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SPATIAL DISTRIBUTION OF ARTHROPODS ON *ACACIA MANGIUM* (FABALES: FABACEAE) TREES AS WINDBREAKS IN THE CERRADO

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Abstract

Acacia mangium (Fabales: Fabaceae) is broadly used in restoration process of degraded lands in tropical and subtropical regions. Thus, our aim was to assess the spatial distribution of arthropods on tree crown (vertical- upper, median and lower canopy and horizontal-north, south, east and west) and leaf surfaces (adaxial and abaxial) of *A. mangium* trees. Phytophagous arthropods and natural enemies were quantified biweekly in 20 trees during three years. The Shannon index (H') of phytophagous insects were higher on the abaxial surface of leaves on branches facing the west side and basal thirds, while the lowest index was found on the adaxial surface of leaves on branches facing north and on trunk of *A. mangium*. The natural enemies and pollinators presented the highest H' indexes on the abaxial surface of leaves on branches facing north on basal thirds of *A. mangium*, while the lowest index values were found on the adaxial surface of leaves on branches facing the other sides. *Trigona spinipes* Fabricius (Hymenoptera: Apidae, Meliponinae), *Aethalion reticulatum* (Hemiptera: Aetalionidae) and Pentatomidae sp.1 (Hemiptera) were the most abundant and with the lowest *k*-dominance on different parts of *A. mangium* trees. *Camponotus* sp.2 (Hymenoptera: Formicidae), *Tetragonisca angustula* (Latreille) (Hymenoptera: Apidae) and *Polistes* sp. (Hymenoptera: Vespidae) had higher abundance and lower *k*-dominance. These results may be a support for programs of pest control and maintenance of natural enemies and pollinators in future plantations of *A. mangium*. For instance, application of biopesticides may reach better results if aimed directly to the preferred sites of target organisms, beyond minimizing possible negative effects on non-target ones.

Key Words: canopy sampling, phytophagous, natural enemies, pollinators

Resumen

Acacia mangium (Fabales: Fabaceae) es ampliamente utilizado en el proceso de restauración de las tierras degradadas en las regiones tropicales y subtropicales. Por lo tanto, nuestro objetivo fue evaluar la distribución espacial de los artrópodos en la copa del árbol (vertical - dosel superior, medio e inferior y horizontal - norte, sur, este y oeste) y las superficies de las hojas (adaxial y abaxial) de *A. mangium*. Artrópodos fitófagos y enemigos naturales fueron cuantificados quincenalmente en 20 árboles durante tres años. El índice de Shannon (H') de los insectos fitófagos fueron más altos en la superficie abaxial de las hojas en las ramas que se enfrenta el lado oeste y tercios basales, mientras que se encontró el índice más bajo en la superficie adaxial de las hojas en las ramas que dan al norte y en el tronco de *A. mangium*. Los enemigos naturales y polinizadores presentan los más altos índices H' en la superficie abaxial de las hojas en las ramas que dan al norte en tercios basales de *A. mangium*, mientras que se encontraron los valores de los índices más bajos en la superficie adaxial de las hojas en las ramas que se enfrentan los otros lados. *Trigona spinipes* Fabricius (Hymenoptera: Apidae), *Aethalion reticulatum* (Hemiptera: Aetalionidae) y Pentatomidae sp.1 (Hemiptera) fueron las más abundantes y con el más bajo *k*-dominación en diferentes partes de *A. mangium*. *Camponotus* sp. 2 (Hymenoptera: Formicidae) , *Tetragonisca angustula* (Latreille) (Hymenoptera: Apidae) y *Polistes* sp. (Hymenoptera: Vespidae) presentó mayor abundancia y más bajo *k*-dominación. Estos resultados pueden ser un apoyo para los programas de control de plagas y el mantenimiento de los enemigos naturales y polinizadores en las futuras plantaciones de *A. mangium*. Por ejemplo, la aplicación de biopesticidas puede alcanzar mejores resultados si dirigido directamente a los sitios preferidos de los organismos objetivo, más allá de minimizar los posibles efectos negativos en los que no va destinado.

