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Faunistic diversity of insect and predatory spiders on tree mulberry in Chikkaballapura and Kolar districts of Karnataka

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Abstract

A study on diversity of insect and predatory spider fauna on tree mulberry was undertaken in tree mulberry gardens of Chikkaballapura and Kolar districts, during July 2017 to January 2018. Totally 55 species of insect fauna belonging to 31 families, under six orders and 21 species of spiders belonging to nine families under order Araneae were associated with tree mulberry. Similarly, 27 species of insect fauna belonging to 17 families, under six orders and 14 species of spiders belonging to seven families under order Araneae were associated with bush mulberry. The Shannon-Weiner diversity indices (H) revealed that, order Lepidoptera (0.137) showed maximum diversity, followed by Araneae (0.131), Coleoptera (0.129), Hemiptera (0.111), Hymenoptera (0.068), Diptera (0.061) and Orthoptera (0.023); whereas in bush mulberry, the members of order Araneae registered greater diversity (0.115), followed by insects belonging to the Orders Coleoptera (0.083) > Lepidoptera (0.081) > Hemiptera (0.043) > Orthoptera (0.039) > Diptera (0.039), in the decreasing order of 'H' value.

Keywords: tree mulberry, insect fauna, predatory spiders, shannon-weiner diversity index

1. Introduction

Mulberry, being an evergreen perennial plant with luxuriant foliage, affords an unlimited source of food, nutrition, space and shelter for a variety of pests, inflicting damage to the plant in varying intensities. So far, over 300 species of insects and non-insects have been reported to cause damage to mulberry from different mulberry growing countries, of which over 50 pests are known to cause considerable loss [1-3]. They infest the crop at different stages, seasons and intensities causing substantial loss to mulberry crop. The morphological factors like thick and tough plant tissues offer mechanical obstruction to feeding and oviposition and the total leaf thickness also affects the occurrence of insect pests [4]. Several workers have reviewed and reported the arthropod fauna. Maki (1916) listed 87 insect and 6 non-insect species injurious to mulberry in Taiwan [5]. Umeya and Omi (1935) listed 118 insect pests on mulberry in Korea [6]. Chu (1936) mentioned 126 species that infest mulberry and their distribution and degree of infestation in China [7]. The mulberry canopy inhabiting arthropod fauna of six natural orders, 25 families, 42 genera and 47 species. A total 15,077 arthropods, of which 10,324 insects and 4,753 mites were encountered from foliage of mulberry from two study sites, where pit system with M₅ and row system with local varieties were cultivated. The sucking insects constituted a total of 6,885 and 1,512 accounting for 82 and 18 per cent of total fauna, in pit and row system respectively [2]. Singh *et al.* (2002) reported *Spilarctia* (= *Spilosoma*) *oblique* Walker, *Glyphodes* (= *Glyphoda*) *pyloalis* Walker and *Mimastra* *cyanura* Hope as pests at RSRS, Dehradun on 10-12 years old tree mulberry plantations causing major damage [8]. As the cultivation of tree mulberry with wider spacing is gaining momentum among farmers due to scarcity of water, labour and other inputs, it was planned to assess the fauna associated with tree mulberry *vis-à-vis* bush mulberry in Chikkaballapura and Kolar Districts of Karnataka during 2017-18.

2. Materials and Methods

Chikkaballapura and Kolar districts were the two clusters selected in order to study the fauna associated with both tree and bush mulberry, wherein five tree mulberry gardens of one year old and above and one bush mulberry garden as a control were identified in each cluster.

