

Aranhas de uma plantaç o jovem
de eucalipto: diversidade e predador potencial das
esp cies arbor colas mais freq entes

Spiders of a young plantation
of eucalypt: diversity and potential predator
of the most frequent arboreal species

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As the sixth group in global diversity the spiders occur in almost all terrestrial communities and act as factors of stabilization of other arthropod population including agricultural pests (RIECHERT & LOCKLEY, 1984; WISE 1995).

Spiders are endemic and finely adapted to their specific climate and ecosystem which minimally impacts native flora and fauna, thus preventing incompatibilities commonly accompanying introductions of exotic natural enemies (CADY & HALAJ, 1998).

Protection and promotion of the natural enemies in agroecosystems depend on the information about their phenology, habitat preferences, and behavior. The first step is to gather knowledge about the spider fauna that inhabitant the commercial fields and forests. VALLEJO, FONSECA & GONÇALVES (1987) and FERREIRA & MARQUES (1998) indicated that spiders were abundant

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in Brazilian eucalyptus forests, but they did not show the species composition and their richness.

The commercial eucalyptus forests in Brazil cover about 4.6 millions hectares. The associated insect fauna represents more than 300 species being 3.3% pests. Researches with eucalypts in Brazil begun in 1904 but actually there are more than 216 insect species, belonging to 60 families and eight taxonomic orders, which are harmful to the eucalyptus plantations in Brazil. Leaf-cutting ants, caterpillars, and leaf-eating beetles are the most important groups of pests. (BERTI-FILHO, 1985).

This study was conducted in an open commercial *Eucalyptus grandis* area to estimate the abundance, the species composition, and richness of the arboreal and soil spiders relative to their use of the habitat.

MATERIAL & METHOD

STUDY AREA

The survey was conducted in Botucatu, State of São Paulo, Brazil (23° 02' 19''S, 48° 34' 57''W, 715 to 898 m high) in an eucalyptus plantation on the Morrinhos Farm owned by Eucatex S. A. Division Forest. This farm has an area of 3,372 ha planted with *Eucalyptus*. The specific studied area was 51.85 ha planted with de *E. grandis* Hill Ex-Maiden surrounded by a native Gallery Forest and other eucalyptus areas. This is a minimum tillage system with an understory about 0.70 m high with abundant "pequí" (Cariocaceae), Melastomataceae, and Asteraceae, and a varying-depth litter layer (0.80 meters). The remaining planted wood is used to manufacture fiber board and plywood. The field received fertilization three times (NPK + micronutrients), and the herbicide Scout (Monsanto), 2 kg/ha.

The eucalyptus trees were grown from seeds and were 14 months old and 5 m high at the beginning of the experiment. Annual growth was about 45 cm each month, and the trees had reached 6,0 m by the end of the study.

SAMPLING

The spider fauna was surveyed by taking six collections with 2-month intervals. The first three rows of trees at the edge and 50 m away from the edge were defined as the edge and interior study sites respectively. At each date of collection five sampling points for both interior and edge sites were defined along a three kilometer transect. At each point three trees were chosen randomly for the hand capture and three other trees for foliage beating. Three pitfall traps were install in each collection point. Thus, at each collection 60 trees and 30 pitfalls were sampled to provide a total of 360 trees and 180 pitfalls.

The foliage beating consisted of sharply striking the foliage with a stick and collecting the spiders dislodged on a 68 X 58 cm white plastic tray with a 11 cm tall rim impregnated with unrefined talc, hindering their escape. Hand capture was performed by two collectors during 12 ± 4 minutes per tree. The pitfall traps were installed with 40% alcohol plus some drops of detergent 2.5 m from each other, and they were operated for 5 days.

DATA ANALYSES

Most spiders were identified using KASTON (1980) and RAMIREZ (pers. comm., Dr Martin J. Ramírez - Museo Argentino de Ciencias Naturales “Bernardino Rivadavia”, Buenos Aires, Argentina).

The guild associations are according to UETZ, HALAJ & Cady (1999). The rarefaction curve, Shannon-Wiener (H'), and evenness (J) indices were calculated according to LUDWIG & REYNOLDS (1988).

The spiders are deposited in the Spiders Collection of the Department of Zoology, Biosciences Institute (UNESP), Botucatu, São Paulo (UBTU Collection — Spider — <http://splink.cria.org.br>).

