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Influence of weather parameters on predatory spider population in rice ecosystem of terrain region of West Bengal

Shriti Moses, Nilanjana Chaudhuri, Suprakash Pal and Jaydeb Ghosh

Abstract
The field experiment was conducted at the agricultural research farm of Uttar Banga Krishi Vishwavidhyalaya, Pundibari, Cooch Behar, and West Bengal, India in 2019 to 2021 to study the influence of weather parameters on predatory spider population in rice ecosystem of terrain region of West Bengal. Sampling was done at different rice growth stages i.e. nursery, vegetative, reproductive and maturity stages during Kharif and Rabi seasons. Total of 16 species of predatory spider fauna belonging to 6 families of order Araneida were found. In the study it was found that climatic factors also influence the population of predatory spiders to some extent. It was observed that rainfall had direct impact on the population of spiders. The population of spiders was inversely proportional to rainfall during Kharif season while directly proportional to rainfall during Rabi season. During Kharif season spider's population were mostly negatively correlated with almost all the weather parameters while in Rabi seasons it was positively correlated.

Keywords: Predatory spiders, population, rice, ecosystem

Introduction
Rice is the most important food crop in Asia where 55% of the world population lives and 92% of rice is grown and consumed (Tabot, 2009) [17]. Globally rice occupies an area of 163 m ha with a production of 719 m tonnes (FAO, 2012) [2]. West Bengal is the richest reservoir of rice bio-diversity and the rice bowl of the country. The ecotypes of rice, spontaneously evolved in the state, are so diverse and different that scientists at one time coined them as *Oryza sativa* var. *bengalensis* (Chatterjee *et al*., 2008) [1].

Recent trends in agriculture towards reduced pesticide use and ecological sustainability have led to increased interest in spiders as potential biological control agents. Although the Chinese have augmented spider populations in field crops as a pest management strategy for centuries, much debate remains as to whether spiders will effectively control pest populations in US agricultural ecosystems (Riechert and Lockley 1984 [10]; Riechert and Bishop 1990) [9]. In order for a predator to effectively and economically control an insect pest, the predator must be capable of not only reducing pest densities to levels below an economic threshold, but also stabilize those pest densities over time. If the pest population is not stable, the predator may drive the prey to local extinction, then die off itself, thus allowing for the potential of an unchecked secondary pest outbreak in the absence of this predator (Pedigo 2001 [8]; Morin 1999) [5]. Spiders may be capable of fulfilling both of pest reduction and pest stabilization requirements. According to Hairston *et al.* (1960) [3], herbivore populations are not limited by competition for food. This idea is supported by the observation that green plants are abundant. Therefore, it is theorized that herbivores must be limited by predation. However, in many agricultural systems repeated physical and chemical disruptions have led to local extirpation of predators. Herbivores, released from control by predators, become abundant to the point of severely damaging crop plants. If a predator could be established that would feed upon these herbivores, their numbers might be lowered. Spiders may be such a predator. Although the spiders (Araneae) are a diverse arachnid order consisting of over 3500 species in North America (Young and Edwards 1990) [16], all are obligate predators, and many feed upon herbivorous pest insects. The orb-web weavers Araneidae and Tetragnathidae feed upon Homoptera such as leafhoppers, Diptera, and Orthoptera, especially grasshoppers. The smaller, sheet-web weavers such as Linyphiidae, Dictynidae, and Theridiidae capture Diptera, Hemiptera and Homoptera (especially aphids and leafhoppers), as well as beetles in the family Curculionidae. The funnel-web weavers (Agelenidae, Atypidae, Ctenizidae, and Eresidae) prey upon Orthoptera, Coleoptera, and Lepidoptera (Riechert and Bishop 1990 [9];

Nyffeler *et al.* 1994a) [6]. Hunting spiders, (Lycosidae, Oxyopidae, Thomisidae, and Salticidae) frequently capture Orthoptera, Homoptera, Hemiptera, Lepidoptera, Thysanoptera, Diptera, and some Coleoptera and Hymenoptera (Riechert and Bishop 1990 [9]; Young and Edwards 1990 [16]; Nyffeler *et al.* 1994a) [6].

