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SHORT COMMUNICATION

A DIVERSITY OF SPIDERS (ARACHNIDA: ARANEAE) FROM A CASHEW ECOSYSTEM IN KERALA, INDIA

Mamparambath Subramanian Smitha & Ambalaparambil V. Sudhikumar

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A diversity of spiders (Arachnida: Araneae) from a cashew ecosystem in Kerala, India

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Abstract: An exhaustive study was conducted to document spider fauna in cashew orchards of the Cashew Research Station, Madakkathara, Kerala, India from January 2015 to July 2017. A total of 63 species of spiders under 52 genera belonging to 14 families were recorded. The most species-rich families were Salticidae and Araneidae representing 33 and 27 per cent, respectively, of the total spider fauna. A guild structure analysis revealed six feeding guilds, viz.: stalkers, orb-web builders, foliage runners, scattered line weavers, ground runners, and ambushers. The occurrence of spiders was at a maximum during the monsoon with 59 species, followed by 26 during winter, 16 species during summer, and eight species being present all-round the year.

Keywords: Araneidae, Cashew orchards, guild structure, Madakkathara, Salticidae, seasonal variation.

Cashew is a perennial agricultural ecosystem with a rich arthropod diversity including pests and natural enemies. Cashew growers mainly depend on synthetic insecticides for the management of insect pests without any consideration to the system that may have deleterious effects on natural pest controlling biota. Hence, there is a need to redefine pest management with an emphasis on non-chemical methods. Ants and spiders are the most abundant general predators in a cashew ecosystem (Beevi & Mahapatro 2008).

The World Spider Catalog (2020) documents a total of 48,642 described species belonging to 4,173 genera and 128 families worldwide. Presently, 1,843 species under 471 genera in 61 families are known from India (Caleb & Sankaran 2020). Spiders have an important role in ecosystem functioning (Kralj-Fiser & Gregoric 2019) and were reported as predators of the Tea Mosquito Bug *Helopeltis antonii* Signoret, a major insect pest of cashew, causing economic yield loss (Devasahayam & Nair 1986).

The diversity as well as the role of spiders in agricultural fields have been documented in several studies (Breene et al. 1993; Marc et al. 1999; Rajeshwaran et al. 2005; Baba et al. 2018; Yang et al. 2018). They serve as general predators in agricultural ecosystems (Riechert & Bishop 1990) especially in orchard crops associated with diverse pest fauna. So far, a few attempts have been made to document spider fauna associated with the cashew ecosystem in Kerala. Choudhuri (1962) reported spiders under seven families occurring in cashew plantations of Kerala. Raghavendra (2001) collected 156 spider specimens belonging to Araneidae, Salticidae, Thomisidae, and Oxyopidae. Several spiders

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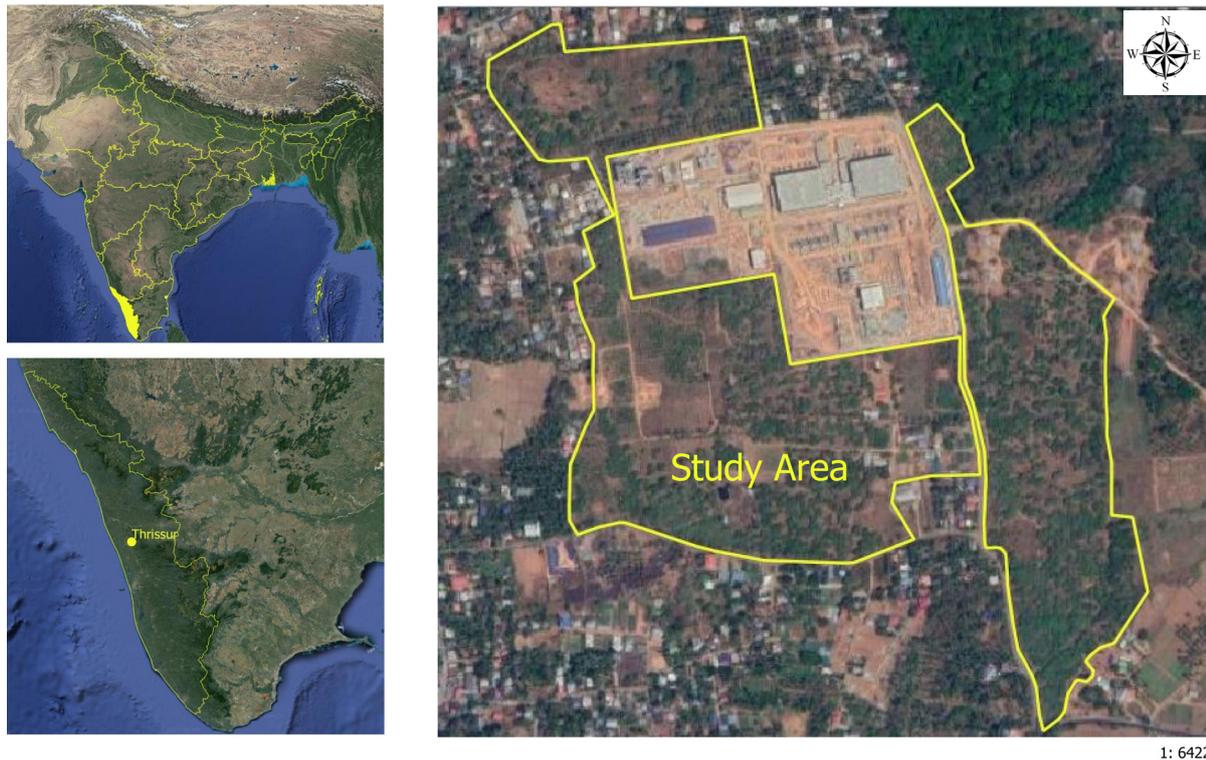