RESULTS AND DISCUSSION

The combined samples (beating, hand-capture, and pitfall trap) yielded 944 specimens representing 51 species across 17 families. From this total 86.0 % inhabited the eucalyptus trees. The species

diversity and evenness indices suggest a varied spider fauna (Table1).

Table 1. Total numbers of spiders captured from the edge and interior of a young *Eucalyptus grandis* plantation, Botucatu, SP, Brasil. H' = Shannon-Wiener, J = evenness.

EUCALYPT HABITATS	NUMBER OF SPIDERS		SPIDERS FAMILIES		SPIDER SPECIES			INDICES	
	Interior	Edge	Interior	Edge	Interior	Edge	Shared	H'	J
TREES	445	379	11	10	35	32	27		
LEAF-LITTER	62	58	6	6	11	11	10		
	507	437	17	16	46	43	37	3.13	0.80
TOTAL	944		17		51				

Comparing interior and edge areas of the forest, the abundance of spiders was higher in interior and except for Uloboridae, which were the same in both areas. The species number was slightly higher in interior shared 37 species with the edge (Table 1). The similar composition and number of species between the interior and edge forest was probably due to the minimum tillage system adopted in the area that promoted a dense understory and leaf-litter accumulation.

The expected number of species curves for arboreal and leaf-litter spiders reached a plateau showing both were sufficiently sampled (Fig. 1).

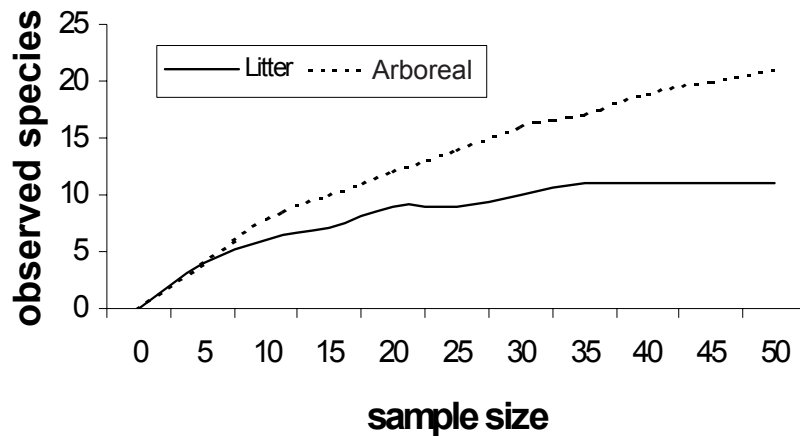


Fig. 1. Expected number of spider species in leaf litter and trees of young *Eucalyptus grandis* plantation, Botucatu (SP), Brasil.

Six families constituted 87.1% of the community, with 58.2 % of them weavers (Araneidae, Tetragnathidae, and Theridiidae) and 28.9% of them hunters (Salticidae, Miturgidae, and Lycosidae) (Fig. 2).

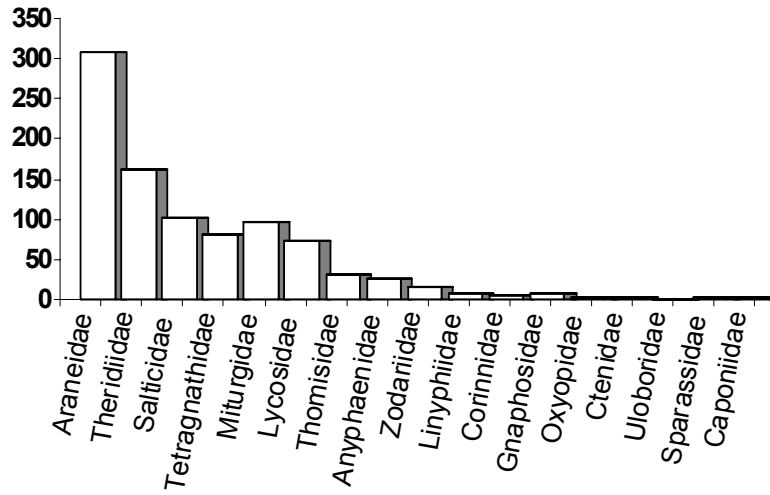


Fig. 2. Abundance of spider families in a young *Eucalyptus grandis* plantation, Botucatu – SP, Brasil. Six collections with 2-month intervals starting September/1998.

