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SPIDER ASSEMBLAGE IN OLIVE GROVES IN SOUTHERN OF BRAZIL

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ABSTRACT

Spiders represent an abundant group of predators within the agroecosystems, and in olive groves of Europe spiders are important predators and may significantly reduce the attack of pests. In Brazil there are only few investigations that study the assembly of spiders in agroecosystems. This research aimed to characterize the assembly of spiders in olive groves in Rio Grande do Sul. The study was conducted from October 2010 to October 2012, in five groves of the Municipalities of Pelotas, Bagé, Rio Grande, Cachoeira do Sul and Santana do Livramento. Spiders were monthly collected from the tree canopy by beating tree branches using a modified japanese umbrella device. Two samples per tree were taken (one on the shaded face and another on the sunny face). Each sample took 10 seconds, so 400 seconds were spent in 20 plants of each olive grove. The faunal analysis of the results was performed by determining dominance, abundance, frequency and constancy of species. It was obtained a wealth of 38 species of spiders distributed in 10 families. The predominant species were *Sphecozone* sp.1 and sp.2, *Anelosimus studiosus*, *Eustala* sp.1, *Cheiracanthium inclusum*, *Misumenops* sp.1, *Sanogasta* sp.2, and morphospecies sp.1 (Salticidae).
Additional key words: Biological control, natural enemies, olives, predators

RESUMEN

Colección de arañas en olivares del sur de Brasil

Dentro de los agroecosistemas, las arañas constituyen un grupo de depredadores muy abundante. En olivares de Europa las arañas son importantes depredadores y pueden reducir significativamente el ataque de plagas. En Brasil son escasos los trabajos que estudian las especies de arañas en los agroecosistemas. Debido a ello, el presente trabajo se orientó a caracterizar las especies de arañas en olivos de Rio Grande del Sur. El estudio fue realizado entre octubre de 2010 y Octubre de 2012, en cinco olivares de los municipios de Pelotas, Bagé, Rio Grande, Cachoeira del Sur y Santana do Livramento. En cada área experimental se realizó un muestreo de la araneofauna a través de colectas mensuales realizadas con paraguas entomológicos en la copa de los árboles. Se realizaron dos colectas por árbol, tanto en la cara sombreada como en la soleada. Cada muestra se tomó durante 10 segundos lo que resultó en un tiempo total de 400 segundos en las 20 plantas muestreadas por olivar. Se realizó el análisis faunístico de los resultados, determinando la dominancia, abundancia, frecuencia y constancia de las especies encontradas. Se observó una riqueza de 38 especies de arañas distribuidas en 10 familias. Las especies predominantes fueron *Sphecozone* sp.1 e sp.2, *Anelosimus studiosus*, *Eustala* sp.1, *Cheiracanthium inclusum*, *Misumenops* sp.1, *Sanogasta* sp.2 y morfoespecie sp.1 (Salticidae).
Palabras clave adicionales: Control biológico, depredadores, enemigos naturales, olivos

INTRODUCTION

The Order Araneae has 42,055 species in 110 families worldwide, of which 808 species of 51 families occur in Rio Grande do Sul State, in Brazil (Buckup et al., 2010, Cardenas and Barrientos, 2011). Spiders comprise a large fraction of predator species in agroecosystems, where insects (especially flies and moths) are the main prey. These arachnids are more sensitive to pesticide application than their prey, and therefore are good bioindicators of the risk of an outbreak of pests in olive groves (Loverre and Addante, 2011). Given their exclusive predator habit, they contribute to the regulation of pest population levels (Garcia, 1997).

In Brazil, there are few descriptions of the assemblage of spiders in agroecosystems, which

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include irrigated rice (Corseuil et al., 1995), grain sorghum (Campos et al., 1999), corn (Garcia et al. 2004), soybeans (Corseuil et al., 1994; Chiaradia et al., 2011), citrus groves (Ott et al., 2007, Morais et al., 2007), and eucalyptus forests (Rodrigues et al. 2010).

