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# REPRESENTATIVES OF SPIDER FAMILIES (ARACHNIDA: ARANEAE) IN EXPERIMENTAL PLOTS OF PHYSIC NUT PLANTATIONS (*JATROPHA CURCAS* L.) IN KAMPAENG SAEN CAMPUS OF KASETSART UNIVERSITY, THAILAND

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## Abstract

KOŠULIČ ONDŘEJ, VICHITBANDHA PATCHANEE. 2015. Representatives of Spider Families (Arachnida: Araneae) in Experimental Plots of Physic Nut Plantations (*Jatropha curcas* L.) in Kampaeng Saen Campus of Kasetsart University, Thailand. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 63(2): 425–431.

This paper makes a faunistic contribution to knowledge of the spider family composition in the experimental research plots of Kasetsart University in Thailand (Kampaeng Saen Campus, Nakhon Pathom province). Spider families were investigated both on the foliage and on the ground in physic nut plantations (*Jatropha curcas* L.). Ground dwelling spiders were collected by pitfall traps while foliage spiders were sampled by sweeping and hand collecting. In total, 655 spider specimens were collected and identified as belonging to 17 families. The dominant ground dwelling spider families were Lycosidae (50, 1%) and Gnaphosidae (5, 3%) while the dominant foliage spider families were Oxyopidae (14, 4%) and Salticidae (8, 4%). We found that significant determinant of spider diversity and abundance was vegetation and foliage coverage which affect number of spider families throughout the investigated area.

Keywords: Araneae, families' diversity, physic nut plantation, *Jatropha curcas* L., Kasetsart University, Thailand

## INTRODUCTION

The potential of bio-diesel production from physic nuts (*Jatropha curcas* L.) has been studied in several countries (Prueksakorn *et al.*, 2010; Nithiyanantham *et al.*, 2012; Ye *et al.*, 2009) and production areas are increasing. Thus, physic nut plantations have become one of the future agricultural systems that need to be investigated. There are some studies on the influence of mites, insects and true bug pests on physic nut (Grimm, 1999; Grimm & Maes, 1997; Grimm & Führer, 1998; Kavitha *et al.*, 2007). However, little information is available on impact of spiders on this system in Southeast Asia, while spiders in other agricultural habitats have been investigated extensively (Barrion & Litsinger, 1984, 1995; Murphy & Murphy, 2000). Therefore, the current faunistic investigation of spiders was undertaken in several experimental research plots of physic nut plantations located in Kampaeng Saen Campus of Kasetsart University in Thailand.

Spiders were used as model organisms because they are among the most common ubiquitous land invertebrates, constituting an essential portion of the predatory arthropods in several ecosystems (Wise, 1993; Chatterjee *et al.,* 2009). In agroecosystems, spiders play an important role as a generalist pest control agent (Marc *et al*., 1999; Nyffeler & Benz, 2009). According to Ekschmit *et al*. (1997), they are a necessary component of efficient, sustainable, and low-input agricultural systems. Therefore, spiders are recognized as important natural enemies that help to reduce pest populations, particularly early in the season when specialized predators are not present (Oraze and Grigarick, 1989; Riechert, 1999; Birkhofer *et al*., 2008).

The occurrence of spiders in agricultural landscapes is limited foremost by microhabitat conditions (Luczak, 1979; Samu *et al*., 1999). Environmental conditions on the microhabitat scale are determined especially by vegetation structure, bare soil patches, and succession stage of the microhabitat (Gibson *et al*., 1992; Seyfulina, 2005). Particularly, these microhabitat conditions are maintained in agroecosystems by agricultural interventions (e.g. chemical treatment, management methods) which can interfere with many epigeic and even foliage spiders (Ysnel & Canard, 2000; Bajwa & Niazee, 2001; Horton *et al*., 2001; Pekár, 1999; Pekár & Kocourek, 2004; Hanna & Hanna, 2012).