Palabras Clave: canopy muestreo, fitófagos, enemigos naturales, polinizadores

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The arboreal species *Acacia mangium* Willd. (Fabales: Fabaceae) is used in the initial succession and to restore degraded areas in tropical and subtropical regions (Yu & Li 2007; Phan Minh et al. 2013). This plant presents high potential for restoring or enhancing soil fertility by N-fixing and making fixed nitrogen and other plant nutrients available to other plants (Galiana et al. 1998).

Acacia mangium can also be used in windbreaks to prevent wind and water erosion and to improve environmental conditions (Brandle et al. 2004). A plant species used in windbreaks should be perennial, grow rapidly, but not be invasive nor excessively competitive, while having a dense crown for maximum efficiency and protection against erosion (Brandle et al. 2004; Norisada et al. 2005). These trees can be a barrier to the movement of herbivorous insects and to impede their capacity to locate their host plants (Rao et al. 2000). The plant canopy in a wind break offers great diversity of resources to maintain biodiversity, and their branches and leaves affect the environment by affecting humidity and evapotranspiration and by being refugia for birds and insects (Brandle et al. 2004).

Interactions between *Acacia* spp. plants and insects have been studied (Kruger & McGavin 1998; Fleming et al. 2007; Palmer et al. 2007) and insects are the main organisms responsible for the decline in Arabic gum production from these plants in Sudan (Jamal 1994). On the other hand, conversion of natural forests to *A. mangium* plantations has negatively impacted communities of insect groups, such as termites, ants, flies and beetles (Tsukamoto & Sabang 2005).

The aim of this study was to assess the spatial distribution of arthropods along the vertical canopy (apical, middle and basal parts and trunks), horizontal orientation (branches facing north, south, east and west) and leaf surface (adaxial and abaxial) of *A. mangium* plants.

Material and methods

Study Sites

This study was carried out in a pasture area of the Institute of Agricultural Sciences at the Universidade Federal de Minas Gerais (ICA/UFMG), Brazil. Samplings occurred from Jan 2005 to Mar 2007 in an area with Aw climate, i.e., tropical savanna according to the classification of Köppen with a dry winter and a rainy summer and a dystrophic red-yellow latosol.

Study Design

Windbreaks, 100 m long with 2 rows of *A. mangium* spaced 3 × 3 m were used. Seedlings of this species were prepared in a nursery and planted in Sep 2003 in 30 × 30 × 30 cm holes with 360 grams of natural reactive phosphate mixed into the subsoil of a *Brachiaria decumbens* Stapf. (Poales: Poaceae) pasture.

The phytophagous insects, natural enemies and pollinators insects in twenty 16-month old *A. mangium* trees were visually counted biweekly every yr. The arthropods were counted on the adaxial and abaxial leaf surfaces in the upper, median and lower apical canopy on branches facing north, south, east and west with a total of 12 leaves per canopy and nine per tree branch position in each sampling. Arthropod collection also occurred on the trunks of 20 trees per sampling. All material collected was stored in flasks with 70% ethanol, separated by morphospecies and sent for identification.

TABLE 1. SHANNON (H') BIODIVERSITY INDEXES OF PHYTOPHAGOUS AND NATURAL ENEMY ARTHROPODS ON *ACACIA MANGIUM* AS FUNCTIONS OF POSITIONS (CARDINAL POINTS) OF THE TREE'S BRANCHES, HEIGHTS WITHIN THE CANOPY AND UPPER OR LOWER LEAF SURFACES DURING THREE YEARS OF SAMPLING.