Spider diversity in orchards is different than in natural systems, because orchards provide a stable and lasting environment that favors some families of spiders that live in the canopy (Morais et al., 2007). Spiders included in the families Linyphiidae, Philodromidae, Thomisidae and Salticidae are important predators in the canopy (Ghavami, 2006, Cardenas and Barrientos, 2011). Linyphiidae presents the highest population in olive groves in America and Europe. The species *Philodromus* spp. are the most frequent followed by *Salticus* spp. (Latreille, 1804), and *Icius hamatus* (Koch, 1846) (Morris et al., 1999; Ghavami, 2006).

Spiders are important predators of the olive moth *Prays oleae* (Bernard, 1788) (Lepidoptera: Yponomeutidae) and may reduce it by 80 %, being *Philodromus* spp., *Salticus* spp. and *Iciushamatus* the most common. They feed on eggs and larvae and in some cases have reduced the pest population by 60 to 80% in olive groves in Spain (Morris et al., 1999; Ghavami, 2006),

The occurrence of spiders in olive groves can be an important contribution to reducing natural populations of phytophagous arthropods due to their exclusively predator diet (Rei et al., 2011). Spiders have been found in olive groves in Portugal in the canopy and on the ground; this represents 20 % of the total predators caught in an olive grove, and presents the greatest diversity of species. Several families were found, such as Thomisidae, Philodromidae, Clubionidae, Oxyopidae and Theridiidae (Rei et al., 2011). Moreover, Santos et al (2009) using beating trays in olive groves in Portugal found that almost 50 % of the predators belongs to Araneae.

Considering the lack of publications about spiders in olive groves in South America, this study aimed to characterize the assemblage of spiders in olive groves in Rio Grande do Sul State.

MATERIAL AND METHODS

The study was conducted from October 2010 to October 2012, in five olive groves in Rio Grande do Sul State, Brazil (Table 1).

In each experimental area, monthly samplings of araneofauna were carried from the canopy by beating tree branches using a modified japanese umbrella device, according to the methodology proposed by Rei et al. (2011). Two samplings were performed in each of 20 olive trees, one on the shaded side and the other on the sunny side, spending 10 seconds at each side, totaling 400 seconds per olive grove. Specimens collected were placed in vials with 70 % alcohol and taken to the Laboratory of Insect Ecology, Federal University of Pelotas. The species were identified by the second author in comparison with the material deposited in the collection of the Instituto Butantan, SP.

The frequency of spiders was determined by the percentage of individuals of each species in relation to the total number of adults obtained in the collections performed at each site. Species were classified as uncommon (PF), frequent (F) and very frequent (VF) (Thomazini and Thomazini, 2002). The constancy measure was determined for each species in the studied crop through the equation presented in Silveira et al. (1976) where species are classified as constant (W), accessory (Y) and accidental (Z). The calculation of populations abundance and their classification into rare (R), disperse (D), common (C), abundant (A) and very abundant (Va) were performed according to Garcia and Corseuil (1998). The species dominance for each orchard was also determined and the species were classified into dominant (D) when the frequency values were higher than the limit calculated by the equation proposed by Silveira et al. (1976).

RESULTS AND DISCUSSION

A richness of 38 spider species distributed into 10 families was recorded (Table 2). In a study conducted in olive groves in Spain, Cardenas et al. (2015) found 12 families with 39 species in Córdoba, and 10 families with 47 species in Granada.

The most representative families were Anyphaenidae, with eight species, and Araneidae, with seven species. The families with the lowest number of species were Miturgidae, Nesticidae and Tetragnathidae, each with one species only (Figure 1).

The families Anyphaenidae and Araneidae contain 38.5 % of the total numer of species, followed by Theridiidae and Salticidae, with 13.2 % each. These families have also been found associated with citrus orchards in Rio Grande do Sul State (Ott et al., 2007; Morais et al., 2007).