This report provides the first faunal records on spider families in physic nut plantations with description of significant determinants affecting spider families' diversity. We conclude that these results could be used for future studies focused on effect of different agricultural and chemical treatments on spiders and their importance in pest regulation in this kind of agroecosystem.

## MATERIAL AND METHODS

### Location of Study Plots

Faunal investigation of physic nut plantations was carried out on an experimental farm of Kasetsart University (Fig. 1) located in central Thailand (Kampaeng Saen campus, Nakhon Pathom Province). We studied three plots of physic nut plants which differed in the amounts of shade cover by shrubs of *Jatropha curcas* and undergrowth of herbal vegetation:

1. Shade cover around 50%, undergrowth of herbal vegetation 50%, GPS location 14°1'58.77"N, 99°58'13.37"E;
2. Shade cover around 75%, undergrowth of herbal vegetation 90%, GPS location 14°1'56.08"N, 99°58'9.55"E;
3. Shade cover around 90%, undergrowth of herbal vegetation 10%, GPS location 14°1'52.23"N, 99°58'7.79"E.

1: *Row of physic nut shrubs in experimental site 3 (Kampaeng Saen Campus, Kasetsart University in Thailand)*

### Collection and Evaluation of Material

We used pitfall traps as a primary collecting technique supplemented by sweeping of herbal vegetation and searching the foliage of randomly selected physic nut plants during November and December 2011 (dry season). These methods covered the major components of the spider fauna, i.e. which contains the majority of bioindicatively-important species (Růžička, 1987). Pitfall traps were filled with 4% formaldehyde solution as a fixative fluid.

Five pitfall traps were placed in each of the study plot (altogether three plots). The traps were arranged at about 5-meter intervals. They were first placed on November 6 and collected two times at 14-day intervals (November 20 and December 4).

Sweeping of herbal vegetation and hand collecting from foliage of randomly selected physic nut plants took place in three lines on each plot. After collection, the obtained material was preserved in 70% ethanol. Voucher specimens are deposited in personal collection of Ondřej Košulič (Mendel University in Brno).

All spider material was determined to the family level, and some of the specimens were determined to the genus and species level by means of relevant literature (Daxiang *et al.*, 1999; Deeleman-Reinhold, 2001; Murphy & Murphy, 2000; Jocqué & Dippenaar-Schoeman, 2006). The Shannon Index, Richness, Sorensen similarity Index, Simpson Index, and Evenness (Southwood & Henderson, 2000) were used to compare the community structures and diversity of spiders among different plots. Nomenclature and arrangement of families, genera and species follow the most recent version of the World Spider Catalog (2015).

## RESULTS AND DISCUSSION

### Faunistic Overview

During the arachnological research of physic nut plantations from 6 November 2011 to 20 December 2011, 655 spider specimens were collected in total (550 adults and 105 juveniles). They belonged to 17 families. Most spiders (467 specimens in 12 families) were found using the method of pitfall traps (Tab. I). Other 188 specimens belonging to eight families were collected using the sweeping and visual searching methods. From these, five families were not recorded using the pitfall traps. As expected, they were specialized web-building and foliage dwelling spiders belonging to the families Araneidae, Oxyopidae and Philodromidae. The families Clubionidae and Sparassidae also belong to this group, however they can be found under stones and on the ground as well as ground dwelling spiders. Among the most richness families belong Lycosidae (epigeic representatives), Oxyopidae and Salticidae (both of them foliage spiders) (Tabs. I–II).

### Presence of Epigeic Spiders

The most abundant epigeic spider family found at the *Jatropha curcas* plantation was Lycosidae with a total of 333 adult specimens (Tab. I). Here, we found two representatives (*Hippasa* sp., *Pardosa* sp.) which belonged to the most numerous spiders at all.