Figure 1. Location map of Cashew Research Station Farm, Madakkathara, Thrissur, Kerala

were reported predated on early instar nymphs of *H. antonii* (Sundararaju 1984; Devasahayam & Nair 1986). Among a list of arthropod predatory fauna recorded from cashew panicles, Sundararaju (2003) reported six species of spiders. A notable initiative was made by Beevi & Mahapatro (2008); they recorded 35 species of spiders under nine families and differentiated them under four guild structures, namely: stalkers, orb weavers, and foliage & ground runners. According to Bhat et al. (2013), among 117 species under 18 families recorded in a cashew ecosystem, *Telamonia dimidiata*, *Oxyopes shweta*, and *O. sunandae* have a preference for the Tea Mosquito Bug in spite of spiders being generalist predators.

Systematic documentation is necessary to conserve these natural pest-regulating factors for maintaining ecosystem sustainability and conservation of biodiversity. The studies that have been done so far in Kerala documented some species but almost a decade has passed and there has been no attempt to update the status of spider diversity associated with cashew ecosystems. In view of the importance of spiders in an ecosystem, the present study will help improve the understanding on diversity and seasonal occurrence and thereby help in developing a future integrated pest management strategy (IPM) in cashew.

MATERIALS AND METHODS

The study was carried out in cashew plantations of 120 acre farm area under Cashew Research Station, Madakkathara, Kerala Agricultural University, Thrissur, India in two crop seasons in fields planted under normal spacing of 7m × 7m. The farm is situated between 10.555–10.548 N & 76.259–76.268 E and at an altitude of 30m. Soil type is laterite with pH 5.5, annual rainfall of 280cm, maximum temperature 29.1–36.5 °C and minimum temperature 21.2–25.1 °C (Beevi & Mahapatro 2008). The study area consists of only cashew plantations with different weeds including grasses in the ground level vegetation.

Field observations were made from January 2015 to July 2017. Spiders were handpicked from the foliage and twigs, covering all age-classes of cashew trees. The specimens were collected from reachable tree-heights and were preserved in 70% ethyl alcohol in glass vials labeled with the date of collection. The spiders were categorized based on their abundance in the cashew orchard and noted with respect to their seasonal occurrence. Specimens were observed under a Leica M205 C stereozoom microscope and identified following the literature available from World Spider Catalog (2020). Voucher specimens were deposited at Centre for Animal Taxonomy and Ecology (CATE), Department of Zoology,

Table 1. List of spider species collected from cashew ecosystem with seasonal occurrence.

