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Sampling and Diversity of Hymenoptera (Insecta) in an Orange Orchard/Brazilian Savannah Fragment Interface

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Abstract. The aim of this work was to assess the diversity of Hymenoptera in an orange orchard / Brazilian Savannah fragment interface in Descalvado, State of São Paulo, Brazil, using Moericke, Malaise and pitfall traps. The sampling was carried out from February to June 2006, when 5,148 specimens of Hymenoptera, from 12 superfamilies and 36 families, were caught: Chalcidoidea (1,885 specimens; 36.6% out of the total; 14 families), Ichneumonoidea (715; 13.9%; 2), Vespoidea (554; 10.8%; 5), Apoidea (444; 8.6%; 2), Diaprioidea (430; 8.4%; 2), Chrysidoidea (366; 7.1%; 3), Platygastroidea (340; 6.6%; 2), Ceraphronoidea (211; 4.1%; 2), Cynipoidea (107; 2.1%; 1), Evanioidea (83; 1.6%; 1), Tenthredinoidea (7; 0.1%; 1) and Trigonaloidea (6; 0.1%; 1). The Moericke and Malaise traps installed in the Brazilian Savannah fragment were responsible for capturing the highest number of Hymenoptera (2,158 specimens; 41.9% out of the total collected and 1,739; 33.8%, respectively), followed by the Moericke traps placed in the orange orchard (1,123; 21.8%) and by the pitfall traps (128; 2.5%). The results indicate that the diversity of families of Hymenoptera in the Brazilian Savannah fragment is greater than in the culture of citrus and expresses the greatest diversity of hosts existing in that environment. The study made clear that the combined use of different kinds of traps allows the capture of a large diversity of Hymenoptera.

Keywords: Biodiversity; Neotropical region; Parasitic Hymenoptera; Sampling; Traps.

Amostragem e Diversidade de Hymenoptera (Insecta) em uma Interface Cultura de Citros/Fragmento de Cerrado

Resumo. O objetivo deste estudo foi avaliar a diversidade de himenópteros de uma interface cultura de citros/fragmento de Cerrado em Descalvado, SP, Brasil, através do uso de armadilhas de Moericke, de Malaise e de pitfall. As amostragens ocorreram entre fevereiro e junho de 2006, quando foram obtidos 5.148 exemplares de himenópteros pertencentes a 12 superfamílias e 36 famílias: Chalcidoidea (1.885 exemplares; 36,6% do total; 14 famílias), Ichneumonoidea (715; 13,9%; 2), Vespoidea (554; 10,8%; 5), Apoidea (444; 8,6%; 2), Diaprioidea (430; 8,4%; 2), Chrysidoidea (366; 7,1%; 3), Platygastroidea (340; 6,6%; 2), Ceraphronoidea (211; 4,1%; 2), Cynipoidea (107; 2,1%; 1), Evanioidea (83; 1,6%; 1), Tenthredinoidea (7; 0,1%; 1) e Trigonaloidea (6; 0,1%; 1). As armadilhas de Moericke e de Malaise instaladas no fragmento de Cerrado capturaram o maior número de exemplares de himenópteros (2.158 exemplares; 41,9% do total coletado e 1.739; 33,8%, respectivamente), seguidas pelas de Moericke instaladas na cultura de citros (1.123; 21,8%) e *pitfall* (128; 2,5%). Os resultados obtidos indicam que a diversidade de famílias de himenópteros no fragmento de Cerrado é maior do que na cultura de citros e expressa a maior diversidade de hospedeiros existente naquele ambiente. O uso combinado de diferentes tipos de armadilhas possibilitou a captura de maior diversidade de grupos de himenópteros.

Palavras-chave: Amostragem; Armadilhas; Biodiversidade; Himenópteros Parasitoides; Neotrópico.

Hymenoptera is one of the largest and most diverse orders of insects and includes more than 115 thousand recognized species; conservative estimates indicate that there is in the planet as much as 250 thousand of them (Hanson & Gauld 2006). In the Neotropical region it is possible to find 21 superfamilies and 76 families of Hymenoptera; for the Brazilian territory has been reported the occurrence of 18 superfamilies and 63 families (Fernández & Sharkey 2006; Hanson & Gauld 2006).