Table 1. Areas of arthropod collections in Rio Grande do Sul State: Location and characteristics of groves

Municipalities	Location	Area (ha)	Spacing (m)	Age (years)	Cultivars*
Pelotas	S 31°40'54" W 52°26'11"	2	6 x 6	4-5	1,2,3,4,5,6
Bagé	S 31°08'44" W 54°11'42"	2	7 x 2.8	4-5	1,2,3,4,5,6
Rio Grande	S 31°08'42" W 54°11'45"	1.5	10 x 5	>40	7
Cachoeira do Sul	S 30°00'30" W 52°51'53"	40	6 x 4	4-5	1,2,3,4,5,6
Santana do Livramento	S 31°08'42" W 54°11'45"	20	7 x 4	2-3	1,2,3,4,5,6

*Cultivars: 1-Arbequina; 2-Arbosana; 3-Koroneiki; 4-Frantoio; 5-Manzanilla; 6- Picual; 7- Galega.

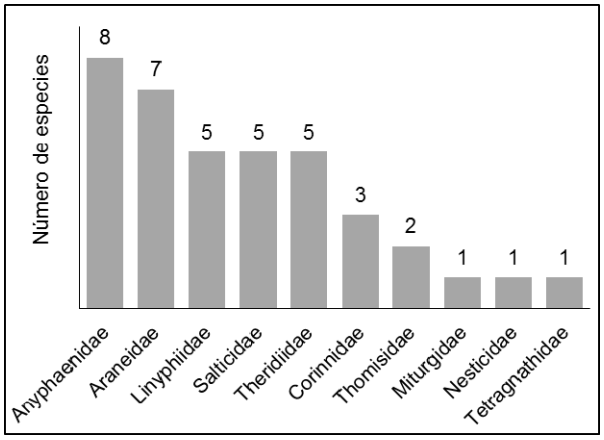

Figure 1. Number of species per family using beating trays in five olive groves at five municipalities of Rio Grande do Sul State from October 2010 to October 2012

As for abundance, the most abundant families were Linyphiidae, Salticidae, Theridiidae, Araneidae and Anyphaenidae. In olive groves of Portugal the most abundant families were Theridiidae, Thomisidae, Philodromidae, Araneidae and Salticidae, corresponding to 85% of the catches of Araneae (Rei et al., 2011). Also in Portugal, the most abundant families were Salticidae and Philodromidae (Morris et al., 1999). Linyphiidae had higher populations in olive groves in America and Europe (Ghavami, 2006), which corresponds to the results obtained here, with Linyphiidae showing the highest population.

A total of 437 spiders, discriminated in 65 males, 87 females (adults 34.8%) and 285 juveniles (65.2%) were collected, which indicated that olive trees serve as a shelter for immature spiders. Cardenas and Barrientos (2011) obtained 35.9% adults and 64.1% immature among 4,298 individuals collected. As a feature of the community, we obtained a Shannon-Weaner index of 3.15, and an Equitability Index of 0.9.

The highest number of spider individuals per species sampled in the groves were *Sphecozone* sp. 2 with 20 individuals, *Anelosimus studiosus* (Hentz, 1850) with 15, *Eustala* sp. 1 with 12, and *Cheiracanthium inclusum* (Hentz, 1847) with 11. A second group was formed by morphoespecie Salticidae sp. 2 and *Misumenops* sp. 1 with 9, Salticidae sp. 1 with 8, and *Sanogasta* sp. 2 and *Sphecozone* sp. 1, each with 7 individuals. The third group included five or less individuals, and among them, there were 16 species with only one individual (Table 2).

The most abundant, constant, dominant, and very frequent species were *Sphecozone* sp.1 and *Sphecozone* sp.2 (Linyphiidae), *A. studiosus* (Theridiidae), *Eustala* sp.1 (Araneidae), *C. inclusum* (Miturgidae), *Salticidae* sp.1 (Salticidae), *Misumenops* sp.1 (Thomisidae) and *Sanogasta* sp.2 (Anyphaenidae) (Table 2). The species *Sphecozone* sp. was the most abundant in citrus orchards in Rio Grande do Sul State (Morais et al., 2007). Our results corroborate the observation of Morais et al. (2007) that this genus is adapted to arboreal extracts.