Materials and methods

Studies on the diversity of spiders were conducted in the instructional farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, and West Bengal from 2019 to 2021 during both *Kharif* and *Rabi* season. In order to study the influence of weather parameters on spider's population, a rice field was maintained by using variety Swarna (MTU-7029). The rice crop was sown in the second week of June followed by transplanting in the second week of July in *Kharif* season and first week of February followed by transplanting in the first week of March in *Rabi* season during 2019 to 2021 in an area of about 1 bighas (1333 sq. m.). The crop was raised under standard agronomic practices with the fertilizer dose of 80:40:40 kg NPK/ha during *Kharif* season and dose of 120:60:60 kg NPK/ha during *Rabi* season with a spacing of 20 cm X 15 cm in both *Kharif* and *Rabi* season of each year respectively. No pesticide was used in the rice field for the natural growth of the spiders. Population of spiders were recorded at various stages by following different sampling methods i.e. direct count, ground collection, foliage collection.

Results and Discussions

Spider population during Kharif season

The study was initiated from 24th SW and continued till 47th SW for both the year 2019 and 2021. The total spider population collected during the first Kharif season was 188 comprising of 16 species belonging to six families. Maximum number of spider population was observed during both 42nd SW and 45th SW (15, 15) followed by 38th SW. The corresponding weather parameters of 42nd SW was 32.37 ºC maximum temperature, 21.73 ºC minimum temperature, 75.71 maximum RH, 62.43 minimum RH, no rainfall, 7 hours of bright sunshine. The weather parameters during 45th SW was 30.19 ºC maximum temperature, 18.51 ºC minimum temperature, 77.57 maximum RH, 64.00 minimum RH, 4mm rainfall, 5.41 hours of bright sunshine. The weather parameters during 38th SW was 32.43 ºC maximum temperature, 24.84 ºC minimum temperature, 90.00 maximum RH, 76.43 minimum RH, 49.30 mm rainfall, 4.43 hours of bright sunshine. The total spider population collected during the second season Kharif 2021 was 182 comprising of 16 species belonging to six families. Maximum number of spider population was observed during 41st SW (16) followed by 37th SW (14). The corresponding weather parameters of 41st SW was 35.31 ºC maximum temperature, 21.73 ºC minimum temperature, 76.00 maximum RH, 62.57 minimum RH, no rainfall 7.13 hours of bright sunshine. The weather parameters during 37th SW was 34.73 ºC maximum temperature, 22.61 ºC minimum temperature, 79.00 maximum RH, 69.14 minimum RH, 65.80 mm rainfall, 4.64 hours of bright sunshine. The results indicated that the population of spiders remained in lower form at initial stage and it gradually increased with advanced crop growth stage.

Correlation of spider fauna with weather parameters of Kharif season 2019

During the first season Kharif 2019 correlation between spider populations based on families was established with the weather parameters. Glycosidase showed positive correlation with bright sunshine hours (r= 0.0802) whereas negative correlation with maximum and minimum temperatures (r= -0.1764, -0.4047), maximum and minimum relative humidity (r= -0.2233, -0.2584) and rainfall (r= -0.5447). Oxyopidae also showed positive correlation bright sunshine hours (r= 0.1428) whereas negative correlation with maximum and minimum temperature (r= -0.1507, -0.4252), maximum and minimum relative humidity (r= -0.1771, -0.2841) and rainfall (r= -0.2817). Tetragnathidae correlated positively with bright sunshine hours (r= 0.1177) whereas negative correlation with maximum and minimum temperatures (r= -0.1703, -0.4725), maximum and minimum relative humidity (r= -0.2772, -0.3366) and rainfall (r= -0.4195). Negative correlations have been recorded in Saltacidae family with all the weather parameters i.e. maximum and minimum temperatures (r= -0.2790, -0.3557), maximum and minimum relative humidity (r= -0.0638, -0.1838), rainfall (r= -0.4569) and bright sunshine hours (r= -0.2078). Thomisidae resulted positive correlation with maximum temperature (r= 0.0565), bright sunshine hours (r= 0.3109) whereas negative correlation with minimum temperature (r= -0.1465), maximum and minimum relative humidity (r= -0.2593, -0.2578) and rainfall (r= -0.3366). A positive correlation was noted in Araneidae family with bright sunshine hours (r= 0.2942) whereas negative correlation with maximum and minimum temperatures (r= -0.0164, -0.2635), maximum and minimum relative humidity (r= -0.1559, -0.2540) and rainfall (r= -0.3299). The results are more or less similar to the finding of Singh *et al.* (2000) [12], wherein they found that most of abiotic factors had negative correlation with spider population in the rice field from Faizabad. Yadav *et al*. (2017) [15] reported that maximum RH had a significant and positive impact on the population of the *Oxyopes* sp. in rice agro ecosystem of Bihar; Sidar *et al*. (2017) [11] revealed a non-significant positive correlation with maximum (0.074) and minimum temperature (0.28), morning (0.27) and evening RH (0.15), whereas rainfall (-0.20), wind velocity (-0.39) and sun shine hours (-0.14) expressed a non-significant negative correlation with maize in Chhattisgarh. Patel *et al*. (2020) [7] reported that morning and evening RH and rainfall exhibited a positive correlation with spiders in cotton. In Telangana, the abundance of spiders revealed a positive correlation with RH and a negative one with temperature and rainfall in rice (Laxman *et al*., 2016) [4].