The three villages viz., Arekere (one tree garden), Akkimangala (Two tree gardens) and Doddihalli (two tree gardens and one bush garden) in Chikkaballapura and two villages viz., Venugopalapura (three tree gardens and one bush garden) and Hanumantharayanadinne (two tree gardens) in Kolar districts were identified for the study. Each garden was again divided into five sub-plots and four plants were randomly selected in each sub-plot and labelled for recording the observations. Fortnightly field visits were made for collecting the insects and non-insects associated with mulberry in both tree and bush gardens identified in both clusters from July 2017 to January 2018. The insects and predatory spiders were collected from same mulberry trees (20 trees/garden) or bush mulberry (20 plants/garden) which were labelled earlier and the same set of trees or bushes were observed throughout the period of this study. The adult and immature stages of insects and predatory spiders collected as per the standard techniques and got identified from Dr. C. A. Virakthamath, Professor (Emeritus) and Dr. H.M. Yeshwanth, Assistant Professor, All India Network Project on Insect Biosystematics, ICAR Niche Area of Excellence on Taxonomy of Insects and Mites, Department of Agricultural Entomology, UAS, GKVK, Bengaluru, India. The predatory spiders were identified by Dr. P. A. Sebastian, Head and Principal Investigator (DST Project), Division of Arachnology, Department of Zoology, Sacred Heart College, Thevara, Kochi, Kerala, India.

2.1 Shannon-weiner diversity index (H)

The Shannon-Weiner index (H) is a popular diversity index in the ecological studies where it is known as Shannon's diversity index, the Shannon-Wiener index, the Shannon-Weaver index and the Shannon entropy. The 'H' quantifies the uncertainty (entropy or degree of surprise) associated with this prediction. It was calculated as follows:

$$H = - \sum_{i=1}^R p_i \ln p_i$$

Where, p_i is often the proportion of individuals belonging to the i^{th} species in the dataset of interest, H is the Shannon index.

3. Results and Discussion

3.1 Comparative occurrence of insect fauna on tree and bush mulberry

Totally 62 species of insect fauna belonging to 38 families under six orders were recorded during July 2017 to January 2018, of which 55 species belonging to 31 families were found to occur on tree mulberry, whereas 27 species belonging to 17 families were associated with bush mulberry, which clearly indicated that greater number of fauna occurred on tree mulberry than bush mulberry. Out of 62 species of insect fauna recorded, 21 species, belonging to six families, were found to occur both on tree and bush mulberry (Table 1). Sidhu *et al.* (1966) reported 13 species^[9], Rangaswamy *et al.* (1976) reported 30 species^[10], Kotikal (1982) reported 62 insect species and four non-insect pests^[1] and Nagappa Biradar (1989) have reported 47 species on the foliage of bush mulberry^[2].

3.2 Comparative occurrence of predatory spider fauna on tree and bush mulberry

Totally 25 species of predatory spiders belonging to the 11 families of Araneae were recorded during the investigation,

out of which 21 species belonging to nine families were recorded on tree mulberry and 14 species belonging to seven families were recorded on bush mulberry. Out of 25 species of predatory spiders that were recorded, nine species belonging to the five families were relatively found on both tree and bush mulberry (Table 2). Tree mulberry registered greater number of predatory spider species (21) than bush mulberry (14), since food availability for spiders in the form of greater abundance of insect fauna is available in tree mulberry as compared to bush mulberry.