	Tree Branch Position on Trunk			
Index of Shannon (H')	North	South	East	West
Phytophagous	0.28	0.40	0.40	0.59
Natural enemies	0.84	0.76	0.76	0.76
	Canopy Height			
Index of Shannon (H')	Upper	Median	Lower	Trunk
Phytophagous	0.40	0.41	0.56	0.38
Natural enemies	0.70	0.76	0.78	0.39
	Leaf Surfaces			
Index of Shannon (H')	Abaxial (lower)		Adaxial (upper)	
Phytophagous	0.52		0.38	
Natural enemies	0.80		0.71	

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TABLE 2. K-DOMINANCE AND ABUNDANCE VALUES (BETWEEN BRACKETS) OF PHYTOPHAGOUS AND NATURAL ENEMY ARTHROPODS ON *ACACIA MANGIUM* TREES AS FUNCTION OF LEAF SURFACES DURING THREE YEARS OF SAMPLING.

Phytophagous Arthropods			
Abaxial (lower) surface		Adaxial (upper) surface	
Trigona spinipes Fabricius (Hymenoptera: Apidae)	53.5 (304)	*Aethalion reticulatum* L. (Hemiptera: Aetalionidae):	48.8 (21)
Aethalion reticulatum L. (Hemiptera: Aetalionidae)	85.5 (182)	*Trigona spinipes* Fabricius (Hymenoptera: Apidae)	95.3 (20)
Pentatomidae sp.1 (Hemiptera)	94.4 (50)	Pentatomidae sp.1 (Hemiptera)	97.6 (1)
Diabrotica speciosa Germar (Col.: Chrysomelidae)	95.7 (8)	Tettigoniidae (Orthoptera)	100 (1)
Tropidacris collaris Stoll (Orthoptera: Romaleidae)	96.8 (6)	*Tropidacris collaris* Stoll (Orthoptera: Romaleidae)	100 (0)
Coleoptera	97.7 (5)	*Dalbulus maidis* DeLong & Wolcott (Hom.: Cicadellidae)	100 (0)
Fulgoroidea (Hemiptera)	98.0 (2)	Fulgoroidea (Hemiptera)	100 (0)
Mahanarva posticata Stal (Homoptera: Cercopidae)	98.4 (2)	Lepidoptera	100 (0)
Podalia sp. (Lepidoptera: Megalopygidae)	98.8 (2)	*Mahanarva posticata* Stal (Homoptera: Cercopidae)	100 (0)
Discodon sp. (Coleoptera: Cantharidae)	99.1 (2)	*Diabrotica speciosa* Germar (Coleoptera: Chrysomelidae)	100 (0)
Dalbulus maidis DeLong & Wolcott (Homoptera: Cicadellidae)	99.3 (1)	Coleoptera	100 (0)
Lepidoptera	99.4 (1)	Pentatomidae sp.2 (Hemiptera)	100 (0)
Pentatomidae sp.2 (Hemiptera)	99.6 (1)	Membracidae (Hemiptera)	100 (0)
Membracidae (Hemiptera)	99.8 (1)	*Podalia* sp. (Lepidoptera: Megalopygidae)	100 (0)
Euxesta sp. (Diptera: Otitidae)	100 (1)	*Euxesta* sp. (Diptera: Otitidae)	100 (0)
Natural enemies and pollinators			
Camponotus sp.2 (Hymenoptera: Formicidae)	39.5 (262)	*Camponotus* sp.2 (Hymenoptera: Formicidae)	46.4 (26)
Tetragonisca angustula Latreille (Hym.: Meliponinae)	63.5 (159)	*Tetragonisca angustula* Latreille (Hym.: Meliponinae)	69.6 (13)
Polistes sp. (Hymenoptera: Vespidae)	75.7 (81)	*Musca domestica* Linnaeus (Diptera: Muscidae)	76.8 (4)
Musca domestica Linnaeus (Diptera: Muscidae)	82.3 (44)	*Polistes* sp. (Hymenoptera: Vespidae)	82.1 (3)
Camponotus sp.5 (Hymenoptera: Formicidae)	87.4 (34)	Chrysopidae (Neuroptera)	87.5 (3)
Apis mellifera L. (Hymenoptera: Apidae)	91.1 (24)	*Podisus* sp. (Hemiptera: Pentatomidae)	92.9 (3)
Podisus sp. (Hemiptera: Pentatomidae)	92.9 (12)	Araneidae	94.6 (1)
Brachymyrmex sp.1 (Hymenoptera: Formicidae)	94.4 (10)	*Aphirape uncifera* Tullgren (Araneae: Salticidae)	96.4 (1)