Correlation between spider fauna and weather parameters of Kharif season 2021

During the second season Kharif 2021 correlation was established with the weather parameters in the same manner. Glycosidase showed positive correlation with maximum temperature (r= 0.1247) and bright sunshine hours (r= 0.3537) whereas negative correlation with minimum temperature (r= -0.2602), maximum and minimum RH (R= -0.3877, -0.3544) and rainfall (r= -0.4200). Oxyopidae also exhibited positive correlation with maximum temperature (r= 0.0795) and bright sunshine hours (r= 0.3744) whereas negative correlation with minimum temperatures (r= -0.2505), maximum and minimum relative humidity (r= -0.3503, -0.2709) and rainfall (r= -0.2667). A positive correlation was found with maximum temperature (r= 0.0664) and bright sunshine hours (r= 0.4031) whereas negative correlation with minimum temperature (r= -0.3727), maximum and minimum relative humidity (r= -

0.4700, -0.4230) and rainfall (r= -0.3759) in family Tetragnathidae. Salticidae also expressed positive correlation with maximum temperature (r= 0.0345) and bright sunshine hours (r= 0.4803) whereas negative correlation with minimum temperatures (r= -0.3568), maximum and minimum relative humidity (r= -0.5487, -0.4404) and rainfall (r= -0.3798). A positive correlation was noted under family Thomisidae with bright sunshine hours (r= 0.2050) whereas negative correlation with maximum and minimum temperatures (r= -0.0105, -0.2823), maximum and minimum relative humidity (r= -0.2961, -0.2485) and rainfall (r= -0.2929). Araneidae exhibited a positive correlation with maximum temperature (r= 0.0072) and bright sunshine hours (r= 0.2854) whereas negative correlation with minimum temperatures (r= -0.2481), maximum and minimum relative humidity (r= -0.3054, -0.2761) and rainfall (r= -0.2182). The results are more or less similar to the observations of Singh *et al*. (2000) [12], wherein they found that most of abiotic factors had been exhibited negative correlation with spider's population in the rice field from Faizabad. Yadav *et al*. (2017) [15] revealed that maximum RH had a significant and positive impact on the population of the *Oxyopes* sp. in rice agro ecosystem of Bihar; Sidar *et al*. (2017) [11] had been observed a non-significant positive correlation with maximum (0.074) and minimum temperature (0.28), morning (0.27) and evening RH (0.15), whereas rainfall (-0.20), wind velocity (-0.39) and sun shine hours (-0.14) produced a non-significant negative correlation with maize in Chhattisgarh. Patel *et al*. (2020) [7] noted that morning and evening RH and rainfall exhibited a positive correlation with spiders in cotton. In Telangana, the abundance of spiders revealed a positive correlation with RH and a negative one with temperature and rainfall in rice (Laxman *et al*., 2016) [4].