3.3 Shannon-weiner diversity indices (H) for different orders of insect and predatory spider fauna

The results revealed that as for insect and predatory spider as the orders are concerned, the diversity index (H) was higher for tree mulberry as compared to bush mulberry in Lepidoptera (0.137>0.083), similarly in the other orders also 'H' value was higher for tree mulberry compared to bush mulberry, *i.e.*, Hemiptera (0.111>0.043), Coleoptera (0.129>0.073), Hymenoptera (0.068>0.019), Diptera (0.061>0.039) and Araneae (0.131>0.080). However, for order Orthoptera, the 'H' value was greater for bush mulberry (0.039) as compared to tree mulberry (0.023). In tree mulberry, the highest diversity index (H) was registered in case of order Lepidoptera (0.137), followed by Araneae (0.131) > Coleoptera (0.129) > Hemiptera (0.111) > Hymenoptera (0.068) > Diptera (0.061) > Orthoptera (0.023) in that decreasing order of 'H' value. However, in case of bush mulberry, the highest diversity index was recorded in case of order Lepidoptera (0.083), followed by Araneae (0.080), Coleoptera (0.073) > Hemiptera (0.043) > Orthoptera and Diptera (0.039 each) > Hymenoptera (0.019) in that decreasing order of 'H' value (Table 3). Similar results were also reported earlier by Rosina Kyerematen *et al.* (2014), regarding to species composition and diversity of insects in Kogyae Strict Nature Reserve, Ghana, West Africa, wherein the Lepidopterans were found to be most abundant as compared to other orders. In the present findings also, Shannon-Weiner diversity index (H) was maximum for Lepidoptera in case of tree mulberry (Fig. 1 and 2), which was in concurrence with the findings of Rosina Kyerematen *et al.* (2014). However, in the present study with respect to bush mulberry Araneae registered the highest H value, followed by Coleoptera and Lepidoptera and these findings do not agree with the earlier reports of Rosina Kyerematen *et al.* (2014).

3.4 Shannon-Weiner Diversity Index (H) for different families of insect and predatory spider family on tree mulberry

Among Lepidopterans the diversity index (H) was recorded to be highest in family Erebidae (0.342), followed by Pyralidae (0.298) > Psychidae (0.004) in that decreasing order. The diversity index (H) among Hemiptera was highest in case of the family Eurybrachidae (0.049), followed by Membracidae (0.031) > Scutelleridae (0.028) > Pentatomidae (0.017) > Plataspidae (0.017) > Reduviidae (0.008) > Alydidae, Cicadellidae, Issidae, Lygaeidae and Miridae (0.004 each) in that decreasing order, while the diversity index with respect to Coleopterans was found to be highest for the family Curculionidae (0.071), followed by Coccinellidae (0.065) > Cerambycidae and Scarabaeidae (0.014 each) > Chrysomelidae (0.011) > Anthicidae (0.004). The diversity index (H) value for order Orthoptera was found to be highest for the family Acrididae and Tettigoniidae (0.011 each),

followed by Pyrgomorphidae (0.004). The diversity index (H) for order Hymenoptera was highest in case of family Formicidae (0.040), followed by Apidae (0.011) > Ichneumonidae and Scolidae (0.004 each). The highest diversity index (H) in order Diptera was registered in family Mycetophilidae (0.135), followed by Muscidae (0.023) > Stratiomyidae (0.017) > Ulidiidae (0.014) > Sarcophagidae (0.011) in that decreasing order. Among the families of Araneae the diversity index (H) was recorded to be highest in case of Theridiidae (0.135), followed by Araneidae (0.74) > Salticidae (0.053) > Oxyopidae (0.020) > Lycosidae (0.014) > Eutichuridae, Thomisidae and Philodromidae (0.008 each) > Clubionidae (0.004) (Table 4). Finally, it could be inferred that, on tree mulberry Lepidopteran families viz., Erebidae (0.342), followed by Pyralidae (0.298) registered highest H value, thus indicating greater diversity of species belonging to these two families as compared to the remaining families coming under six other orders on tree mulberry (Table 4).

3.5 Shannon-weiner diversity index (H) for different families of insect and predatory spider family on bush mulberry

Among Lepidopterans, the diversity index (H) was highest for family Pyralidae (0.121) followed by Erebidae (0.115). The diversity index (H) among Hemiptera, was found to be highest in the family Pentatomidae (0.012), followed by Issidae, Plataspididae, Pyrrhocoridae and Reduviidae (0.008