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TABLE 2. (CONTINYUED) K-DOMINANCE AND ABUNDANCE VALUES (BETWEEN BRACKETS) OF PHYTOPHAGOUS AND NATURAL ENEMY ARTHROPODS ON *ACACIA MANGIUM* TREES AS FUNCTION OF LEAF SURFACES DURING THREE YEARS OF SAMPLING.

Phytophagous Arthropods			
Abaxial (lower) surface		Adaxial (upper) surface	
Camponotus sp.1 (Hymenoptera: Formicidae)	95.6 (8)	*Mantis religiosa* L. (Mantodea: Mantidae)	98.2 (1)
Araneidae	96.6 (7)	*Cycloneda sanguinea* L. (Coleoptera: Coccinellidae)	100 (1)
Lampyridae (Coleoptera)	97.2 (4)	Lampyridae (Coleoptera)	100 (0)
Aphirape uncifera Tullgren (Araneae: Salticidae)	97.9 (4)	*Apis mellifera* L. (Hymenoptera: Apidae)	100 (0)
Cephalotes sp. (Hymenoptera: Formicidae)	98.3 (3)	Dolichopodidae (Diptera)	100 (0)
Episyrphus balteatus De Geer (Diptera: Syrphidae)	98.7 (3)	*Cephalotes* sp. (Hymenoptera: Formicidae)	100 (0)
Mantis religiosa L. (Mantodea: Mantidae)	99.2 (3)	*Episyrphus balteatus* De Geer (Diptera: Syrphidae)	100 (0)
Dolichopodidae (Diptera)	99.5 (2)	*Chrysoperla externa* Hagen (Neuroptera: Chrysopidae)	100 (0)
Chrysopidae (Neuroptera)	99.7 (1)	*Brachymyrmex* sp.2 (Hymenoptera: Formicidae)	100 (0)
Chrysoperla externa Hagen (Neur.: Chrysopidae)	99.8 (1)	*Oxyopes Salticus* Hentz (Araneae: Oxyopidae)	100 (0)
Oxyopes salticus Hentz (Araneae: Oxyopidae)	100 (1)	*Camponotus* sp.5 (Hymenoptera: Formicidae)	100 (0)

Statistical Analysis

The ecological indexes (number of individuals, richness, diversity and abundance of species) were calculated for the arthropod species identified. All ecological indexes were measured by calculating the dataset of taxa by samples in BioDiversity Pro Version 2 software. Diversity was calculated by the Shannon-Weaver formula: H = pi ln (pi). Abundance and species richness (S) were calculated by the Simpson formula: D = (.ni /N) * 100, where: pi = ni /N; ni = number of individuals per species; N= total number of individuals; S= richness (number of species present). *k*-Dominance were calculated by plotting the percentage cumulative abundance against log species rank (Lambshead et al. 1983). The *k*-dominance values indicate the dominance and evenness distribution of individuals among species (Gee et al. 1985).

RESULTS AND DISCUSSION

Phytophagous arthropods presented their greatest biodiversity Shannon (H') index values on the abaxial (lower) leaf surfaces, on branches facing west, and in the lowest part of *A. mangium* canopies. In contrast, phytophagous arthropods presented the lowest H' values on the adaxial (upper) leaf surfaces, on branches facing north, and on the trunks of this plant (Table 1). The natural enemies and pollinators presented the greatest H' indexes on the abaxial surface of leaves on branches facing north on the lowest parts of *A. mangium*, while the lowest index values were found on the adaxial surface of leaves on branches facing the other directions (Table 1). It is likely that the preference of phytophagous arthropods for the above distributions in the canopy are related to a lower risk of parasitism (Ramanand & Olckers 2013) or predation by natural enemies, such as ants (Elbanna 2011). Furthermore, the presence of ants may attract pollinators (Gonzalvez et al. 2013), which might explain the greatest abundance of both at the same sites.