The Hymenoptera are popularly known by bees, wasps and ants; the order also includes a large group of other wasps called parasitoids that are mostly small, little known and flashy; 56 hymenoptera families present habit parasitoid, 17 act as phytophagous, three as predators and two as pollinators; the Hymenoptera are present in almost all terrestrial environments and its economic importance is due to the role that develop in pest control, pollination and production of commercial products (Hanson & Gauld 2006).

The parasitic Hymenoptera plays important role as regulator of several groups of herbivorous insects and can be used as indicators of their population's presence; without the hymenopterans' controlling action there would be a very high increase of the herbivorous populations that could cause the destruction of several vegetation that species they consume. Therefore, the parasitic Hymenoptera are essential for ecological balance and contributes for the biodiversity of other organisms (LaSalle & Gauld 1993). The evaluation of the parasitoids' distribution and seasonality patterns are highly relevant since parasitic Hymenoptera can represent more than 20% of all insect species, meaning that they are the largest component of the terrestrial ecosystems (LaSalle & Gauld 1993; Hanson & Gauld 2006). In spite of the continental dimension, as well as the wide diversity of environments found in Brazil, there are few and relatively recent studies about parasitic Hymenoptera in wild environments (Azevedo *et al.* 2002; Perioto & Lara 2003; Perioto *et al.* 2005,

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among others), and in agroecosystems (Dall'Oglio *et al.* 2000; Perioto *et al.* 2002a; 2002b; 2004; Nakayama *et al.* 2008; among others).

All insect collecting techniques are, in a lower or higher degree, selective and the combined use of different ones, whenever possible, is one of the approaches used to mitigate this limitation. Missa *et al.* (2009) asserted that when different sampling methods are used, the result is a more diversified capture of insects than that obtained when only one method is used for multiple repetitions. When studying Hymenoptera, or other groups of insects, different collecting techniques are used, depending on the researcher's need. Noyes (1989); Hanson (1995); Perioto & Lara (2003) and Perioto *et al.* (2004, 2005), among others, reported that traps such as Malaise, Moericke and sweeping nets are efficient collecting devices for the capture of parasitic Hymenoptera.

The aim of this study was to analyze the Hymenoptera fauna in an orange orchard/Brazilian Savannah fragment interface in Descalvado, State of São Paulo, Brazil, using different sampling methods.

MATERIAL AND METHODS

The experiment was carried out in a *Citrus sinensis* (L.) Osbeck, Valência cv. orchard, which was 12-year-old at the beginning of the sampling process, and in a fragment of Brazilian Savannah adjacent to this orange orchard in a farm called Itaúna (21°54'09"S, 47°43'55"W), in Descalvado, São Paulo, Brazil. The orange orchard sampled received the same agricultural practices applied to the remaining areas of the farm. The collections were carried out fortnightly from February to April and monthly from May to June 2006. The sampling of Hymenoptera was carried out using Malaise, Moericke and pitfall (with a removable plastic cover) traps, which stayed active in the field for a week. With the Moericke traps yellow disposable plates were used, with a diameter of 15 cm and 4.5 cm high. In the Moericke and pitfall traps, a solution of formalin (1%) was used as a preservative, while a Dietrich solution was for the Malaise traps.

In the Brazilian Savannah fragment, two parallel transects were used, measuring 200 m long each and 50 m *apart*. At each transect, two Malaise traps were installed, 100 m apart; two sets of five Moericke traps each, 100 m apart installed over the soil and 12 pitfall traps, where the first four were placed 1 m apart, and the remainder 10 m apart. In the orange orchard the transects, measuring 100 m long and following the same alignment as those in the Brazilian Savannah fragment, received 12 pitfall traps distributed following the pattern used for those in the Brazilian Savannah fragment. In one of the transects, four sets, composed of three Moericke traps each, were fixed in wood sticks, 1 m high from the soil and 5 m apart.

The identification of the Hymenoptera caught was carried out based on Hanson & Gauld (2006) and Fernández & Sharkey (2006), except for the Apoidea, which was identified as Apidae (*lato sensu*, which includes Andrenidae, Colletidae, Halictidae and Megachilidae), Crabronidae and Sphecidae.