each), while the diversity index with respect to Coleoptera was highest in case of Curculionidae (0.059), followed by Coccinellidae (0.038). The diversity index (H) for Orthopteran families was found to be highest in the family Acrididae (0.034), followed by Tettigoniidae (0.008). The diversity index (H) for families coming under the order Hymenoptera was found to be highest in the family Formicidae (0.014), followed by Halictidae (0.008). The highest diversity index (H) for Dipteran families was registered in case of family Calliphoridae (0.019), followed by Dolichopodidae, Muscidae, Mycetophilidae, Sarcophagidae and Stratiomyidae (0.008 each). The diversity index (H) in the order Araneae was recorded to be highest in the spider family Araneidae (0.083), followed by Lycosidae (0.019) > Philodromidae (0.010) > Eutichuridae, Sparassidae, Tetragnathidae and Thomisidae (0.008 each) (Table 5). It could be inferred from the above findings that on bush mulberry, the Lepidopteran families, Pyralidae (0.121) followed by Erebidae (0.115) registered the highest H value, thus indicating greater diversity of insect species belonging to these two families as compared to the remaining families coming under six different orders recorded. Likewise, for predatory spiders, the families Araneidae (0.083) > Lycosidae (0.019) registered the highest diversity index compared to other spider families. This may be attributed to the luxuriant growth of bush mulberry due to intensive cultivation.

Table 1: Comparative occurrence of insect fauna on tree and bush mulberry in Chikkaballapura and Kolar Districts during 2017-18.

Sl. No.	Order	Family	Genus/Species	Incidence of insect fauna		Status
				TM	BM	
1	Lepidoptera	Erebidae	<i>Amata</i> sp.	+	+	Defoliator
			<i>Cretonotos</i> sp.	+	-	Casual visitor
			<i>Spilarctia obliqua</i> (Walker)	+	+	Defoliator
		Nymphalidae	<i>Hypolimnas misippus</i> Bernardi	+	-	Casual visitor
		Psychidae	Bagworm (Unidentified)	+	-	Casual visitor
		Pyralidae	<i>Diaphania (=Glyphodes) pulverulentalis</i> Hampson	+	+	Defoliator
2	Hemiptera	Alydidae	<i>Riptortus linearis</i> (Fabricius)	+	-	Sap sucker
		Cicadellidae	<i>Neodartus acocephaloides</i> (Melichar)	+	-	Casual visitor
		Derbidae	<i>Proutista moesta</i> (Westwood)	+	-	Sap sucker
		Eurybrachidae	<i>Eurybrachis tomentosa</i> (Fabricius)	+	-	Sap sucker
		Issidae	<i>Brahmaloka</i> sp.	+	+	Sap sucker
		Lygaeidae	<i>Spilostethus pandurus</i> Scopoli	+	-	Sap sucker
		Membracidae	<i>Telingana</i> sp.	+	-	Sap sucker
		Miridae	<i>Eurystylus</i> sp.	+	-	Sap sucker
		Pentatomidae	<i>Agonoscelis nubilis</i> (Fabricius)	+	-	Sap sucker
			<i>Eocanthecona furcellata</i> (Wolff)	+	+	Predator
		Plataspidae	<i>Captosoma</i> sp.	+	-	Sap sucker
			<i>Megacopta</i> sp.	+	-	Sap sucker
		Pyrrhocoridae	<i>Antilocleus</i> sp.	-	+	Sap sucker
		Reduviidae	<i>Isyndus heros</i> (Fabricius)	+	+	Predator
		Scutelleridae	<i>Chrysocoris stollii</i> (Wolff)	+	-	Sap sucker
3	Coleoptera	Anthicidae	Unidentified (1)	+	-	Casual visitor
		Cerambycidae	<i>Niphona tibialis</i> Gahan	+	-	Stem borer
		Chrysomelidae	<i>Zygogramma bicolorata</i> Pallister	+	-	Natural Enemy
		Coccinellidae	<i>Anegleis cardoni</i> Weise	+	-	Predator
			<i>Brumoides suturalis</i> (Fabricius)	+	-	Predator
			<i>Cheilomenes sexmaculata</i> (Fabricius)	+	+	Predator
			<i>Chrysomyia</i> sp.	+	-	Predator
			<i>Coccinella transversalis</i> Fabricius	+	+	Predator
			<i>Illeis cincta</i> (Fabricius)	+	+	Predator
			<i>Jauravia</i> sp.	+	-	Predator
			<i>Psyllobora bisoconotata</i> (Mulsant)	+	-	Predator
		Curculionidae	<i>Hypolixus</i> sp.	+	+	Defoliator
			<i>Mylocerus discolor</i> Boheman	+	-	Defoliator
			<i>Mylocerus dorsatus</i> Fabricius	+	+	Defoliator

