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Species Composition and Abundance of Riceland Spiders in Yezin Area, Nay Pyi Taw, Myanmar

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ABSTRACT

Spiders play an important role in regulating insect pests in agriculture ecosystems. In this study, spiders in rice fields were collected by visual countat weekly interval during monsoon rice, 2018. A total of 554 individuals, representing 7 families, 14 spider species and only a few unknown specimens were captured. Lycosidae was found as the most dominant family and comprised38.81% of the total catch, followed by Tetragnathidae (35.74%) and Linyphiiade (11.37%). Oxyopidae (5.96%) and Araneidae (5.96%) showed almost the same abundance. Salticidae(1.26%) and Theridae (0.96%) were the least abundant families. As an individual species, *Pardosapseudoannulata* (Lycosidae) represented as the most abundant spider whereas*Coleosomoctomaculatum* (Theridae) showed the least abundantaraneid fauna. On the other hand, spiders were positively correlated with some climatic factors such as sunshine, rainfall and temperature during study period.

KEYWORDS: *Spiders, species composition, diversity, rice fields*

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INTRODUCTION

Spiders are one of the most abundant predatory groups in terrestrial ecosystem. There are 110 families, 3859 genera and 42751 species of spider described in the world [1]. Spiders are important predators in natural and agricultural environments. They are carnivorous. A large number of spiders use web to capture prey whereas some spiders use “sit-and-wait” strategy to ambush and pursuit their prey. They feed on insects and small creatures. Therefore, they play an important role in pest control.

Rice is attacked by more than 100 species of insects and about 20 species can cause yield loss and economic damage [2]. The most important insect pests of rice are yellow rice stem borer, planthoppers, leafhoppers, etc. A variety of pest management practices have been employed in order to suppress the pest population density below the economic threshold levels. However, predation of insect pests by the naturally occurring natural enemies has nowadays received much attention.

Spiders can effectively decrease pest populations [3] including the most destructive insect pests of rice. The spiders play important roles in pest suppression in both natural and arable ecosystems. Spiders, which comprise over 35,000 species [4], are among the most abundant invertebrate predators in terrestrial ecosystems and are proposed to be model organisms for predators [3]. The great majority of spider species feed principally on insects. They colonize almost all habitats and the higher species diversity was found in natural and agricultural ecosystems.

Species richness, the number of species in a site or habitat, is a parameter in estimating the diversity of a particular area. Hence, species play an important role in measuring the diversity [5]. The integrated pest management is mainly focused on the acceptance of sustainable agriculture, the mood towards biodiversity conservation, the level of disturbance of agricultural communities and the species diversity in the community [6]. To evaluate ecosystem fitness, species richness and diversity are the most important parameters and they are also at high priority in biodiversity conservation [7]. High biodiversity returns ecosystems the flexibility to adapt and survive in a continually changing world. Therefore, addressing decrease biodiversity is crucial to ensure the continued existence of these ecosystems.

Monitoring the spider populations by visual sampling helps selecting the indicator species in rice fields. Management practices such as insecticide application and irrigation had a profound effect on the abundance of generalist predators in rice. Therefore, scientific study concerning with spiders harboring in agro ecosystems is highly valuable. From this study, the effect of Riceland spiders on herbivorous pests and the changes of climatic factors on spider colonization can be observed [8]. In Myanmar, however, there is a dearth of information concerning with Riceland's spiders. The present study is therefore aimed at documenting the species composition of spiders in rice fields in Yezin area, Nay Pyi Taw, Myanmar.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out in the fields near Yezin Agricultural University and Kantharaye village located in Nay Pyi Taw, Myanmar. It is located at 19.8409N and 96.2633E. The altitude is about 114 m. The temperature ranged from 21°C to 42°C, the relative humidity 78% - 95%, rainfall from 0 mm to 14 mm and sunshine 2.93 hour to 6.93 hour, respectively during the study period. The study was conducted during the monsoon rice season (August – October), 2018.

Experimental protocol

Spiders in the rice fields were collected at weekly interval from one week after transplanting rice seedlings to one week before harvest. Two experimental sites, one acre in each location, were selected for collecting spiders by visual count. In each location, two 0.5 acre fields were selected for data collection. Subsequently, five sampling plots, one square meter each, were subdivided as sampling site within each 0.5-acre field. There were 24 hills within each sampling plot. Spiders were collected from those sampling plots. All collected spiders species were kept in a mixed solution of 75% ethanol + 5% glycerine + 5% glacial acetic acid for further identification.