RESULTS

In the Brazilian Savannah fragment and in the orange orchard using the different sampling methods were obtained 5,148 specimens of Hymenoptera from 12 superfamilies and 36 families: Chalcidoidea (1,885 specimens; 36.6% out of the total; 14 families), Ichneumonoidea (715; 13.9%; 2), Vespoidea (554; 10.8%; 5), Apoidea (444; 8.6%; 2), Diaprioidea (430; 8.4%; 2), Chrysidoidea (366; 7.1%; 3), Platygastroidea (340; 6.6%; 2), Ceraphronoidea (211; 4.1%; 2), Cynipoidea (107; 2.1%; 1), Evanioidea (83; 1.6%; 1), Tenthredinoidea (7; 0.1%; 1) and Trigonaloidea (6; 0.1%; 1) (Table 1).

The Moericke traps were responsible for the highest capture of specimens of Hymenoptera (63.7% out of the total collected), which were more frequent in the Brazilian Savannah fragment (2,159 specimens; 41.9%) than in the orange orchard (1,123; 21.8%) (Table 1). The pitfall traps caught just a few Hymenoptera (128; 2.5%); the specimens caught in the Brazilian Savannah fragment and in the orange orchard were counted together, making impossible an individual analysis per environment (Table 1). A comparison with the Malaise traps was not possible since they were used only in the Brazilian Savannah fragment area.

The Moericke and Malaise traps installed in the Brazilian Savannah fragment caught the largest number of specimens of Hymenoptera (2,159 specimens; 41.9% out of the total collected and 1,739; 33.8%, respectively), followed by the Moericke ones installed in the orange orchard (1,123; 21.8%) and by the pitfall traps (128; 2.5%) (Table 1). Chalcidoidea were more frequent in the Moericke traps operating in the Brazilian Savannah fragment (54.6%) and in the orange orchard (37.8%), Ichneumonoidea were more frequent in the Malaise traps of the Brazilian Savannah fragment (29.1%) and Vespoidea in the pitfall traps, in both environments (25.0%) (Table 1).

Among the ten most numerous families captured by each collection device, Braconidae (Ichneumonoidea) and Encyrtidae (Chalcidoidea) were the only ones found in all traps and in both environments; Ichneumonidae (Ichneumonoidea) only in the Malaise traps of the Brazilian Savannah fragment; Evaniidae (Evanioidea) and Mymaridae and Pteromalidae (Chalcidoidea) in the Moericke traps of the Brazilian Savannah fragment (Figures 1-4).

Among the Chalcidoidea, Eulophidae were the most abundant in the pitfall (62.1%) and Malaise traps of the Brazilian Savannah fragment (33.3%), Encyrtidae in the Moericke ones of the Brazilian Savannah fragment (71.9%) and Aphelinidae in the Moericke traps of the orange orchard (44.9%) (Tables 1 and 2).

Braconidae were the most frequent in the pitfall traps (100.0%), Moericke in the Brazilian Savannah fragment (96.8%) and Moericke of the orange orchard (83.8%) whereas Ichneumonidae (Ichneumonoidea) was found only in the Malaise traps of the Brazilian Savannah fragment (62.8%) (Tables 1 and 2).

Among the Diaprioidea, Diapriidae were the most abundant in all collection devices, reaching more than 90%, regardless of the ecosystem; Monomachidae, in spite of the few specimen obtained, were found in all but not in the Moericke traps of the orange orchard (Tables 1 and 2).

Among the Chrysidoidea, Bethylidae were the most abundant in all collection devices (pitfall traps 100%, Malaise and Moericke of the Brazilian Savannah fragment, 97.6% and 64.8%, respectively, and Moericke of the orange orchard 64.3%); Chrysididae were obtained in the Moericke of the orange orchard (3.6%) and Malaise of the Brazilian Savannah fragment (1.6%) and Dryinidae in the Moericke of the Brazilian Savannah fragment (35.2%) and Moericke of the orange orchard (32.1%) (Tables 1 and 2).

Ceraphronidae (Ceraphronoidea) was obtained with a frequency of 100.0% in the Moericke traps of the Brazilian Savannah fragment, Moericke of the orange orchard and pitfall; in the Malaise of the Brazilian Savannah fragment, they made a total of 96.0%; the remainder 4.0% was of Megaspilidae (Ceraphronoidea) (Tables 1 and 2).