The greatest abundance of *Trigona spinipes* Fabricius (Hymenoptera: Apidae, Meliponinae), *Aethalion reticulatum* L. (Hemiptera: Aetalionidae) and Pentatomidae sp.1 (Hemiptera) on the abaxial (lower) surface of leaves (Table 2) is likely owing to the biomechanical properties on this area. In general, densities of phytophagous insects are negatively correlated with work to tear and shear leaves (Peeters et al. 2007). Thus, it would be expected to find the greatest abundance of such insects on the abaxial surface of leaves where the epidermis is thinner, favoring insect feeding and, consequently, a higher fitness (Fiene et al. 2013).

The largest population of herbivorous insects on the abaxial leaf surfaces may attract arthropod natural enemies and pollinators, such as *Camponotus* sp.2 (Hymenoptera: Formicidae), *Tetragonisca*

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TABLE 3. K-DOMINANCE AND ABUNDANCE VALUES (BETWEEN BRACKETS) OF PHYTOPHAGOUS AND NATURAL ENEMY ARTHROPODS ON *ACACIA MANGIUM* PLANTS AS A FUNCTION OF THE POSITION OF A TREE BRANCH RELATIVE TO THE CARDINAL POINTS DURING THREE YEARS OF SAMPLING.

North		South		East		West	
Phytophagous Arthropods							
Trigona spinipes	91.4 (53)	*Trigona spinipes*	51.4 (74)	*Trigona spinipes*	53.1 (137)	*Trigona spinipes*	39.7 (60)
Diabrotica speciosa	94.8 (2)	*A. reticulatum*	95.1 (63)	*A. reticulatum*	96.1 (111)	Pentatomidae sp.1	73.5 (51)
Tropidacris colaris	96.6 (1)	*Diabrotica speciosa*	97.2 (3)	Coleoptera	96.9 (2)	*A. reticulatum*	92.7 (29)
Tettigoniidae	98.3 (1)	*Discodon* sp.	98.6 (2)	*T. colaris*	97.3 (1)	*Tropidacris colaris*	94.7 (3)
Podalia sp.	100 (1)	*Tropidacris colaris*	99.3 (1)	*Dalbulus maidis*	97.6 (1)	Coleoptera	96.7 (3)
A. reticulatum	100 (0)	*M. posticata*	100 (1)	Fulgoroidea	98.0 (1)	*Diabrotica speciosa*	98.0 (2)
Pentatomidae sp.1	100 (0)	Pentatomidae[1]	100 (0)	Lepidoptera	98.4 (1)	Fulgoroidea	98.6 (1)
Dalbulus maidis	100 (0)	*Dalbulus maidis*	100 (0)	*M. posticata*	98.8 (1)	Pentatomidae sp.2	99.3 (1)