4	Orthoptera	Scarabaeidae	<i>Myllocerus viridanus</i> (Fabricius)	+	+	Defoliator	
			<i>Myllocerus</i> sp.	+	+	Defoliator	
		Acrididae	<i>Oxyctenia versicolor</i> (Fabricius)	+	-	Defoliator	
			<i>Acrida exaltata</i> Walker	-	+	Defoliator	
			<i>Cyrtacanthacris tatarica tatarica</i> (Linnaeus)	+	+	Defoliator	
			<i>Diabolocantatops pulchellus</i> (Walker)	+	+	Defoliator	
			<i>Leva</i> sp.	-	+	Defoliator	
			<i>Phlaeoba</i> sp.	-	+	Defoliator	
			Pyrgomorphidae	<i>Pyrgomorpha bispinosa bispinosa</i> Walker	+	-	Defoliator
				<i>Ducetia</i> sp.	-	+	Defoliator
Tettigoniidae	<i>Isopsera</i> sp.	+	-	Defoliator			
	<i>Phaneroptera</i> sp.	-	-	Defoliator			
5	Hymenoptera	Apidae	<i>Apis cerena indica</i> Fabricius	+	-	Nectar forager	
			<i>Apis dorsata</i> Fabricius	+	-	Nectar forager	
		Formicidae	<i>Camponotus sericeus</i> (Fabricius)	+	+	Pollinator/ Scavenger	
			<i>Crematogaster</i> sp.	+	-	Pollinator/ Scavenger	
			<i>Diacamma rugosum</i> Le Guillou	+	-	Pollinator/ Scavenger	
		Halictidae	<i>Hoplonomia</i> sp.	-	+	Casual visitor	
		Ichneumonidae	<i>Xanthopimpla</i> sp.	+	-	Parasitoid	
		Scolidae	<i>Scolia</i> sp.	+	-	Predator	
6	Diptera	Calliphoridae	<i>Chrysomya</i> sp.	+	+	Casual visitor	
		Dolichopodidae	Unidentified (1)	-	+	Casual visitor	
		Muscidae	Unidentified (1)	+	+	Casual visitor/ Scavenger	
		Mycetophilidae	Unidentified (1)	+	-	Scavenger	
		Sarcophagidae	<i>Miltogramma</i> sp.	+	+	Casual visitor/ Scavenger	
		Stratiomyidae	<i>Hermetia illucens</i> Linnaeus	+	+	Casual visitor/ Scavenger	
Ulidiidae	<i>Physiphora aenea</i> Fabricius	+	-	Casual visitor/ Scavenger			

+ Present, - Absent, TM: Tree mulberry (n= 200 plants per observation × 14 observations at fortnight intervals= 2800), BM: Bush mulberry (n = 40 plants per observation × 14 observations at fortnight intervals), as a standard check.

Table 2: Comparative occurrence of predatory spiders on tree and bush mulberry in Chikkaballapura and Kolar Districts during 2017-18.