Among the Apoidea, Apidae (*lato sensu*) was the most abundant in all collection devices (pitfall traps 100%, Moericke of the orange orchard 95.0%, Malaise of the Brazilian Savannah fragment 57.8% and Moericke of the Brazilian Savannah fragment 56.3%); the highest percentage of Crabronidae was obtained in the Moericke traps of the orange orchard (43.8%) (Tables 1 and 2).

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Table 1. Hymenoptera collected using Malaise, Moericke and pitfall traps in an orange orchard (CC) and Brazilian Savannah fragment (BS) in Descalvado, SP, between February and June 2006.

Superfamily	BS - Malaise trap			BS - Moericke trap			CC - Moericke trap			BS + CC - Pitfall			Total	
Family	**total**	**RFSt**	**RFFt**	**total**	**RFSt**	**RFFt**	**total**	**RFSt**	**RFFt**	**total**	**RFSt**	**RFFt**	**Σ**	**RFSt**
Apoidea	**71**	**4.1**	**100.0**	**48**	**2.2**	**100.0**	**321**	**28.6**	**100.0**	**4**	**3.1**	**100.0**	**444**	**8.6**
Apidae (*lato sensu*)	41		57.7	27		56.3	305		95.0	4		100.0	377	
Crabronidae	30		42.3	21		43.8	16		5.0	0		0.0	67	
Ceraphronoidea	25	1.4	100.0	155	7.2	100.0	23	2.0	100.0	8	6.3	100.0	211	4.1
Ceraphronidae	**24**		**96.0**	**155**		**100.0**	**23**		**100.0**	**8**		**100.0**	**210**	
Megaspilidae	1		4.0	0		0.0	0		0.0	0		0.0	1	
Chalcidoidea	**252**	**14.5**	**100.0**	**1,179**	**54.6**	**100.0**	**425**	**37.8**	**100.0**	**29**	**22.7**	**100.0**	**1,885**	**36.6**
Agaonidae	1		0.4	0		0.0	1		0.2	0		0.0	2	
Aphelinidae	1		0.4	57		4.8	191		44.9	1		3.4	250	
Chalcididae	0		0.0	6		0.5	3		0.7	0		0.0	9	
Encyrtidae	56		22.2	848		71.9	164		38.6	8		27.6	1076	
Eucharitidae	11		4.4	9		0.8	0		0.0	0		0.0	20	
Eulophidae	84		33.3	35		3.0	23		5.4	18		62.1	160	
Eupelmidae	3		1.2	5		0.4	4		0.9	0		0.0	12	
Eurytomidae	10		4.0	5		0.4	3		0.7	0		0.0	18	
Mymaridae	40		15.9	96		8.1	20		4.7	0		0.0	156	
Pteromalidae	25		9.9	105		8.9	8		1.9	2		6.9	140	
Signiphoridae	14		5.6	5		0.4	2		0.5	0		0.0	21	
Tanaostigmatidae	1		0.4	0		0.0	0		0.0	0		0.0	1	
Torymidae	6		2.4	8		0.7	0		0.0	0		0.0	14	
Trichogrammatidae	0		0.0	0		0.0	6		1.4	0		0.0	6	
Cynipoidea	**55**	**3.2**	**100.0**	**9**	**0.4**	**100.0**	**37**	**3.3**	**100.0**	**6**	**4.7**	**100.0**	**107**	**2.1**
Figitidae	55		100.0	9		100.0	37		100.0	6		100.0	107	
Chrysidoidea	**249**	**14.3**	**100.0**	**88**	**4.1**	**100.0**	**28**	**2.5**	**100.0**	**1**	**0.8**	**100.0**	**366**	**7.1**
Bethylidae	243		97.6	57		64.8	18		64.3	1		100.0	319	
Chrysididae	4		1.6	0		0.0	1		3.6	0		0.0	5	
Dryinidae	2		0.8	31		35.2	9		32.1	0		0.0	42	
Evanioidea	**27**	**1.6**	**100.0**	**50**	**2.3**	**100.0**	**5**	**0.4**	**100.0**	**1**	**0.8**	**100.0**	**83**	**1.6**
Evaniidae	27		100.0	50		100.0	5		100.0	1		100.0	83	
Ichneumonoidea	**506**	**29.1**	**100.0**	**157**	**7.3**	**100.0**	**37**	**3.3**	**100.0**	**15**	**11.7**	**100.0**	**715**	**13.9**
Braconidae	188		37.2	152		96.8	31		83.8	15		100.0	386	
Ichneumonidae	318		62.8	5		3.2	6		16.2	0		0.0	329	
Platygastroidea	**96**	**5.5**	**100.0**	**135**	**6.3**	**100.0**	**89**	**7.9**	**100.0**	**20**	**15.6**	**100.0**	**340**	**6.6**
Platygastridae	96		100.0	135		100.0	89		100.0	20		100.0	340	
Diaprioidea	**144**	**8.3**	**100.0**	**256**	**11.9**	**100.0**	**18**	**1.6**	**100.0**	**12**	**9.4**	**100.0**	**430**	**8.4**
Diapriidae	141		97.9	250		97.7	18		100.0	11		91.7	420	
Monomachidae	3		2.1	6		2.3	0		0.0	1		8.3	10	
Vespoidea	**312**	**18.0**	**100.0**	**73**	**3.4**	**100.0**	**137**	**12.2**	**100.0**	**32**	**25.0**	**100.0**	**554**	**10.8**
Mutillidae	69		22.1	10		13.7	1		0.7	6		18.8	86	
Pompilidae	103		33.0	33		45.2	22		16.1	21		65.6	179	
Scoliidae	20		6.4	0		0.0	0		0.0	0		0.0	20	
Tiphiidae	46		14.7	4		5.5	8		5.8	2		6.3	60	
Vespidae	74		23.7	26		35.6	106		77.4	3		9.4	209	
Trigonaloidea	**0**	**0.0**	**0.0**	**3**	**0.1**	**100.0**	**3**	**0.3**	**100.0**	**0**	**0.0**	**0.0**	**6**	**0.1**
Trigonalidae	0			3		100.0	3		100.0	0			6	
Tenthredinoidea	**1**	**0.1**	**100.0**	**6**	**0.3**	**100.0**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**	**7**	**0.1**
Pergidae	1		100.0	6		100.0	0		0.0	0		0.0	7	
Total	**1,738**	**100.0**		**2,159**	**100.0**		**1,123**	**100.0**		**128**	**100.0**		**5148**	**100.0**
% trap	**33.8**			**41.9**			**21.8**			**2.5**			**100.0**	