I: *Total numbers of spiders in each family collected by two different methods (pitfall trapping between the central rows of physic nut plots, and sweeping, together with hand collecting, from bushes of randomly selected physic nut plants)*

| Families | Pitfall traps | Sweeping and hand collecting | Total | Percentage |
|---|---|---|---|---|
| Lycosidae | 333 | | 333 | 50.84 |
| Oxyopidae | | 94 | 94 | 14.35 |
| Salticidae | 7 | 48 | 55 | 8.40 |
| Gnaphosidae | 35 | | 35 | 5.34 |
| Theridiidae | 25 | | 25 | 3.82 |
| Agelenidae | 20 | | 20 | 3.05 |
| Araneidae | | 18 | 18 | 2.75 |
| Tetragnathidae | 6 | 12 | 18 | 2.75 |
| Zodariidae | 18 | | 18 | 2.75 |
| Thomisidae | 8 | | 8 | 1.22 |
| Linyphiidae | 3 | 4 | 7 | 1.07 |
| Philodromidae | | 6 | 6 | 0.92 |
| Pisauridae | 5 | | 5 | 0.76 |
| Stenochilidae | 5 | | 5 | 0.76 |
| Clubionidae | | 4 | 4 | 0.61 |
| Corinnidae | 2 | | 2 | 0.31 |
| Sparassidae | | 2 | 2 | 0.31 |
| **Total** | **467** | **188** | **655** | **100** |

II: *Number of individuals and families in each of three studied plots*

| **Number of families in each habitat** | **16** | **13** | **13** |
|---|---|---|---|
| **Families** | **Number of individuals in each habitat** | | |
| | **Plot 1** | **Plot 2** | **Plot 3** |
| Agelenidae | 17 | 3 | |
| Araneidae | 15 | 1 | 2 |
| Clubionidae | 1 | | 3 |
| Corinnidae | 1 | | 1 |
| Gnaphosidae | 15 | 12 | 8 |
| Linyphiidae | 3 | 2 | 2 |
| Lycosidae | 198 | 100 | 35 |
| Oxyopidae | 49 | 30 | 15 |
| Philodromidae | 4 | 2 | |
| Pisauridae | 4 | | 1 |
| Salticidae | 30 | 19 | 6 |
| Sparassidae | | 1 | 1 |
| Stenochillidae | 5 | | |
| Tetragnathidae | 4 | 3 | 11 |
| Theridiidae | 4 | 15 | 6 |
| Thomisidae | 6 | 2 | |
| Zodariidae | 4 | 5 | 9 |
| **Total** | **360** | **195** | **100** |

These spiders comprised nearly half of the lycosid material. Further highest representation of epigeic families were found in ground dwelling spiders of Gnaphosidae and Theridiidae which were found in all study plots. Representatives of less common and scarce families in Thailand (Stenochilidae, Pisauridae, Corinnidae) were also found in all plots by pitfall traps. Stenochilids belong to the interesting findings as these spiders are more common in nature or semi natural habitats in forest ecosystems than in disturbed urban regions like our study area (Deeleman-Reinhold, 2001; Murphy & Murphy, 2000). Only a few specimens of these family were found.

## Presence of Foliage Spiders

The most common foliage spider family found at the plantation was Oxyopidae. Within this family, only *Oxyopes lineatipes* (C. L. Koch, 1847) was found and determined to the species level. This species has been reported as an important predator in brinjal fields (*Solanum melongena* L.), snakegourd plantations (*Trichosanthes cucumerina* L.) (Sankari & Thiyagesan, 2010) and rice fields (Barrion *et al.*, 2012). Other abundant foliage spider families were Salticidae and Araneidae. Araneidae are orb web builders that prey upon many leafhoppers and small epigeic bugs which are potential pests of physic nut plants (Grimm, 1999). All of these mentioned representatives of spider families represent an important part of physic nut plantations, as they can play a role as important predators of various pests (Ekschmit *et al.*, 1997; Marc *et al.*, 1999). The lowest abundance was found in families Sparassidae (*Heteropoda venatoria* Linnaeus, 1767 – two adult males were found by hand collecting on the bark of a physic nut plant) and Clubionidae and Linyphiidae.