	Species	Seasonal occurrence		
		M	S	W
	I. Araneidae			
1	<i>Anepision maritatum</i> (O. Pickard-Cambridge, 1877)	+	-	-
2	<i>Araneus bilunifer</i> Pocock, 1900	+	+	-
3	<i>Araneus mitificus</i> (Simon, 1886)	+	-	-
4	<i>Argiope anasuja</i> Thorell, 1887	+	-	-
5	<i>Argiope pulchella</i> Thorell, 1881	+	+	+
6	<i>Cyclosa bifida</i> (Doleschall, 1859)	+	-	-
7	<i>Cyclosa confraga</i> (Thorell, 1892)	+	-	-
8	<i>Cyrtarachne raniceps</i> Pocock, 1900	+	+	-
9	<i>Cyrtophora citricola</i> (Forsskal, 1775)	+	-	+
10	<i>Eriovixia excelsa</i> (Simon, 1889)	+	-	-
11	<i>Eriovixia laglaizei</i> (Simon, 1877)	+	-	-
12	<i>Eriovixia poonaensis</i> (Tikader & Bal, 1981)	+	-	-
13	<i>Gasteracantha geminata</i> (Fabricius, 1798)	+	-	+
14	<i>Neoscona mokerjei</i> Tikader, 1980	-	+	+
15	<i>Neoscona molemensis</i> Tikader & Bal, 1981	+	-	-
16	<i>Parawixia dehaani</i> (Doleschall, 1859)	+	-	-
17	<i>Porcataraneus bengalensis</i> (Tikader, 1975)	+		
	II. Cheiracanthiidae			
18	<i>Cheiracanthium danieli</i> Tikader, 1975	+	-	+
19	<i>Cheiracanthium melanostomum</i> (Thorell, 1895)	+	-	+
	III. Clubionidae			
20	<i>Clubiona drassodes</i> O. Pickard-Cambridge, 1877	+	-	+
21	<i>Matidia incurvata</i> Reimoser, 1934	+	-	+
	IV. Corinnidae			
22	<i>Aetius decollatus</i> O. Pickard-Cambridge, 1897	+	-	-
23	<i>Castaneira zetes</i> Simon, 1897	+	-	-
	V. Gnaphosidae			
24	<i>Drassodes delicatus</i> (Blackwall, 1867)	+	-	-
25	<i>Gnaphosa rohtakensis</i> Gajbe, 1992	+	-	-
	VI. Hersiliidae			
26	<i>Hersilia savignyi</i> Lucas, 1836	+	-	-
	VII. Lycosidae			
27	<i>Hippasa agelenoides</i> (Simon, 1884)	+	-	+
28	<i>Pardosa sumatrana</i> (Thorell, 1890)	+	-	-
	VIII. Oxyopidae			
29	<i>Oxyopes birmanicus</i> Thorell, 1887	-	+	+
30	<i>Oxyopes javanus</i> Thorell, 1887	-	+	+
31	<i>Oxyopes wroughtoni</i> Pocock, 1901	+	+	+