Table 1: Spider population during Kharif season 2019

SW	Number of spiders/plot	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	RAINFALL (mm)	BSH (hrs/day)
24	0	33.96	24.51	86.43	70.86	235.30	6.01
25	0	34.21	26.14	88.57	71.43	43.30	5.23
26	0	31.30	25.21	90.29	81.86	132.90	2.69
27	0	33.23	26.57	81.86	74.71	117.40	6.38
28	2	27.10	24.27	100.00	97.57	520.80	0.00
29	4	30.59	24.73	95.86	83.86	276.30	4.40
30	2	31.53	25.26	91.71	82.14	209.20	3.41
31	8	33.83	26.29	84.86	71.29	40.00	6.34
32	8	35.87	26.27	82.71	69.86	121.20	6.79
33	9	32.64	25.51	91.57	82.57	110.40	5.53
34	5	34.39	25.76	86.86	69.57	84.80	4.83
35	9	34.59	26.36	82.57	73.00	5.30	6.86
36	12	33.41	25.54	91.86	74.14	72.00	6.09
37	9	30.30	25.36	96.00	87.57	37.30	1.07
38	14	32.43	24.84	90.00	76.43	49.30	4.43
39	13	27.89	21.96	97.43	87.57	222.40	1.31
40	13	31.77	23.57	89.71	72.00	4.60	3.63
41	8	30.93	21.57	90.00	71.57	47.80	3.44
42	15	32.37	21.73	75.71	62.43	0.00	7.00
43	11	27.51	20.19	87.29	73.57	2.50	1.81
44	9	31.64	19.00	71.86	54.86	0.00	8.04
45	15	30.19	18.51	77.57	64.00	4.00	5.41
46	13	30.91	18.66	82.29	56.29	0.00	7.04
47	9	28.43	16.50	87.86	59.71	0.20	4.41
Total	188						

Table 2: Spider population during Kharif season 2021

SW	Number of spiders/plot	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	RAINFALL (mm)	BSH (hrs/day)
24	0	32.83	22.04	87.71	73.43	97.60	3.79
25	0	33.61	22.59	82.14	68.29	10.20	3.99
26	0	29.19	21.97	96.00	90.71	406.60	1.43
27	1	29.99	22.00	95.43	86.57	207.40	0.63
28	2	33.17	22.81	87.86	72.43	197.50	4.36
29	3	32.23	22.83	92.57	79.00	152.20	3.47
30	4	34.04	24.16	84.57	71.71	76.20	6.01
31	4	33.59	23.26	87.57	71.14	107.00	4.99
32	8	31.79	22.34	94.43	84.57	200.50	3.21
33	7	30.70	22.64	94.43	87.71	128.00	1.10
34	5	30.44	21.84	96.29	87.43	270.60	1.04
35	10	29.79	21.64	95.57	87.14	341.20	1.82
36	10	33.46	22.83	89.71	70.29	48.80	4.46
37	14	34.73	22.61	79.00	69.14	65.80	4.64
38	10	33.21	22.06	87.00	70.43	29.40	4.74
39	11	34.56	22.66	76.14	68.00	23.00	6.39
40	12	30.30	20.64	91.29	80.14	191.80	1.99
41	16	35.31	21.73	76.00	62.57	0.00	7.13

42	11	30.67	21.33	84.14	78.71	75.60	4.31
43	9	30.86	17.49	81.29	65.43	0.40	5.70
44	12	31.34	14.70	69.00	47.14	0.00	7.39
45	13	30.84	12.77	73.57	47.29	0.00	7.06
46	10	29.77	12.03	74.71	47.14	0.00	7.07
47	10	28.03	12.71	79.71	60.29	0.00	5.06
Total	182						

Table 3: Correlation of spider fauna with weather parameters of Kharif season 2019

Family	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	RAINFALL (mm)	BSH (hrs/day)
Lycosidae	-0.1764	-0.4047	-0.2233	-0.2584	-0.5447	0.0802
Oxyopidae	-0.1507	-0.4252	-0.1771	-0.2841	-0.2817	0.1428
Tetragnathidae	-0.1703	-0.4725	-0.2772	-0.3366	-0.4195	0.1177
Salticidae	-0.2790	-0.3557	-0.0638	-0.1838	-0.4569	-0.2078
Thomisidae	0.0565	-0.1465	-0.2593	-0.2578	-0.3366	0.3109
Araneidae	-0.0164	-0.2635	-0.1559	-0.2540	-0.3299	0.2942

Table 4: Correlation of spider fauna with weather parameters of Kharif season 2021