## Evaluation of Studied Experimental Plots

The lowest occurrence of spiders (abundance and diversity) was found in the third experimental plot characterized by highest shade cover (90% close canopy of *Jatropha curcas*). However, in comparison by richness indexes, the highest values of diversities with the Shannon index, Simpson index, and Evenness were found there. This pattern might result from the less dominant families which were collected in this plot. However, spider compositions in all three plots were more or less similar (Sorensen similarity index among these plots were about 0.8; Tab. III).

The highest occurrence of spiders was in the first experimental plot characterized by a disturbed grass turf and non continuous vegetation structure with exposed soil substrate (Tab. III). These microhabitat conditions support the occurrence of epigeic species (Hatley & Macmahon, 1980; Sunderland & Samu, 2000; Tropek *et al.*, 2010), especially species of spider which are typical for open habitats (Murphy & Murphy, 2000; Košulič *et al.*, 2014). In the second and third plots, the species richness and abundance was substantially lower than in the first plot (Tab. III). There was a tigher connection with the physic nut shrubs which shaded the ground in the second and third plots. Shading resulted in a change of

III: *Abundance, Richness, Evenness, Shannon index, Simpson index, and Sorensen similarity index estimated from specimens collected from all methods in each plot*

| Estimated values of | Plot 1 | Plot 2 | Plot 3 |
|---|---|---|---|
| % Shade | 50 | 75 | 90 |
| % Vegetation | 50 | 90 | 10 |
| Abundance | 360 | 195 | 100 |
| Richness | 16 | 13 | 13 |
| Evenness | 0.60 | 0.64 | 0.80 |
| Shannon index | 1.67 | 1.64 | 2.00 |
| Simpson index | 0.67 | 0.70 | 0.81 |
| | Plot 1 & Plot 2 = 0.83 | | |
| Sorensen similarity index | | Plot 2 & Plot 3 = 0.8 | |
| | Plot 1 & Plot 3 = 0.83 | | |

the microclimatic features, maintained by the herbal vegetation cover in the first plot, so that conditions were not suitable for some epigeic spiders (Costello & Daane, 1998; Košulič & Hula, 2013). The same assumption was confirmed in the foliage spiders where the abundance levels declined from the first plot to the third plot. Seyfulina (2005) also suggested the preference of dry microhabitat of some epigeic and foliage species of spiders in winter wheat agroecosystem. Thus, the less shade or the drier habitat in plot 1 may positively affect the abundance of epigeic and foliage spiders in the physic nut plantations.

## CONCLUSION

From November to December 2011, a research of araneofauna of physic nut plantations was performed on three study sites located in experimental plots of Kasetsart University in Thailand. Altogether, 655 specimens belonging to 17 families were captured. Majority of spider (467 specimens in 12 families) were found using the method of pitfall traps. Using the sweeping and hand collecting, 188 additional specimens belonging to eight families were collected. Lycosidae, Oxyopidae and Salticidae were the most dominant families. Out of these, *Oxyopes lineatipes* belong to the most abundant foliage spider and *Hippasa* sp. and *Pardosa* sp. were the most dominant epigeic spiders. Overall, the physic nut plantations offered a relatively rich diversity of spiders. Important factor affecting spider diversity and abundance was vegetation and foliage coverage which affect number of spider families througout the investigated area.

We conclude that these features (mainly foliage coverage) may affect the microhabitat conditions (vegetation structure, presence of bare soil, presence of sparse grass turf) which can interfere with many epigeic and even foliage spiders. In future studies, more collecting efforts should be considered in survey of spider fauna in the physic nut plantations. We assume that more comprehensive studies could confirm importance of different environmental factors for diversity and abundance of spiders in this kind of agroecosystem.

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