	IX. Philodromidae			
32	<i>Philodromus bigibbus</i> (O. Pickard-Cambridge, 1876)	+	-	-
	X. Salticidae			
33	<i>Asemonea tenuipes</i> (O. Pickard-Cambridge, 1869)	+	+	-
34	<i>Brettus cingulatus</i> Thorell, 1895	+	-	-
35	<i>Carrhotus viduus</i> (C.L. Koch, 1846)	+	-	-
36	<i>Epeus indicus</i> Proszynski, 1992	+	+	+
37	<i>Epeus triangulopalpis</i> Malamel, Nafin, Sudhikumar & Sebastian, 2019	+	-	-
38	<i>Harmochirus brachiatus</i> (Thorell, 1877)	+	-	-
39	<i>Hasarius adansoni</i> (Audouin, 1826)	-	+	-
40	<i>Hyllus semicupreus</i> (Simon, 1885)	+	+	+
41	<i>Indopadilla insularis</i> (Malamel, Sankaran & Sebastian, 2015)	+	-	+
42	<i>Menemerus bivittatus</i> (Dufour, 1831)	+	-	-
43	<i>Myrmaplata plataleoides</i> (O. Pickard-Cambridge, 1869)	+	+	-
44	<i>Myrmarachne ramunni</i> Narayan, 1915	+	-	-
45	<i>Phintelloides jesudasi</i> (Caleb & Mathai, 2014)	+	-	-
46	<i>Piranthus planolancis</i> Malamel, Nafin, Sudhikumar & Sebastian, 2019	+	-	-
47	<i>Plexippus petersi</i> (Karsch, 1878)	+	+	+
48	<i>Phintella vittata</i> (C.L. Koch, 1846)	+	+	+
49	<i>Portia fimbriata</i> (Doleschall, 1859)	+	-	-
50	<i>Rhene danieli</i> Tikader, 1973	+	-	-
51	<i>Siler semiglaucus</i> (Simon, 1901)	+	-	-
52	<i>Telamonia dimidiata</i> (Simon, 1899)	+	+	+
53	<i>Thiania bhamoensis</i> Thorell, 1887	+	-	-
	XI. Sparassidae			
54	<i>Heteropoda venatoria</i> (Linnaeus, 1767)	+	+	+
55	<i>Olios milleti</i> (Pocock, 1901)	+	-	-
	XII. Tetragnathidae			
56	<i>Leucauge decorata</i> (Blackwall, 1864)	+	-	+
57	<i>Tetragnatha viridorufa</i> Gravely, 1921	+	-	-
58	<i>Tylorida striata</i> (Thorell, 1877)	+	-	+
	XIII. Theridiidae			
59	<i>Nesticodes rufipes</i> (Lucas, 1846)	+	-	+
60	<i>Propostira quadrangulata</i> Simon, 1894	+	-	+
	XIV. Thomisidae			
61	<i>Strigoplus netravati</i> Tikader, 1963	+	-	+
62	<i>Thomisus projectus</i> Tikader, 1960	+	-	+
63	<i>Thomisus pugilis</i> Stoliczka, 1869	+	-	+

M—Monsoon (June–November) | W—Winter (December–January) | S—Summer (March–May).

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RESULTS AND DISCUSSION

A total of 63 species of spiders belonging to 52 genera under 14 families were identified during this study (Table 1). The family with the highest number of species is Salticidae with 21 species (33%), followed by Araneidae with 17 species (27%). The families Philodromidae and Hersiliidae were recorded with only a single species (Table 2, Figure 2). A study of seasonal variation showed that more species (i.e., 59 species) were recorded during the monsoon followed by 26 species in winter and 16 species in summer (Figure 3). The sampled spiders belong to six functional groups (guilds) based on their foraging behavior (Uetz et al. 1999). The dominant guild was the stalkers with 24 species followed by orb-web builders (20 species), foliage runners (six species), ground runners (six species) and ambushers (five species). Scattered line weavers (two species) were the least represented among the feeding guilds from the study area (Figure 4).

The study recorded 63 species of spiders belonging to 14 families representing 22.95% of the total 61 families reported from India. The maximum number of species was collected during monsoon, clearly indicating the occurrence in response to the availability of prey populations (Bhat et al. 2013), mainly leaf feeding caterpillars and leaf miners infesting cashew in the flushing phase coinciding August–September. This is followed by winter with crop in full bloom during which the inflorescence pests are available in plenty. The availability of inflorescence pests from December to April has supported the spiders during winter and even in the summer season as evidenced from the diversity with 16 species during summer.

CONCLUSION

The present investigation documents the diversity of spiders associated with cashew representing a perennial agro-ecosystem. This data provides scope for further

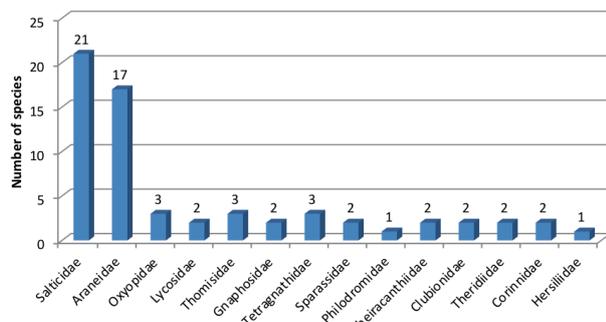


Figure 2. Family diversity of spiders in a cashew ecosystem.

Table 2. Families, genera, species, and functional guilds of spiders collected from cashew orchards of Cashew Research Station, Madakkathara, Kerala.

