - Records of Zoo-logical Surveyof India, Occasional Papers,1981:30:1-149.
15. Tikader BK. Spider fauna of Sikkim. - Records of the Zoological Survey of India,1970:64:1-83.
16. Tikader BK. Studies on spider fauna of Andaman and Nicobar islands, Indian Ocean. - Re-cords of Zoological Survey of India,1977:72:153-212.
17. Tikader BK. Handbook of Indian Spiders (Anon, Ed). Zoological Survey of India, Calcutta, 1987, 251.
18. Uetz GW. Habitat structure and spider foraging. In: Bell SS, McCoy ED, Mushinsky HR (eds) Habitat structure: the physical arrangement of objects in space. Chapman and Hall, London,1991, 325-348.