Sl. No.	Family	Genus/Species	Incidence of spiders	
			Tree Mulberry*	Bush Mulberry#
1	Araneidae	<i>Araneus mitificus</i> (Simon)	+	+
		<i>Argiope anasuja</i> Thorell	+	+
		<i>Cyclosa</i> sp.	+	-
		<i>Cyrtophora cicatrosa</i> (Stoliczka)	-	+
		<i>Eriovixia excela</i> (Simon)	+	-
		<i>Neoscona molemensis</i> Tikader & Bal	+	+
		<i>Neoscona muckerjei</i> Tikader	+	-
2	Clubionidae	<i>Clubiona</i> sp.	+	-
3	Eutichuridae	<i>Cheiracanthium melanostomum</i> (Thorell)	+	+
4	Lycosidae	<i>Hippasa greenalliae</i> (Blackwall)	+	-
		<i>Pardosa pseudoannulata</i> (Bösenberg & Strand)	+	-
		<i>Trochosa</i> sp.	+	-
5	Oxyopidae	<i>Oxyopes birmanicus</i> Thorell	+	+
		<i>Peucetia viridana</i> (Stoliczka)	+	+
6	Philodromidae	<i>Tibellus elongatus</i> Tikader	+	-
7	Salticidae	<i>Hyllus semicupreus</i> (Simon)	+	+
		<i>Marengo</i> sp.	+	+
		<i>Telamonia dimidiata</i> (Simon)	-	+
		<i>Rhene danieli</i> Tikader	+	-
8	Sparassidae	<i>Carrhotus viduus</i> (C. L. Koch)	+	-
9	Tetragnathidae	<i>Olios</i> sp.	-	+
10	Tetragnathidae	<i>Leucauge tessellata</i> (Thorell)	-	+
10	Theridiidae	<i>Parasteatoda mundula</i> (L. Koch)	+	-
11	Thomisidae	<i>Thomisus projectus</i> Tikader	+	+

+ Present, - Absent, *n= 200, #n=40 (as a standard check).

Table 3: Shannon-Weiner diversity indices (H) for different orders of insect and predatory spider fauna on tree and bush mulberry

Order	Tree Mulberry				Bush Mulberry			
	Number of families	Composition*		H	Number of families	Composition*		H
		No.	Per cent			No.	Per cent	
Lepidoptera	3	1427	85.14	0.137	2	803	91.56	0.083
Hemiptera	11	54	3.22	0.111	5	8	0.91	0.043
Coleoptera	6	67	4.00	0.129	2	19	2.17	0.073

Orthoptera	3	7	0.42	0.023	2	7	0.80	0.039
Hymenoptera	4	28	1.67	0.068	2	3	0.34	0.019
Diptera	6	24	1.43	0.061	6	7	0.80	0.039
Araneae	9	69	4.12	0.131	7	30	3.42	0.080
Total	42	1676			26	877		

Note: * Recorded during July, 2017 to February, 2018 at fortnightly intervals, each value denotes total number of insects/spiders counted under each order.

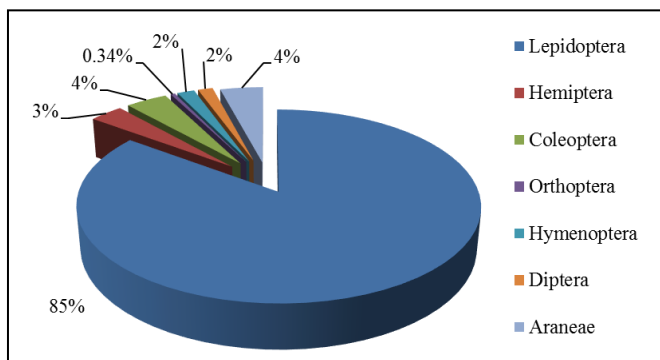


Fig 1: Occurrence of insect and predatory spider fauna on tree mulberry

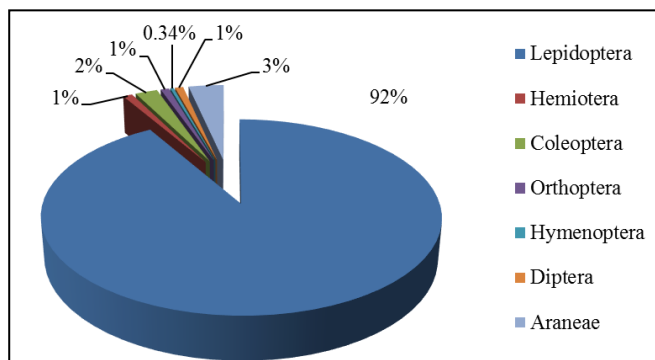


Fig 2: Occurrence of insect and spider fauna on bush mulberry

Table 4: Shannon-Weiner diversity indices (H) for different families of insect and predatory spider fauna on tree mulberry