	Family	Number of genera	Number of species	Guild structure
1	Araneidae	11	17	Orb-web builders
2	Cheiracanthidae	1	2	Foliage runners
3	Clubionidae	2	2	Foliage runners
4	Corinnidae	2	2	Ground runners
5	Gnaphosidae	2	2	Ground runners
6	Hersiliidae	1	1	Ambushers
7	Lycosidae	2	2	Ground runners
8	Oxyopidae	1	3	Stalkers
9	Philodromidae	1	1	Ambushers
10	Salticidae	20	21	Stalkers
11	Sparassidae	2	2	Foliage runners
12	Tetragnathidae	3	3	Orb-web builders
13	Theridiidae	2	2	Scattered line weavers
14	Thomisidae	2	3	Ambushers
	Total	52	63	

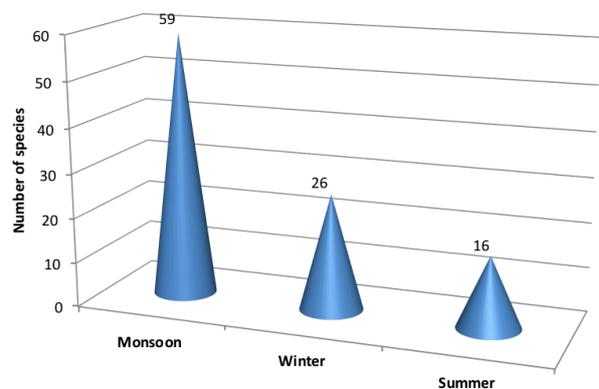


Figure 3. Species diversity of spiders in a cashew ecosystem during different seasons.

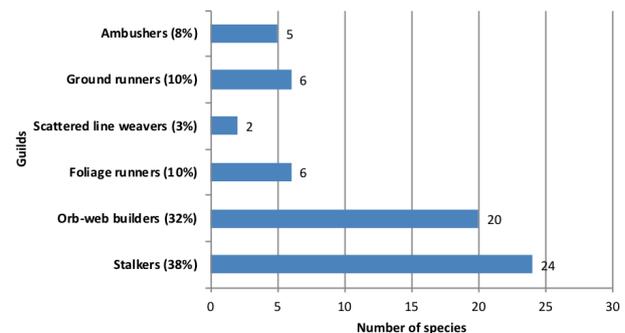


Figure 4. Guild-wise distribution of species of spiders in a cashew ecosystem.



Image 1. *Cyrtarachne raniceps* (Araneidae)



Image 2. *Neoscona mukerjei* (Araneidae)



Image 3. *Cheiracanthium melanostomum* (Chericanthiidae)



Image 4. *Castaneira zetes* (Corinnidae)



Image 5. *Oxyopes javanus* (Oxyopidae)



Image 6. *Asemonea tenuipes* (Salticidae)



Image 7. *Brettus cingulatus* (Salticidae)



Image 8. *Epeus indicus* (Salticidae)



Image 9. *Hyllus semicupreus* (Salticidae)



Image 10. *Menemerus bivittatus* (Salticidae)



Image 11. *Myrmaplata plataleoides* (Salticidae)



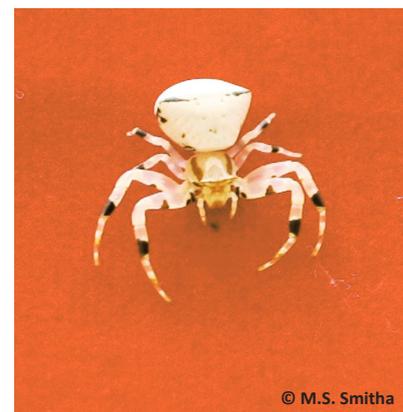
Image 12. *Phintella vittata* (Salticidae)


 Image 13. *Piranthus planolancis* (Salticidae)

 Image 14. *Telamonia dimidiata* (Salticidae)

 Image 15. *Olios milleti* (Sparassidae)

 Image 16. *Leucauge decorata* (Tetragnathidae)

 Image 17. *Thomisus projectus* (Thomisidae)

 Image 18. *Thomisus pugilis* (Thomisidae)

research on the relationship of spider fauna with other biotic factors in the background of bio-intensive pest management in cashew. Further studies could focus on the variation in the spider population with respect to sprayed and unsprayed orchards. In an era of organic crop production, a better understanding of natural pest-regulating factors would assure an ecosystem-oriented pest management and a safe harvest.

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