Because of the difficulty of identifying juvenile spiders, only adult stages were identified in the laboratory of Department of Entomology and Zoology, Yezin Agricultural University using the keys presented by [9].

Data Analysis

Index of Species Diversity: Abundance and species richness of insect species in monsoon rice production was measured by the Shannon-Wiener function [10]. Shannon Wiener function was used to measure the index of species diversity by the following formula:

$$H = -\sum_{i=1}^{s} (P_i)(\log_2 P_i)$$

Where;

H = index of species diversity or information content of sample (bits/individual)

s = number of species

pi = proportion of total sample belonging to i^{th} species

Equitability (evenness) can be measured by the following formula;

E = H / H max

Where;

E = equitability (range 0 – 1)

H = observed species diversity

H max = maximum species diversity = $\log_2 S$

Shannon-Wiener function was analyzed in Excel 2010 and the rest of the data were analyzed using JMP (Version 10). The data were firstly tested for homogeneity of variances (Bartlett's test, P > 0.05). If homogeneity of variances were not met by any transformations, non-parametric tests were used. Total individuals captured in each month were analyzed by one-way ANOVA.

RESULTS AND DISCUSSION

Species diversity and richness of spiders in monsoon rice of Yezinarea

The index of spider species diversity and equitability in monsoon rice at Yezin area were estimated by using Shanon-Wiener function.

For the visual count in two locations of monsoon rice, 14 spider species belong to 7 families and only a few unknown specimens were collected (Table 1). The total number of spiders found in all experimental sites during monsoon season under visual count was 554 individuals (excluding unknown species) in which *Pardosapseudoannulata* (Boesenberg and Strand) was found in the highest number in the rice fields of YAU whereas Tetragnathidae showed more abundant in that of Kantharaye village.

Table 1 Average number of spiders collected during the study period.

No.	Spider Families	Spider species in rice fields	Average spider per week	
			Yezin	Kantharaye
1	Lycosidae	1. Pardosapseudoannulata	20.50	15.33
2	Tetragnathidae	1. Tetragnathamaxillosa	8.33	11.67
		2. Tetragnatha nitens	0.50	0.67
		3. Leucaugefastigata	5.50	6.33
3	Theridiidae	1. Coleosom octomaculatum	0.17	0.17
		2. Chrysso sp.	0.33	0.17
4	Araneidae	1. Singa sp.	0.50	0.83
		2. Argiopebruennichii	0.50	1.50
		3. Argiopecatenulata	0.67	1.50
5	Linyphiidae	1. Erigonidiumgraminicola	3.33	2.83
		2. Atypenaformosana	1.67	2.67
6	Salticidae	1. Myrmarachneassimilis	0.50	0.67
7	Oxyopidae	1. Oxyopesjavanus	1.50	1.83
		2. Oxyopeslineatipes	0.83	1.33

Pardosapseudoanulata (Lycosidae) were the most abundantaraneid fauna gathered from the whole period of study in rice paddies of Yezin area. The population of ground dwelling spiders peaked in the June and were dominated by Lycosidae [12]. The similar studies in temperate zone demonstrated that the Lycosids accounted for 43% of the cursorial species [13].

The abundance of spider families was depicted in Figure (1). Family Lycosidae constituted up to 38.81% followed by Tetragnathidae (35.74%) and Linyphiiade (11.37%), Oxyopidae (5.96%), Araneidae (5.96%), Salticidae (1.26%) and Theridae (0.90%) in descending order. Reference [14] reported the similar results in which Lycosidae is one of the most abundant families of ground dwelling hunting spiders. The possible reason for their high abundance in the collection might be their active foraging behavior and high adaptation in wetland environment.