RFSt= relative frequency of the superfamilies of Hymenoptera in relation to total collected
RFFt= relative frequency of the Hymenoptera families in relation to that collected in the superfamily to which they belong to

Table 2. Amount of Hymenoptera collected using Malaise, Moericke and pitfall traps in an orange orchard and Brazilian Savannah fragment in Descalvado, SP, between February and June 2006.

Hymenoptera	Brazilian Savannah		Citrus crop	Brazilian Savannah + Citrus crop
	Malaise trap	Moericke trap	Moericke trap	Pitfall trap
Apidae (*lato sensu*)	**	**	*****	*
Crabronidae	**	**	**	-
Ceraphronidae	**	****	**	*
Megaspilidae	*	-	-	-
Agaonidae	*	-	*	-
Aphelinidae	*	***	****	*
Chalcididae	-	*	*	-
Encyrtidae	***	******	****	*
Eucharitidae	**	*	-	-
Eulophidae	***	**	**	**
Eupelmidae	*	*	*	-
Eurytomidae	*	*	*	-
Mymaridae	**	***	**	-
Pteromalidae	**	****	*	*
Signiphoridae	**	*	*	-
Tanaostigmatidae	*	-	-	-
Torymidae	*	*	-	-
Trichogrammatidae	-	-	*	-
Figitidae	***	*	**	*
Bethylidae	****	***	**	*
Chrysididae	*	-	*	-
Dryinidae	*	**	*	-
Evaniidae	**	***	*	*
Braconidae	****	****	**	**
Ichneumonidae	*****	*	*	-
Platygastridae	***	****	***	**
Diapriidae	****	*****	**	**
Monomachidae	*	*	-	*
Mutillidae	***	*	*	*
Pompilidae	****	**	**	**
Scoliidae	**	-	-	-
Tiphiidae	***	*	*	*
Vespidae	***	**	****	*
Trigonalidae	-	*	*	-
Pergidae	*	*	-	-