The spider fauna was characterized by a strong vertical stratification of the species in the trees and between the trees and leaf-litter. Weavers (58.37%) were the most represented guild and were dominant in eucalyptus trees (Tab. II). Vegetation architecture is positively correlated with arboreal spiders because they found more microhabitats to attach their webs in all levels of the plant (HATLEY & MACMAHON, 1980; MARC & CANARD, 1997; RYPSTRA *et al.*, 1999). While the arboreal layer contained spiders belonging to five guilds, two guilds occurred in leaf-litter, in particular the lycosid genus *Hogna* spp. (Table 2).

The orb web spiders (41.31%) selected vertically distinct spaces among the stems of the trees. *Gasteracantha cancriformis* located at 1.5 m from the soil in larger webs between two opposite rows of trees, *Manogeta porracea* constructed a small web between the inferior bases of the tree occupied by female and male and *Leucauge*

Table 2. Abundance, techniques collection and frequencies of the spider species in the edge and interior of a commercial *Eucalyptus grandis* plantation, Botucatu, SP. (A= pitfall trap, B= beating, and C= hand capture).

ARANEAE	Edge	Interior	Techniques collection	Frequencies %
<i>GUILD 1 — orb webs</i>				41.31
ARANEIDAE				
<i>Araneus</i> sp.	7	6	C	1.38
<i>Argiope argentata</i> Audouin, 1826	12	8	B,C	2.12
<i>Eustala</i> sp.	5	2	B,C	0.74
<i>Gasteracantha cancriformis</i> Sundevall, 1883	28	20	C	5.08
<i>Hypognatha</i> sp.	0	5	B,C	0.53
<i>Manoega porracea</i> (C.L. Koch, 1839)	66	114	B,C	19.07
<i>Micrathena</i> sp. Sundevall, 1883	2	4	C	0.64
<i>Parawixia</i> sp.	9	5	C	1.48
young	7	6	B	1.37
TETRAGNATHIDAE				
<i>Leucauge</i> sp.	19	62	B,C	8.58
<i>Nephila clavipes</i> Leach, 1815	0	1	C	0.11
ULOBORIDAE				
<i>Uloboridae</i> sp.	0	2	C	0.21
<i>GUILD 2 — space web-</i>				17.06
THERIDIIDAE				
<i>Achaearanea tessellata</i> (Keyserling, 1884)	6	11	C	1.80
<i>Achaearanea hirta</i> (Taczanowski, 1873)	14	8	C	2.33
<i>Anelosimus dubiosus</i> (Keyserling, 1891)	12	6	C	1.91
<i>Argyrodes elevatus</i> Taczanowski, 1873	11	31	B,C	4.45
<i>Argyrodes rioensis</i> Exline & Ivie, 1962	1	0	B	0.11
<i>Argyrodes</i> sp.	0	15	B,C	1.59
<i>Coleosoma floridanum</i> (Banks, 1900)		2	BC	0.21
<i>Dipoena alta</i> Keyserling, 1886	0	1	B	0.11
<i>Episinus nebulosus</i> (Simon, 1895)	3	12	C	1.59
<i>Euryopsis</i> sp.	1	4	B,C	0.53
<i>Latrodectus geometricus</i> C. L. Koch, 1841	5	1	C	0.63
<i>Theridium filum</i> Walckenaer, 1805	3	4	B	0.74
young	2	8	B,C	1.06
<i>GUILD 3 — wandering sheet-</i>				0.85
LINYPHIIDAE				
<i>Linyphiidae</i> sp.	2	3	A	0.53
young	3	0	A	0.32
<i>GUILD 4 — stalkers-</i>				11.34
SALTICIDAE				
<i>Dendryphantinae, Parnaenus?</i>	5	0	B,C	0.53
<i>Phiale gratiosa</i> C.L.Koch, 1846	2	0		0.21
<i>Phiale roburifoliata</i> Holmberg, 1875	0	1	C	0.11
<i>Thiodina melanogaster</i> Mello-Leitão, 1917	21	31	B,C	5.51
<i>Thiodina germaini</i> Simon, 1900	0	1	C	0.11

(continued)

(Table 2 — conclusion)