Fulgoroidea	100 (0)	Fulgoroidea	100 (0)	*D. speciosa*	99.2 (1)	Membracidae	100 (1)
Lepidoptera	100 (0)	Lepidoptera	100 (0)	*Podalia* sp.	99.6 (1)	*Dalbulus maidis*	100 (0)
M. posticata	100 (0)	Tettigoniidae	100 (0)	*Euxesta* sp.	100 (1)	Lepidoptera	100 (0)
Natural enemies and pollinators							
T. angustula	34.6 (44)	*Camponotus* sp.2	42.6 (58)	*Camponotus* sp.2	43.1 (93)	*Camponotus* sp.2	42.5 (102)
Camponotus sp.2	62.2 (35)	*T. angustula*	61.0 (25)	*T. angustula*	68.5 (55)	*T. angustula*	62.5 (48)
Musca domestica	70.9 (11)	*Polistes* sp.	72.7 (16)	*Polistes* sp.	77.3 (19)	*Polistes* sp.	78.7 (39)
Polistes sp.	78.7 (10)	*Camponotus* sp.5	81.6 (12)	*Camponotus* sp.5	83.3 (13)	*Musca domestica*	85.0 (15)
Podisus sp.	82.7 (5)	*Musca domestica*	89.7 (11)	*Musca domestica*	88.4 (11)	*Apis mellifera*	87.5 (6)
Apis mellifera	85.8 (4)	*Apis mellifera*	94.1 (6)	*Apis mellifera*	92.1 (8)	*Brachymyrmex* sp.1	90.0 (6)
Brachymyrmex sp.1	89.0 (4)	*Podisus* sp.	96.3 (3)	*Camponotus* sp.1	93.9 (4)		92.5 (6)
Chrysopidae	91.3 (3)	*Episyrphus balteatus*	97.1 (1)	*E. balteatus*	94.9 (2)	*Podisus* sp.	94.5 (5)
Camponotus sp.5	93.7 (3)	*Chrysoperla externa*	97.7 (1)	*Podisus* sp.	95.8 (2)	Araneidae	96.2 (4)
Araneidae	95.3 (2)	Araneidae	98.5 (1)	*Aphirape uncifera*	96.8 (2)	Lampyridae	97.5 (3)
Aphirape uncifera	96.8 (2)	*Aphirape uncifera*	99.2 (1)	Dolichopodidae	97.2 (1)	*Camponotus* sp.1	98.7 (3)
Lampyridae	97.6 (1)	*Mantis religiosa*	100 (1)	*Cephalotes* sp.	97.6 (1)	*Cephalotes* sp.	99.5 (2)
Dolichopodidae	98.4 (1)	Lampyridae	100 (0)	Chrysopidae	98.1 (1)	*Mantis religiosa*	100 (1)
Mantis religiosa	99.2 (1)	Dolichopodidae	100 (0)	Araneidae	98.6 (1)	Dolichopodidae	100 (0)
Camponotus sp.1	100 (1)	*Cephalotes* sp.	100 (0)	*Oxyopes salticus*	99.0 (1)	Chrysopidae	100 (0)
Cephalotes sp.	100 (0)	Chrysopidae	100 (0)	*Mantis religiosa*	99.5 (1)	*E. balteatus*	100 (0)
E. balteatus	100 (0)	*Brachymyrmex* sp.1	100 (0)	*C. sanguinea*	100 (1)	*C. externa*	100 (0)