1 to 10 specimens = *; 11 to 50 specimens = **; 51 to 100 specimens = ***; 101 to 200 specimens = ****; 201 to 300 specimens = *****; 301 to 500 specimens = ******; above 500 specimens = *******

Mutillidae, Pompilidae, Tiphiidae and Vespidae were obtained from all collection devices. Mutillidae, Scoliidae and Tiphiidae were the most frequent in the Malaise traps of the Brazilian Savannah fragment (22.1%, 6.4% and 14.7%, respectively); Pompilidae in the pitfall traps (65.6%); and Vespidae in the Moericke traps of the orange orchard (77.4%) (Tables 1 and 2).

Platygastroidea, Evanioidea, Cynipoidea, Tenthredinoidea and Trigonaloidea were represented only by one family each: Platygastridae, Evaniidae, Figitidae, Pergidae and Trigonalidae, respectively; the first three were present in all ecosystems and captured by all collection devices; the fourth one in the Moericke traps of the Brazilian Savannah fragment and of the orange orchard and, the last, in the Moericke and Malaise traps of the Brazilian Savannah fragment. The frequency in which such families occurred varied from 0.1 to 6.6% out of the total of Hymenoptera collected (Tables 1 and 2).

The Malaise traps of the Brazilian Savannah fragment did not catch any specimen of Chalcididae and Trichogrammatidae (Chalcidoidea) and Trigonalidae (Trigonaloidea); the pitfall traps did not catch specimens from 19 families, among which 10 of Chalcidoidea (Table 2). Among the Moericke traps, specimens of Megaspilidae (Ceraphronoidea), Agaonidae, Tanaostigmatidae and Trichogrammatidae (Chalcidoidea), Chrysididae (Chrysidoidea) and Scoliidae (Vespoidea) were not captured by the trap located in the Brazilian Savannah fragment and Megaspilidae (Ceraphronoidea), Eucharitidae, Tanaostigmatidae and Torymidae (Chalcidoidea), Monomachidae (Diaprioidea), Scoliidae (Vespoidea) and Pergidae (Tenthredinoidea) by the located in the orange orchard (Table 2).

Specimens of Megaspilidae (Ceraphronoidea) were obtained only in Malaise traps of the Brazilian Savannah fragment; among the Chalcidoidea, Agaonidae in the Malaise of the Brazilian Savannah fragment and Moericke of the orange orchard, Chalcididae in