ARANEAE	Edge	Interior	Techniques collection	Frequencies %
Salticidae sp. 1	8	4	B,C	1.27
Salticidae sp. 2	10	4	C	1.48
young	7	8	B,C	1.59
OXYOPIDAE				
<i>Oxyopes salticus</i> Hentz, 1845	2	3	A	0.53
<i>GUILD 5 – foliage runners-</i>				14.62
ANYPHAENIDAE				
<i>Ayscha prospera</i> Keyserling, 1891	6	3	C	0.95
<i>Gayenna minuta</i> Banks, 1898	5	2	B,C	0.74
<i>Teudis</i> sp.	5	2	B	0.74
young	2	5	B	0.74
MITURGIDAE				
<i>Cheiracanthium inclusum</i> Hentz, 1847	58	32	B,C	9.53
<i>Teminius insularis</i> (Lucas, 1857)	3	4	B	0.74
CORINNIDAE				
<i>Castianeira</i> sp.	1	0	C	0.11
<i>Trachelas</i> sp.	2	4	C	0.64
SPARASSIDAE				
Sparassidae sp.	2	2	C	0.42
<i>GUILD 6 – ambushers-</i>				3.49
THOMISIDAE				
<i>Tmarus</i> sp.	25	6	B,C	3.28
young	2	0	B	0.21
<i>GUILD 7 – soil hunters-</i>				11.33
CAPONIIDAE				
<i>Nops</i> sp.	1	4	A	0.53
GNAPHOSIDAE				
<i>Apopyllus silvestrii</i> (Simon, 1905)	4	2	A	0.64
<i>Camillina pulcher</i> (Keyserling, 1891)	0	2	A	0.21
ZODARIIDAE				
<i>Cybaeodamus</i> Mello-Leitão, 1938 sp.	9	2	A	1.16
<i>Leprolochus</i> sp.	2	3	A	0.53
LYCOSIDAE				
<i>Hogna</i> sp. 1	8	31	A	4.13
<i>Hogna</i> sp.2	4	1	A	0.53
<i>Lycosa erithrognatha</i> Lucas, 1836	6	3	A	0.95
Lycosidae sp.	6	0	A	0.64
young	10	5	A	1.59

sp. occupied web that had an angle of 45° between the stalk and dried stems in the lower part of the tree.

Hunter spiders also use the arboreal habitat (25.96 %) making shelters or nests with eucalyptus leaves, and probably obtained vibratory information that is essential for their survival (RYPSTRA *et al.*, 1999). *Cheiracanthium inclusum* has a characteristic way of folding the eucalypt green leaves, build a curling tetraedric retreat internally covered by white silk. They used it for moulting, egg laying, and as a diurnal retreat. They wander out at night to hunt.

Male and females of the salticid *Thiodina melanogaster* were observed together in a green leaf folded in half and covered with a very dense white silk.

Five species corresponded to 47.77% of the spiders total abundance and were permanently common in the plantation. These species (*Manoega porracea*, *Gasteracantha cancriformes*,

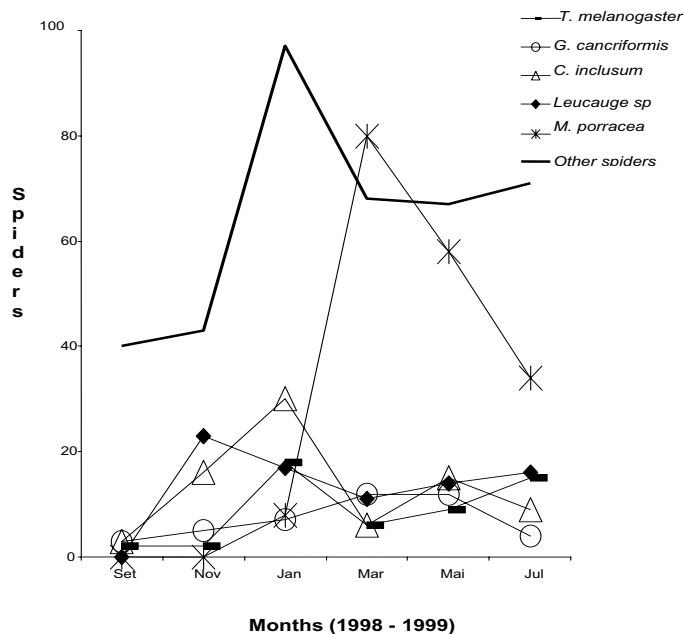


Fig. 3. Distribution of spiders in a young *Eucalyptus grandis* plantation, Botucatu (SP), Brazil. Six collections with 2-month intervals starting September/1998.

Cheiracanthium inclusum, *Leucauge* sp., and *Thiodina melanogaster*) occurred preferentially in the hot-humid season, with *Leucauge* sp. in November, *Thiodina melanogaster* and *C. inclusum* in January, and *M. porracea* and *G. cancriformis* in March. The remaining spiders reached a peak in January (Fig. 3).