In higher population levels, the spider *A. studiosus*, which lives in fruit trees, can damage the plant due to its habit of gathering leaves of several branches with gossamer threads, thus providing shelter for other pests that remain protected against insecticides. Additionally, leaves are deprived of light, becoming chlorotic and dry, thus hindering plant growth (Garcia, 2008). This species was very abundant in the olive groves

examined.

The family Salticidae was dominant, very abundant and very frequent in olive groves. This family has phytophilous species that live on vegetation and are known as flycatchers (Garcia, 2008).

Table 2. Faunal analysis of spiders collected using beating trays in five groves at five municipalities of Rio Grande do Sul State, Brazil. Monthly collections from October 2010 to October 2012. n: total number of individuals; A: abundance; C: constancy; D: dominance; F: frequency

Family	Species	n	A	C	D	F
Anyphaenidae	*Sanogasta* sp. 2	7	MA	W	D	VF
	Sanogasta praesignis	5	C	Y	ND	F
	Xiruana sp. 1	2	R	Y	ND	PF
	Sanogasta sp. 3	2	R	Y	ND	PF
	Sanogasta sp. 1	1	R	Z	ND	PF
	Tasata sp.	1	R	Z	ND	PF
	Sanogasta	1	R	Z	ND	PF
	Aysha prospera	1	R	Z	ND	PF
Araneidae	*Eustala* sp. 1	12	MA	W	D	VF
	Metepeira sp.	4	C	Z	ND	F
	Araneus sp. 1	2	R	Y	ND	PF
	Parawixia sp.	1	R	Z	ND	PF
	Araneus sp.	1	R	Z	ND	PF
	Eustala sp. 2	1	R	Z	ND	PF
	Ocrepeira sp.	1	R	Z	ND	PF
Corinnidae	*Ceto* sp.	1	1	R	Z	ND
	Trachelopachys sp. 1	1	R	Z	ND	PF
Linyphiidae	*Sphecozone* sp. 2	20	MA	W	D	VF
	Sphecozone sp. 1	7	MA	W	D	VF
	sp. 1	2	R	Y	ND	PF
	sp. 2	2	R	Z	ND	PF
	sp. 3	1	R	Z	ND	PF
Miturgidae	*Cheiracanthium inclusum*	11	MA	W	D	VF
Nesticidae	*Nesticus* sp.	1	R	Z	ND	PF
Salticidae	sp. 2	9	MA	Y	D	VF
	sp. 1	8	MA	W	D	VF
	sp. 3	5	C	Y	ND	F
	sp. 4	4	C	Z	ND	F
	Cotinusa sp.	1	R	Z	ND	PF
Tetragnathidae	*Leucauge* sp.	1	R	Z	ND	PF
Theridiidae	*Anelosimus studiosus*	15	MA	W	D	VF
	Cryptachea hirta	5	C	Y	ND	F
	Anelosimus ethicus	3	C	Y	ND	F
	Thymoites	2	R	Y	ND	PF
	Theridion sp.	1	R	Z	ND	PF
Thomisidae	*Misumenops* sp. 1	9	MA	W	D	VF
	Tmarus sp.	1	R	Z	ND	PF

MA: Very abundant; C: Common; R: Rare; W: Constant; Y: Accessory; Z: Accidental; D: Dominant; ND: Non-Dominant; VF: Very frequent; F: Frequent; PF: Uncommon

CONCLUSIONS

The predominant species in olive groves of Rio Grande do Sul State were *Sphecozone* sp1 and sp.2, *Anelosimus studiosus*, *Eustala* sp.1, *Cheiracanthium inclusum*, *Misumenops* sp.1, *Sanogasta* sp.2 and morphoespecie Salticidae sp.1. This is the first record of spiders in olive groves in the Neotropical Region.

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