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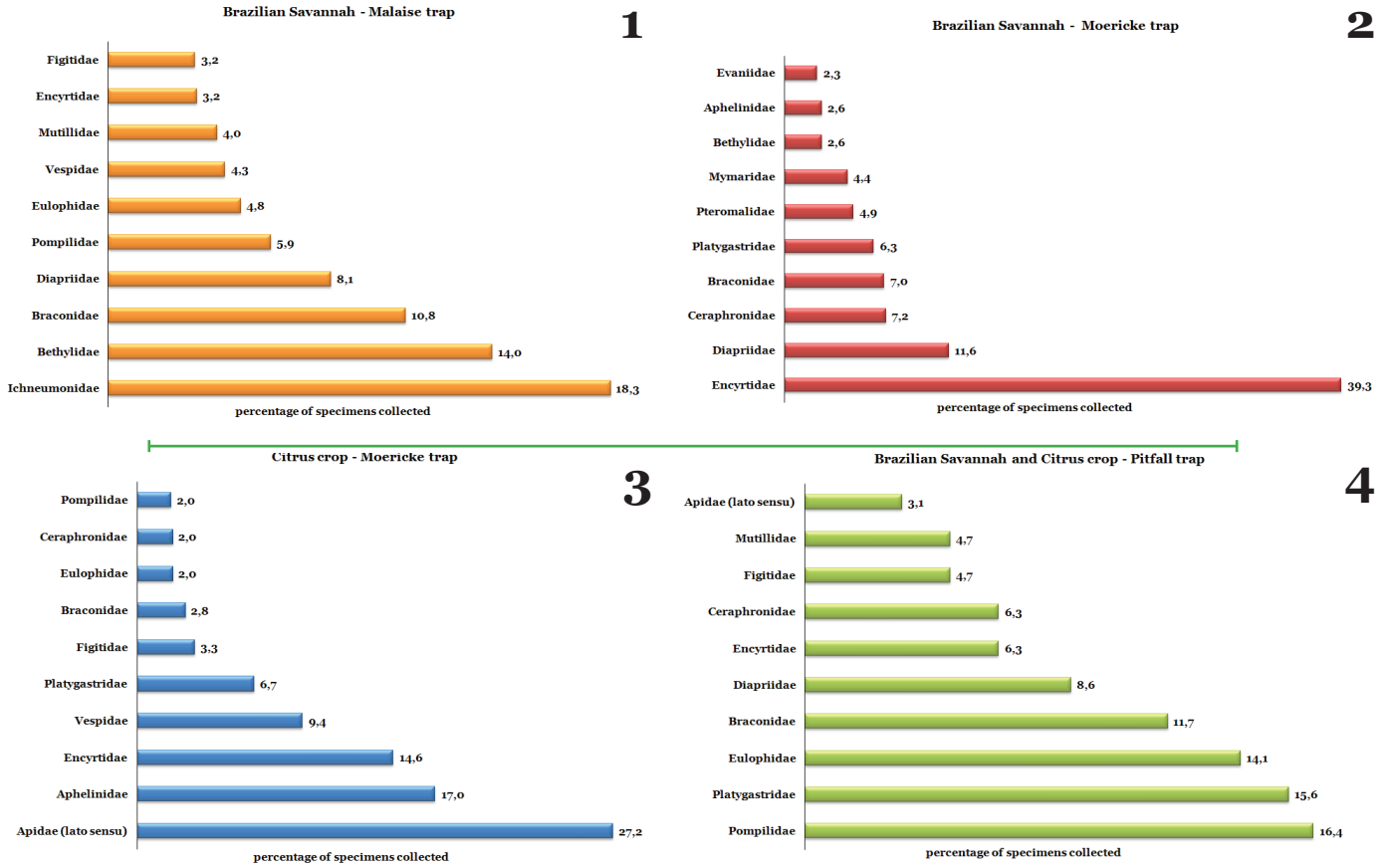

Figures 1-4. The ten most abundant families of Hymenoptera collected using Malaise, Moericke and pitfall traps in an orange orchard and Brazilian Savannah fragment in Descalvado, SP, between February and June 2006. 1. Malaise traps in Brazilian Savannah fragment; 2. Moericke traps in Brazilian Savannah fragment; 3. Moericke traps in orange orchard; 4. Pitfall traps in Brazilian Savannah fragment and orange orchard.

the Moericke of the Brazilian Savannah fragment and of the orange orchard, Eucharitidae in the Malaise and Moericke traps of the Brazilian Savannah fragment, Eupelmidae, Eurytomidae, Mymaridae and Signiphoridae in the Malaise and Moericke traps of the Brazilian Savannah fragment and in the Moericke of the orange orchard, Tanaostigmatidae in the Malaise of the Brazilian Savannah fragment, Torymidae in the Malaise and Moericke traps of the Brazilian Savannah fragment and Trichogrammatidae in the Moericke traps of the orange orchard; among the Chrysidoidea, Chrysididae in the Malaise of the Brazilian Savannah fragment and in the Moericke of the orange orchard and Dryinidae in the Malaise and Moericke traps of the Brazilian Savannah fragment and of the orange orchard; Ichneumonidae (Ichneumonoidea) and Platygastridae (Platygastroidea) in the Malaise and Moericke traps of the Brazilian Savannah fragment and of the orange orchard; Monomachidae (Diaprioidea) in the Malaise and Moericke traps of the Brazilian Savannah fragment and in the pitfall; Scoliidae (Vespoidea) in the Malaise of the Brazilian Savannah fragment; Trigonalidae (Trigonaloidea) in the Moericke of the Brazilian Savannah fragment and of the orange orchard and Pergidae (Tenthredinoidea) in the Malaise and Moericke traps of the Brazilian Savannah fragment (Table 2).