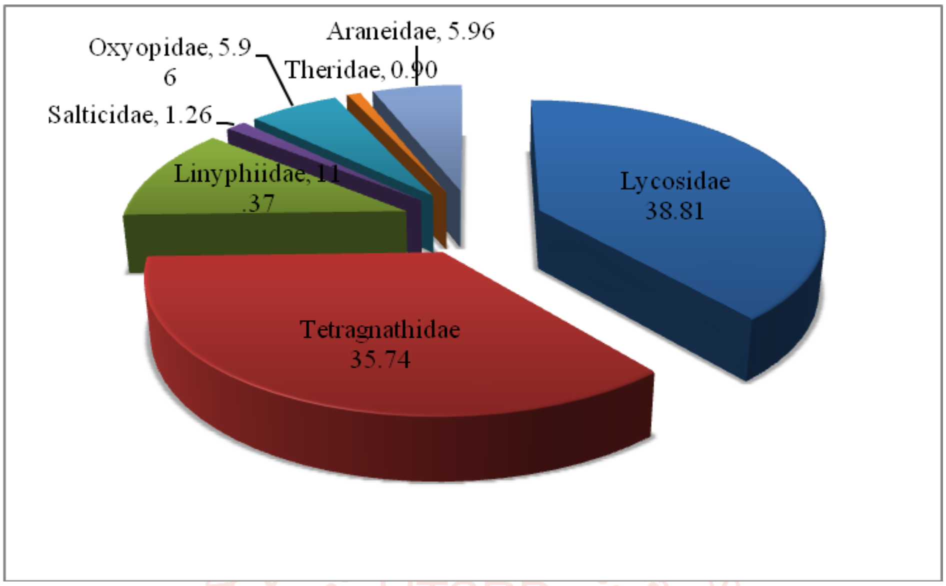


Figure 1 Relative abundance of spider families during the study period

Table 2 Diversity and equitability derived from the Shannon-Wiener function

No.	Spider species in rice paddies of Yezin Area	Proportional abundance (p_i)	$-(p_i)(\log 2p_i)$
1	Pardosapseudoannulata	0.066787	0.001343
2	Tetragnathamaxillosa (Thorell)	0.046931	0.000663
3	Leucaugefastigata (Simon)	0.036101	0.000392
4	Tetragnathanitens (Audouin)	0.023466	0.000166
5	Coleosomoctomaculatum	0.388087	0.045334
6	Chrysso sp.	0.216606	0.014122
7	Singa sp.	0.128159	0.004944
8	Argiopebruennichii (Scopoli)	0.012635	4.81E-05
9	Argiopecatenulata (Doleschall)	0.00361	3.92E-06
10	Erigonidiumgraminicola (Sundevall)	0.005415	8.83E-06
11	Atypenaformosana (Oi)	0.012635	4.81E-05
12	Myrmarachneassimilis Banks	0.021661	0.000141
13	OxyopesjavanusThorell	0.023466	0.000166
14	Oxyopeslineatipes (C.L. Koch)	0.01444	6.28E-05
Index of species diversity, H =			**0.07**
Hmax = Log2S = Log2 (14) = Log14/Log2			**3.81**
Equitability = E = H/Hmax			**0.02**

The index of species diversity (H) of spider during study period is 0.07 and evenness of species (E) is 0.02 (Table 2). The equitability value (E), 0.02indicates that there is single species dominance and the spider species were not equally abundant in study area. Spider abundance is directly related to habitat complexity and kinds of vegetation [9]. The higher the numbers of spiders were observed as the rice plants increase its complexity with time.

Spider species richness

Of the adult individuals, 14morphospecies were determined during the study period in both locations (Table 1). There was a significant difference between the catch of spider species and month of catch($p = 0.0067$). In our results, only 9 species were captured in August (Figure 2), the more spider species was obtained in the catch of September, followed by that of October (Figure 2). According to figures, more lycosids were captured at YAU fields while more tetragnathids obtained from that of Kantharaye village throughout the survey period except August.

According to figure (2), the most abundant araneid was wolf spider *Pardosapseudoannulata* (Lycosidae) that was observed in every week and the least abundant species was *Coleosomoctomaculatum* (Araneidae). In August, the more *P. pseudoannulata*

(Lycosidae) was obtained from Kantharaye fields compared to that of YAU's. However, in catch of September and October, *P. pseudoannulata* (Lycosidae) showed more abundant species at YAU fields, followed by *T. maxillosa* (Tetragnathidae). Only those two spider families represented at higher percentage throughout the study period compared to other families.