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TABLE 4. K-DOMINANCE AND ABUNDANCE VALUES (BETWEEN BRACKETS) OF PHYTOPHAGOUS AND NATURAL ENEMY ARTHROPODS ON *ACACIA MANGIUM* TREES AS FUNCTION OF THE HEIGHT WITHIN THE CANOPY DURING THREE YEARS OF SAMPLING.

Upper Canopy		Median Canopy		Lower Canopy		Trunk	
Phytophagous							
A. reticulatum	49.6 (63)	*T. spinipes*	63.5 (134)	*Trigona spinipes*	48.1 (132)	*Aethalion reticulatum*	58.7 (121)
Trigona spinipes	95.3 (58)	*A. reticulatum*	93.3 (63)	*A. reticulatum*	76.3 (77)	*Trigona spinipes*	95.1 (75)
Fulgoroidea	96.8 (2)	*D. speciosa*	96.6 (7)	Pentatomidae sp.1	94.5 (50)	Homoptera	97.5 (5)
M. posticata	98.4 (2)	Pentatomidae[1]	97.2 (1)	Tropidacris colaris	95.9 (4)	Membracidae	98.5 (2)
Tropidacris colaris	99.2 (1)	*Tropidacris colaris*	97.6 (1)	Coleoptera	97.4 (4)	*Quesada gigas*	99.5 (2)
Podalia sp.	100 (1)	Lepidoptera	98.1 (1)	*Discodon* sp.	98.1 (2)	*Tropidacris colaris*	100 (1)
Pentatomidae sp.1	100 (0)	Coleoptera	98.6 (1)	*Dalbulus maidis*	98.5 (1)	Pentatomidae sp.1	100 (0)
Dalbulus maidis	100 (0)	Pentatomidae sp.2	99.0 (1)	*M. posticata*	98.9 (1)	*Dalbulus maidis*	100 (0)
Lepidoptera	100 (0)	Membracidae	99.5 (1)	Tettigoniidae	99.3 (1)	Fulgoroidea	100 (0)
Tettigoniidae	100 (0)	*Podalia* sp.	100 (1)	*D. speciosa*	99.6 (1)	Lepidoptera	100 (0)
D. speciosa	100 (0)	*D. maidis*	100 (0)	*Euxesta* sp.	100 (1)	*Mahanarva posticata*	100 (0)
Natural enemies and pollinators							
T. angustula	54.3 (69)	*Camponotus* sp.2	40.9 (137)	*Camponotus* sp.2	50.9 (131)	*Camponotus* sp.2	73.4 (58)
Camponotus sp.2	70.1 (20)	*T. angustula*	62.1 (71)	*T. angustula*	63.4 (32)	*Podisus* sp.	86.1 (10)
Camponotus sp.5	76.4 (8)	*Polistes* sp.	77.9 (53)	*Polistes* sp.	73.1 (25)	*Camponotus* sp.5	94.9 (7)
Musca domestica	81.1 (6)	*M. domestica*	84.5 (22)	*Musca domestica*	80.9 (20)	*T. angustula*	97.5 (2)
Polistes sp.	85.8 (6)	*Camponotus* sp.5	89.5 (17)	*Camponotus* sp.5	84.4 (9)	*Musca domestica*	98.7 (1)
Brachymyrmex sp.1	90.5 (6)	*Apis mellifera*	93.7 (14)	*Camponotus* sp.1	87.2 (7)	*Camponotus* sp.1	100 (1)
Apis mellifera	94.5 (5)	*Podisus* sp.	95.8 (7)	*Podisus* sp.	89.4 (6)	Lampyridae	100 (0)
Podisus sp.	96.0 (2)	Araneidae	97.0 (4)	*Apis mellifera*	91.4 (5)	*Apis mellifera*	100 (0)
Araneidae	97.6 (2)	Lampyridae	97.6 (2)	Chrysopidae	93.0 (4)	*Polistes* sp.	100 (0)
Lampyridae	98.4 (1)	*A. uncifera*	98.2 (2)	*Cephalotes* sp.	94.1 (3)	Dolichopodidae	100 (0)
Aphirape uncifera	99.2 (1)	*M. religiosa*	98.8 (2)	*E. balteatus*	95.3 (3)	*Cephalotes* sp.	100 (0)
Mantis religiosa	100 (1)	*Brachymyrmex* sp.1	99.1 (1)	*Brachymyrmex* sp.1	96.5 (3)	Chrysopidae	100 (0)
Dolichopodidae	100 (0)	*O. Salticus*	99.4 (1)	Dolichopodidae	97.3 (2)	*Episyrphus balteatus*	100 (0)
Cephalotes sp.	100 (0)	*Camponotus* sp.1	99.7 (1)	Araneidae	98.0 (2)	*Chrysoperla externa*	100 (0)
Chrysopidae	100 (0)	*C. sanguinea*	100 (1)	*Aphirape uncifera*	98.8 (2)	Araneidae	100 (0)
E. balteatus	100 (0)	Dolichopodidae	100 (0)	Lampyridae	99.2 (1)	*Brachymyrmex* sp.1	100 (0)
C. externa	100 (0)	*Cephalotes* sp.	100 (0)	*C. externa*	99.6 (1)	*Aphirape uncifera*	100 (0)
Oxyopes salticus	100 (0)	Chrysopidae	100 (0)	*Mantis religiosa*	100 (1)	*Oxyopes salticus*	100 (0)