Order	Family	Occurrence*	H
Lepidoptera	Erebidae	398	0.342
	Psychidae	1	0.004
	Pyalidae	1027	0.298
Hemiptera	Alydidae	1	0.004
	Cicadellidae	1	0.004
	Derbidae	2	0.008
	Eurybrachidae	18	0.049
	Issidae	1	0.004
	Lygaeidae	1	0.004
	Membracidae	10	0.031
	Miridae	1	0.004
	Pentatomidae	5	0.017
	Plataspidae	3	0.011
	Reduviidae	2	0.008
	Scutelleridae	9	0.028
	Coleoptera	Anthidae	1
Cerambycidae		4	0.014
Chrysomelidae		3	0.011
Coccinellidae		26	0.065
Curculionidae		29	0.071
Scarabaeidae		4	0.014
Orthoptera	Acrididae	3	0.011
	Pyrgomorphidae	1	0.004
	Tettigoniidae	3	0.011
Hymenoptera	Apidae	3	0.011
	Formicidae	14	0.040
	Ichneumonidae	1	0.004
	Scolidae	1	0.004
Diptera	Calliphoridae	4	0.014
	Muscidae	7	0.023
	Mycetophilidae	1	0.135
	Sarcophagidae	3	0.011
	Stratiomyidae	5	0.017
	Ulidiidae	4	0.014
Araneae	Araneidae	31	0.074
	Clubionidae	1	0.004
	Eutichuridae	2	0.008
	Lycosidae	4	0.014
	Oxyopidae	6	0.020
	Philodromidae	2	0.008
	Salticidae	20	0.053
	Theridiidae	1	0.135

	Thomisidae	2	0.008
	Total	1666	

Note: *Recorded during July, 2017 to February, 2018 at fortnightly intervals, each value denotes total number of insects/spiders counted under each family.

Table 5: Shannon-Weiner diversity indices (H) for different orders of insect and predatory spider fauna bush mulberry

Order	Family	Occurrence*	H
Lepidoptera	Erebidae	771	0.115
	Pyralidae	32	0.121
Hemiptera	Issidae	1	0.008
	Pentatomidae	5	0.012
	Plataspidae	1	0.008
	Pyrrhocoridae	1	0.008
	Reduviidae	1	0.008
Coleoptera	Coccinellidae	7	0.038
	Curculionidae	12	0.059
Orthoptera	Acrididae	6	0.034
	Tettigoniidae	1	0.008
Hymenoptera	Formicidae	2	0.014
	Halictidae	1	0.008
Diptera	Calliphoridae	3	0.019
	Dolichopodidae	1	0.008
	Muscidae	1	0.008
	Mycetophilidae	1	0.008
	Sarcophagidae	1	0.008
	Stratiomyidae	1	0.008
Araneae	Araneidae	19	0.083
	Eutichuridae	1	0.008
	Lycosidae	3	0.019
	Philodromidae	4	0.010
	Sparassidae	1	0.008
	Tetragnathidae	1	0.008
	Thomisidae	1	0.008
	Total	879	

Note: *Recorded during July, 2017 to February, 2018 at fortnightly intervals, each value denotes total number of insects/spiders counted under each family.

4. Conclusion

From the present study, it could be inferred that, more number of insect fauna occurred on tree mulberry (55 species) as compared to bush mulberry (27 species). Similarly, more abundance of predatory spider species (21) were observed on tree mulberry than bush mulberry (14), since prey for spiders in the form of greater abundance of insect fauna is available in tree mulberry. The diversity index (H) was higher for tree mulberry as compared to bush mulberry for all orders except for order Orthoptera. The 'H' value was higher in the case of Lepidoptera among both tree (0.137) and bush mulberry (0.083).

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