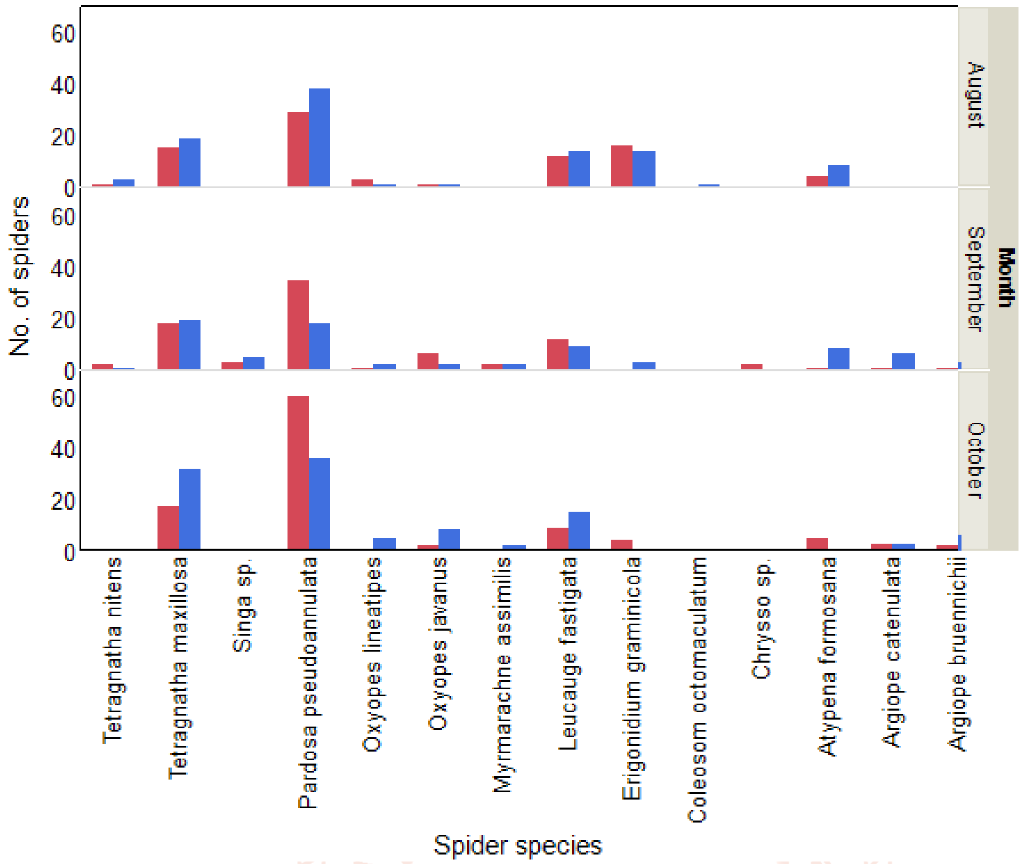
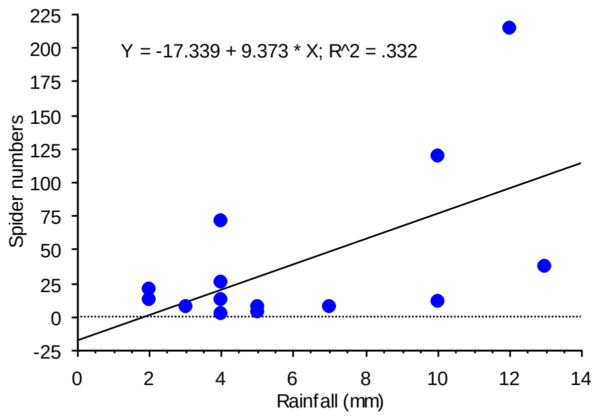


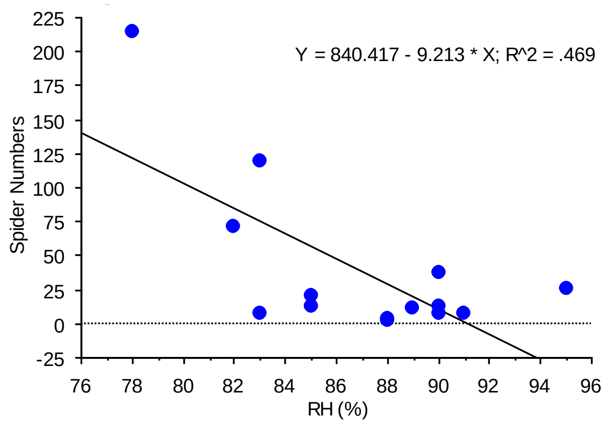
Figure.2 Abundance of the spider species in rice fields of Yezin area duringstudy period (August – October)