Family	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	rainfall (mm)	BSH (hrs/day)
Lycosidae	0.1247	-0.2602	-0.3877	-0.3544	-0.4200	0.3537
Oxyopidae	0.0795	-0.2505	-0.3503	-0.2709	-0.2667	0.3744
Tetragnathidae	0.0664	-0.3727	-0.4700	-0.4230	-0.3759	0.4031
Salticidae	0.0345	-0.3568	-0.5487	-0.4404	-0.3798	0.4803
Thomisidae	-0.0105	-0.2823	-0.2961	-0.2485	-0.2929	0.2050
Araneidae	0.0072	-0.2481	-0.3054	-0.2761	-0.2182	0.2854

Spider population during Rabi season

The population of spider was initiated from 6th SW and continued till 29th SW of the year 2020 and 2021. The total spider population collected during this first season Rabi 2020 was 151 comprising of 16 species belonging to six families. Maximum number of spider population was observed during both 23rd SW and 24th SW (14, 14) followed by 22nd SW (13). The corresponding weather parameters of 23rd SW was 32.01 ºC maximum temperature, 23.76 ºC minimum temperature, 90.29 maximum RH, 74.14 minimum RH, 195.70 mm rainfall, 3.67 hours of bright sunshine. The weather parameters during 24th SW was 32.63 ºC maximum temperature, 24.86 ºC minimum temperature, 89.14 maximum RH, 78.71 minimum RH, 71.70 mm rainfall, 5.53 hours of bright sunshine. The weather parameters during 22nd SW was 30.93 ºC maximum temperature, 21.74 ºC minimum temperature, 84.29 maximum RH, 72.57 minimum RH, 70.80 mm rainfall, 4.43 hours of bright sunshine. The total spider population collected during the second season Rabi 2021 was 147 comprising of 16 species belonging to six families. Maximum number of spider population was recorded during 22nd SW (15) followed by 25th SW (14). The corresponding weather parameters of 22nd SW was 31.83 ºC maximum temperature, 21.17 ºC minimum temperature, 89.86 maximum RH, 74.57 minimum RH, 105.80 mm rainfall, 2.39 hours of bright sunshine. The weather parameters during 25th SW was 33.61 ºC maximum temperature, 22.59 ºC minimum temperature, 82.14 maximum RH, 68.29 minimum RH, 10.20 mm rainfall, 3.99 hours of bright sunshine. Singh *et al.* (2000) [12] recorded more or less similar findings of our present investigation, wherein they found that most of abiotic factors had been exhibited negative correlation with spider's population in the rice field from Faizabad. The results indicated that the population of spiders remained in low level at initial stage and it gradually increased with crop growth stage.

Correlation of spider fauna with weather parameters of Rabi season 2020: During the first season Rabi 2020 correlation between spider populations based on families was established with the weather parameters. Lycosidae showed positive correlation with maximum and minimum temperatures (r= 0.5051, 0.7484), maximum and minimum relative humidity (r= 0.4574, 0.6395) and rainfall (r= 0.3734) whereas negative correlation with bright sunshine hours (r= -0.3218). Oxyopidae also expressed positive correlation with maximum and minimum temperatures (r= 0.3865, 0.7646), maximum and minimum relative humidity (r= 0.4280, 0.7115) and rainfall (r= 0.3666) whereas negative correlation with bright sunshine hours (r= -0.3527). Tetragnathidae also exhibited a positive correlation with maximum and minimum temperatures (r= 0.3981, 0.7099), maximum and minimum relative humidity (r= 0.4010, 0.6180) and rainfall (r= 0.4679) whereas negative correlation with bright sunshine hours (r= -0.3286). A positive correlation had been observed with maximum and minimum temperatures (r= 0.5296, 0.7096), maximum and minimum relative humidity (r= 0.3856, 0.5825) and rainfall (r= 0.4524) whereas negative correlation with bright sunshine hours (r= -0.2673) in family Salticidae. Thomisidae also positively correlated with maximum and minimum temperatures (r= 0.0978, 0.3371), maximum and minimum relative humidity (r= 0.2259, 0.3445) and rainfall (r= 0.0880) whereas negative correlation with bright sunshine hours (r= -0.1589). Araneidae also revealed positive correlation with maximum and minimum temperatures (r= 0.3348, 0.5069), maximum and minimum relative humidity (r= 0.1275, 0.4122) and rainfall (r= 0.4202) whereas negative correlation with bright sunshine hours (r= -0.2666). Yadav *et al.* (2017) [15] reported that maximum RH had a significant and positive impact on the population of the *Oxyopes* sp. in rice agro ecosystem of Bihar; Sidar *et al.* (2017) [11] observed a non-significant positive correlation with maximum (0.074) and minimum temperature (0.28), morning (0.27) and evening RH (0.15), whereas rainfall (-0.20), wind velocity (-0.39) and sun shine hours (-0.14) showed a non-significant negative correlation with maize in Chhattisgarh. Patel *et al.* (2020) [7] found that morning and evening RH and rainfall exhibited a positive correlation with spiders in cotton. In Telangana, the