Spiders were considered important predators of defoliation insects, in particular Tortricidae moths (JENNINGS & DIAMOND, 1988). Literature reported *Cheiracanthium* as predator upon a wide range of insect pest of several crops (MANSOUR *et al.*, 1982; MANSOUR, WISOKI & WITCOMB, 1985; MANSOUR & WITCOMB, 1986; MANSOUR & HEIMBACH, 1993; BOGGIA & MOLS, 1996). The holartic *Cheiracanthium mildei* L. Koch, preys on the spotted tentiform leafminer *Phyllonorycter blancardella* F. (Lepidoptera, Gracillariidae) (CORRIGAN & BENNETT, 1987) and *C. inclusum*, from Americas, preys on the citrus leafminer *Phyllocnistis citrella* (Phyllocnistinae, Gracillariidae) (AMALIN & PENA, 1998). In Brazilian eucalyptus plantations two araneids were observed eating insect pests. They are *Parawixia undulata* (Keyserling, 1892) on the insects Ripiphoridae and Chrysomelidae in State of Bahia and *Eriophora edax* (Blackwall, 1863) on *Costalimaita ferruginea* Klug (Coleoptera, Chrysomelidae) in State of São Paulo (RINALDI, 1995).

Although a combined census of predators and phytophagous pests is necessary to pointed about the importance of spiders in regulation of insect populations, it is emphasized that some *Costalimaita ferruginea* and *Dyrphia rosacordis* (Lepidoptera, Saturniidae) were restricted to a few trees along the plantation edge. They were easily observed to attack pests. It is probable that endemic enemies of insect pests, in particular the abundant spider populations promoted by the minimum tillage system adopted in the eucalyptus area, contributed to the overall health of the eucalyptus trees through reduced pest damage.

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SUMMARY

Spiders of a young commercial eucalypt plantation: diversity and potential predator of the most frequent arboreal species. This study was carried out in area of young commercial *Eucalyptus grandis* plantation (Botucatu, São Paulo, Brazil) for the evaluation of the spider fauna composition inhabiting their trees and litter. Entomological trays, hand captures and pitfall traps were applied within and on the edges of the plantation along a 3-kilometer transection. A total of 944 Araneomorphae individuals belonging to 17 families and 51 species were collected, whereas 87.3% inhabiting the trees. This predator assemblage is has potential to impact against the most prominent arboreal pests.

KEY WORDS: neotropical spiders, biodiversity, natural enemies, *Eucalyptus grandis*, plantation.

RESUMO

Aranhas de um plantio comercial jovem de eucaliptos: diversidade e potencial predador das espécies arbóreas mais frequentes. Este estudo foi conduzido em áreas de plantio comercial jovem de *Eucalyptus grandis*, em Botucatu (São Paulo), Brasil, com o objetivo de estimar a composição e diversidade da fauna de aranhas associadas às árvores e serapilheira. Ao longo de 3 km de transecção foram aplicadas as técnicas da bandeja entomológica, captura manual e armadilha-de-solo tipo alçapão no interior e borda do cultivo. Foram obtidos 944 indivíduos de Araneomorphae pertencentes a 17 famílias e 51 espécies dos quais 87,3 % habitantes da copa das árvores. A assembléia destes predadores potencialmente tem impacto sobre as pragas arbóreas mais proeminentes.

PALAVRAS CHAVE: Aranhas neotropicais, biodiversidade, inimigos naturais, *Eucalyptus grandis*, cultivo.

RÉSUMÉ

Araignées d'une jeune plantation commerciale d'eucalyptus: diversité et prédation en potentiel des espèces arboricoles les plus fréquentes. Cette étude a été réalisée dans des aires d'une jeune plantation commerciale d'*Eucalyptus grandis*, à Botucatu, État de

São Paulo-Brésil, ayant comme objectif d'estimer la composition et la diversité des araignées associées aux arbres et à la litière. Sur une étendue de 3 km, les techniques de plateaux entomologiques, de captures manuelles et de trappes enterrées, ont été employées pour les échantillonnages, à l'intérieur et sur le bord de la plantation. Un total de 944 individus de Araneomorphae appartenant à 17 familles et à 51 espèces a été recueilli, dont 87,3% étaient des résidants de cime d'arbres. Les peuplements de ces prédateurs en potentiel causent impact sur leurs proies arboricoles les plus proéminentes.

MOTS CLÉS: Araignées néotropicales, biodiversité, ennemis naturels, *Eucalyptus grandis*.

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