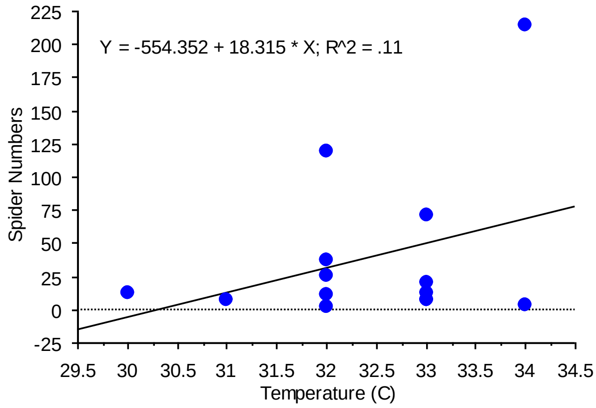
The variation in colonization of spider species in rice fields might depend on their foraging strategies and prey they consume. For example, web-building spiders rely almost exclusively on insects as their prey; cursorial hunting spiders additionally capture and eat other prey including even their conspecifics into their diet [15]. However, cursorial spiders also differ strongly in their foraging mode, as some employ a sit-and-wait strategy (Thomisidae), while others actively hunt down their prey (Salticidae) [3]. Wolf spiders are visually orienting predators, which can detect their prey by movement and vibrations ranging from sit-and-wait strategy (*Hogna*sp) to more active predators that hunt down their prey (*Pardosa*sp). As major prey group of wolf spider diets includes Diptera, Hemiptera, Collembola, and Araneae [16], Lycocid family can occupy the rice fields whether the insect pest is present or not.

Species composition of spiders in relation to some climatic factors

It was observed that spider numbers and some climatic factors such as temperature and rainfall within respective range were positively correlated. However there was a negative correlation between number of spiders captured and relative humidity. Almost no correlation was observed spider numbers and sunshine. According to results, it was clearly demonstrated that increase in rainfall (0 – 14 mm) and temperature (29.5°C– 34.5°C) favored increasing spider population to some extent. During the study period, most of the time was cloudy condition and as a result, a few species of spider were captured. In this study, increase in rainfall (0 – 14 mm) in favored the increase of spider population, however, rainfall over 190 mm suppressed the spider population [17]. There was a scarcity of rain during our study although the RH was comparatively high.







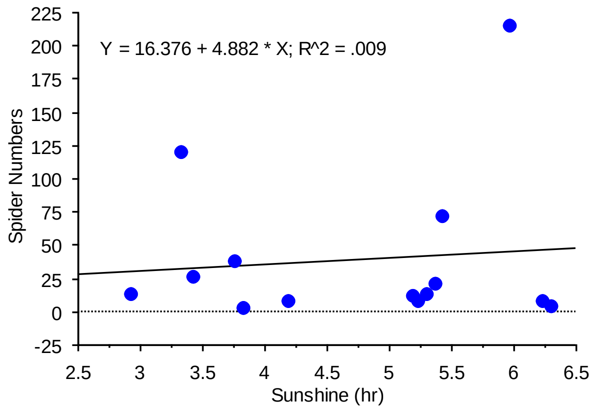


Figure 3 Relationship between spider numbers and (a) rainfall (mm), (b) relative humidity (%), (c) temperature (°C), (d) sunshine (hr) through August to October 2018 in monsoon rice of Yezin area.

Regardless of fairly high temperature through August to October, the spider population kept increased (Figure 3). That result might be temperature has no effect on spiders during this range. However extreme temperature could hinder the increment of spider population. Ecological factors observed in study area kept on boosting spider population regardless of no rain, fairly high temperature and low percent of relative humidity. The seasonal changes in the abundance of the spiders depend on their inherent life cycle schedules and effect of temperature, relative humidity and rainfall [18]. In the present study, the highest abundance of spider was recorded in the month of October due to high temperature with well-suited light period (sunshine) and not much rainfall.

CONCLUSION

This study was a preliminary survey and just to explore the species composition of spiders in rice paddies in Myanmar. In order to get higher species evenness, conservation mode is urgently needed. As spiders are bio-indicators, the conventional practices of rice farmers such as injudicious use of chemical pesticides, prophylactic sprays and destroying refuges should be reviewed.

Moreover, further studies regarding ecological factors of the keystone spider species in relation to their prey will be needed to uncover the hidden generalist predators of the notorious rice insect pests.

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