abundance of spiders revealed a positive correlation with RH and a negative one with temperature and rainfall in rice (Laxman *et al*., 2016) [4].

Correlation of spider fauna with weather parameters of Rabi season 2021

During the second season Rabi 2021 correlation was established with the weather parameters in the similar manner. Family Glycosidase showed positive correlation with maximum and minimum temperatures (r= 0.2968, 0.6641), maximum and minimum relative humidity (r= 0.6005, 0.7181) and rainfall (r= 0.5086) whereas negative correlation with bright sunshine hours (r= -0.5013). A positive correlation had been exhibited with maximum and minimum temperatures (r= 0.5088, 0.6895), maximum and minimum relative humidity (r= 0.4154, 0.6195) and rainfall (r= 0.3187) whereas negative correlation with bright sunshine hours (r= -0.3042) in family Oxyopidae. Tetragnathidae also expressed positive correlation with maximum and minimum temperatures (r= 0.3890, 0.6721), maximum and minimum relative humidity (r= 0.5404, 0.6534) and rainfall (r= 0.3782) whereas negative correlation with bright sunshine hours (r= -0.3790). Salticidae had been positively correlated with maximum and minimum temperatures (r= 0.3166, 0.6752), maximum and minimum relative humidity (r= 0.6012, 0.6849) and rainfall (r= 0.4127) whereas negative correlation with bright sunshine hours (r= -0.3571). Thomisidae also exhibited positive correlation with maximum and minimum temperatures (r= 0.3515, 0.3870), maximum and minimum relative humidity (r= 0.1931, 0.3171) and rainfall (r= 0.2110) whereas negative correlation with bright sunshine hours (r= -0.0880). A positive correlation had been found with maximum and minimum temperatures (r= 0.1476, 0.5112), maximum and minimum relative humidity (r= 0.4184, 0.5364) and rainfall (r= 0.3578) whereas negative correlation with bright sunshine hours (r= -0.2946) in family Araneidae. More or less similar results had been observed by Singh *et al.* (2000) [12], wherein they found that most of abiotic factors had negative correlation with spider's population in the rice field from Faizabad. Yadav *et al*. (2017) [15] reported that maximum RH had a significant and positive impact on the population of the *Oxyopes* sp. in rice agro ecosystem of Bihar; Sidar *et al*. (2017) [11] revealed a non-significant positive correlation with maximum (0.074) and minimum temperature (0.28), morning (0.27) and evening RH (0.15), whereas rainfall (-0.20), wind velocity (-0.39) and sun shine hours (-0.14) showed a non-significant negative correlation with maize in Chhattisgarh. Patel *et al*. (2020) [7] had been noted that morning and evening RH and rainfall exhibited a positive correlation with spiders in cotton. In Telangana, the abundance of spiders revealed a positive correlation with RH and a negative one with temperature and rainfall in rice (Laxman *et al*., 2016) [4].