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angustula (Latreille) (Hymenoptera: Apidae) and *Polistes* sp. (Hymenoptera: Vespidae) (Table 2). The greatest biodiversity of phytophagous arthropos and the natural enemies *Camponotus* sp.2, *Polistes* sp. and *Podisus* sp. (Hemiptera: Pentatomidae) on the west side of the canopy of *A. mangium* (Table 3) may be explained by the lowest impact of predominant wind currents from northeast/east in this region (Leite et al. 2006). Furthermore, parts of plants more exposed to winds may present thicker leaves owing to dehydration, which reduces feeding preference by phytophagous insects. Changes in the microclimate of arboreal systems increase air humidity and decrease the temperature and wind speed with positive effects on insect development (Rao et al. 2000). The quality of food resources may explain the greatest abundance of the bees, *T. spinipes* and *T. angustula,* on the east side of the canopy of *A. mangium* (Table 3) because leaves exposed to wind currents may present a higher evaporation, and thus increased nectar concentration in flowers (deBruijn & Sommeijer 1997).

The phytophagous *T. spinipes* and Hemiptera were most abundant in the median and lower level canopy of *A. mangium*, respectively (Table 4), sites where leaves are likely older than on upper canopy. Older leaves are less chemically defended than young ones, which may favor the herbivory (Alba et al. 2013). Furthermore, the lower canopy may present higher humidities and lower temperatures (Rao et al. 2000), decreasing insect desiccation (Rao et al. 2000) and improving survival conditions. The same protecting factors against desiccation might have influenced the natural enemies *Camponotus* sp.2, *T. angustula* and *Polistes* sp., which were more abundant in the median than in the upper canopy and trunks of *A. manigium* trees, respectively (Table 4).

The lowest *k*-dominance and greatest abundance values of *T. spinipes*, *A. reticulatum* and Pentatomidae sp.1 on different *A. mangium* parts without damaging leaves and flowers of this tree agrees with that reported for Hemiptera with greater number of species on the canopy of *Acacia* spp. (Kruger & McGavin 1998). These insects are harmful to several plant cultures, being responsible for damaging sprouts for removal of fibers to construct their nests (Boica et al. 2004). *Aethalion reticulatum* sucks sap which affects fruit development and sprouting, beyond killing plants at high infestations (Brown 1976).

The natural enemies *Camponotus* sp.2 and *Polistes* sp. and the pollinator *T. angustula* were the most abundant and with the lowest *k*-dominance. *Camponotus* spp. are, in general, associated with sucking insects (Fernandes et al. 2005) such as *A. reticulatum* (Brown 1976), protecting them against predators and parasitoids (Renault et al. 2005), which explains their great abundance on *A. mangium* trees. Therefore, *Camponotus* spp. can indirectly affect host plants by hindering natural enemies impact. However, *T. angustula* is important for dispersing pollen and increasing plant genetic variability (Proni & Macieira 2004).

The potential of soil restoration or improvement by *A. mangium* trees in agroforestry systems can be explained by its benefit on soil structure and fertility due to N-fixing and increasing organic matter (Garay et al. 2003). *Acacia mangium* improves the conditions for the soil fauna, including earthworms (Pellens & Garay 1999; Tsukamoto & Sabang 2005) and for the commensalism between *Pseudomyrmex* spp. (Hymenoptera: Formicidae) and birds on this plant (de Ita and Rojas-Soto 2006). The ant presence can improve bird reproduction by reducing predation on their nests, whereas *Acacia* trees can supply branches, leaves and other materials for the nest building (Ndithia et al. 2007).

In conclusion, organisms, including phytophagous insects, natural enemies and pollinators presented the greatest diversities on the abaxial surface of leaves located on lower parts of the canopy of *A. mangium*. With regards to the canopy side, phytophagous insects presented a greater diversity on the west side, while natural enemies and pollinators presented a greater diversity on the north side. These results may support for programs of pest control and maintenance of natural enemies and pollinators in future plantations of *Acacia mangium*. For instance, application of biopesticides may reach better results if aimed directly to the preferred sites of target organisms, beyond minimizing possible negative effects on non-target ones.

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