Table 5: Spider population during Rabi season 2020

SW	Number of spiders/plot	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	RAINFALL (mm)	BSH (hrs/day)
6	0	25.60	7.91	86.57	41.29	0.00	5.37
7	0	26.70	11.37	89.00	48.29	0.00	3.41
8	0	27.53	13.60	78.71	57.00	0.00	2.76
9	0	27.43	13.23	70.57	50.29	11.00	6.03
10	0	27.33	15.74	83.00	56.00	24.80	5.79
11	0	28.57	16.26	77.71	51.43	10.40	5.97
12	0	28.76	15.73	74.43	49.43	8.20	5.51
13	4	31.36	17.80	67.71	50.43	0.00	6.86
14	4	33.29	17.34	55.43	35.86	0.00	8.64
15	5	33.11	18.69	56.00	46.43	16.30	7.86
16	9	28.73	18.34	84.29	70.57	48.60	4.06
17	10	27.89	19.24	84.14	70.57	36.70	4.04
18	8	31.83	20.84	77.43	62.43	79.20	6.20
19	4	32.17	20.37	76.14	61.29	36.40	6.39
20	12	32.01	22.53	82.86	69.43	68.10	4.43
21	8	26.27	22.36	97.29	92.43	194.00	0.29
22	13	30.93	21.74	84.29	72.57	70.80	4.43
23	14	32.01	23.76	90.29	74.14	195.70	3.67
24	14	32.63	24.86	89.14	78.71	71.70	5.53
25	10	31.67	24.97	92.57	81.57	153.10	3.00
26	10	29.07	24.31	97.29	91.43	638.10	0.24
27	6	32.06	24.99	92.29	80.57	330.40	4.20
28	10	29.00	24.83	99.00	92.71	415.20	1.10
29	10	30.50	24.23	97.57	85.29	373.80	1.23
Total	151						

Table 6: Spider population during Rabi season 2021

SW	Number of spiders/plot	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	RAINFALL (mm)	BSH (hrs/day)
6	0	27.27	7.47	76.00	40.43	0.00	6.57
7	0	27.97	9.93	81.29	43.57	0.00	4.30
8	0	29.27	10.51	76.00	41.57	0.00	6.43
9	0	28.69	13.11	76.71	51.43	0.00	3.66
10	0	29.17	13.66	69.14	51.57	4.70	3.41
11	0	30.74	16.03	71.00	47.57	9.60	3.86
12	0	33.07	15.80	65.43	41.86	0.00	5.77

13	1	30.63	14.50	66.00	49.00	38.20	4.36
14	6	32.77	14.61	58.57	45.71	0.00	6.46
15	5	32.36	17.39	70.43	56.71	46.60	4.99
16	2	29.69	18.06	73.00	65.43	77.20	3.99
17	7	34.47	18.40	63.43	50.14	3.80	7.50
18	10	28.76	17.40	85.71	73.29	60.80	2.81
19	7	29.39	17.41	80.43	71.29	29.40	2.54
20	10	32.16	19.20	82.43	68.57	51.60	4.00
21	11	33.24	21.86	81.29	68.29	26.40	4.70
22	15	31.83	21.17	89.86	74.57	105.80	2.39
23	13	31.84	20.90	86.43	74.29	93.60	2.73
24	10	32.83	22.04	87.71	73.43	97.60	3.79
25	14	33.61	22.59	82.14	68.29	10.20	3.99
26	12	29.19	21.97	96.00	90.71	406.60	1.43
27	8	29.99	22.00	95.43	86.57	207.40	0.63
28	8	33.17	22.81	87.86	72.43	197.50	4.36
29	8	32.23	22.83	92.57	79.00	152.20	3.47
Total	147						

Table 7: Correlation of spider fauna with weather parameters of Rabi season 2020

Family	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	Rainfall (mm)	BSH (hrs/day)
Lycosidae	0.5051	0.7484	0.4574	0.6395	0.3734	-0.3218
Oxyopidae	0.3865	0.7646	0.4280	0.7115	0.3666	-0.3527
Tetragnathidae	0.3981	0.7099	0.4010	0.6180	0.4679	-0.3286
Salticidae	0.5296	0.7096	0.3856	0.5825	0.4524	-0.2673
Thomisidae	0.0978	0.3371	0.2259	0.3445	0.0880	-0.1589
Araneidae	0.3348	0.5069	0.1275	0.4122	0.4202	-0.2666

Table 8: Correlation of spider fauna with weather parameters of Rabi season 2021

Family	T Max (ºC)	T Min (ºC)	RH Max (%)	RH Min (%)	Rainfall (mm)	BSH (hrs/day)
Lycosidae	0.2968	0.6641	0.6005	0.7181	0.5086	-0.5013
Oxyopidae	0.5088	0.6895	0.4154	0.6195	0.3187	-0.3042
Tetragnathidae	0.3890	0.6721	0.5404	0.6534	0.3782	-0.3790
Salticidae	0.3166	0.6752	0.6012	0.6849	0.4127	-0.3571
Thomisidae	0.3515	0.3870	0.1931	0.3171	0.2110	-0.0880
Araneidae	0.1476	0.5112	0.4184	0.5364	0.3578	-0.2946

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