DISCUSSION

The predominance of Aphelinidae and Encyrtidae (Chalcidoidea), Apidae (Apoidea) and Vespidae (Vespoidea) in the Moericke traps of the orange orchard could be explained by a possible association of their populations with hosts commonly found in citrus crops, such as *Phyllocnistis citrella* Staiton (Lepidoptera: Gracillariidae), *Ecdytolopha aurantiana* (Lima) (Tortricidae) and *Heraclides thoas brasiliensis* (Roth. & Jordan) (Lepidoptera: Papilionidae), the scales *Praelongorthezia praelonga* (Douglas) (Hemiptera: Ortheziidae), *Unaspis citri* (Comstock) and *Pinnaspis aspidistrae* (Signoret) (Hemiptera: Diaspididae) and the whitefly *Aleurothrixus floccosus* (Maskell) (Hemiptera: Aleyrodidae) (Gravena 2005). The action of vespids over lepidopterans in citrus crops was reported by Socarrás & Suarez (2007) and Marques *et al.* (2005), the former mentioned that *Polybia occidentalis* (Olivier) (Hymenoptera: Vespidae) is the most relevant predator of *P. citrella* in Colombia and the latter observed the attack of *Polistes versicolor versicolor* (Olivier) (Hymenoptera: Vespidae) over *Heraclides anchysiades capys* (Hübner) (Lepidoptera: Papilionidae) in Bahia, Brazil. Nascimento *et al.* (2011) registered 12 species of bees, out of which 11 natives in an orange orchard in Salinas, State of Minas Gerais, Brazil and, among them there was predominance and dominance of *Apis mellifera* Linnaeus and *Trigona spinipes* (Fabricius) (Hymenoptera: Apidae). For orange orchard in the State of São Paulo, it was reported the presence of *A. mellifera*, *T. spinipes* and *Tetragonisca angustula* Latreille in Bebedouro (Gamito & Malerbo-Souza 2006). Many records of Aphelinidae species in orange orchards for the control of scales and Aleyrodidae have been reported, as for example, Peralta-Gamas *et al.* (2010), in Mexico, that reported the association of *Encarsia citrina* (Craw) with *Abgrallaspis cyanophylli* (Signoret), *Aonidiella aurantii* (Maskell), *Chionaspis* (= *Phenacaspis*) *pinifoliae* (Fitch), *Genaparlatoria pseudaspidiotus* (Lindinger), *Pinnaspis strachani* (Cooley) and *Unaspis citri* (Comstock); of *Encarsia haitiensis* Dozier with *Aleurothrixus floccosus* (Maskell); of *Encarsia perplexa* (Huang & Polaszek) with *Aleurocanthus pectiniferus* Quaintance & Baker, *Aleurocanthus woglumi* Ashby, *Aleuroclava kuwanai* (Takahashi), *A. floccosus* and *Tetraleurodes acaciae* (Quaintance); and *Eretmocerus* sp. with *A. woglumi*, *A. floccosus*, *Bemisia tabaci* (Gennadius) and *T. acaciae*. In Brazil, Rodrigues & Cassino (2003) observed the parasitism of *A. floccosus* by *Encarsia* sp. and *Signiphora* sp. (Hymenoptera, Signiphoridae) in *Citrus reticulata* Blanco; Pazini & Gravena (1994) observed the parasitism of *Parlatoria cinerea* Hadden by the aphelinid *Aphytis hispanicus* Mercet on "*Citrus* x *sinensis*" in Bebedouro. Several studies report the parasitism of *P. citrella* by *Ageniaspis citricola* Logvinovskaya (Hymenoptera: Encyrtidae) and *Galeopsomyia fausta* (LaSalle) (Hymenoptera: Eulophidae) in different Brazilian states (Lioni & Cividanes 2004;

Jahnke *et al.* 2007; Efrom *et al.* 2007, among others); the first observed a predominance of *A. citricola* in the studied areas.

The Moericke traps of the Brazilian Savannah fragment captured predominantly Encyrtidae, Diapriidae, Ceraphronidae, Braconidae, Pteromalidae and Mymaridae which represented about 75% out of the total of Hymenoptera collected, reflecting a large diversity of hosts in that environment. Perioto *et al.* (2008) reported a high frequency of Encyrtidae, Bethylidae and Scelionidae (=Platygastridae) in an area of Brazilian Savannah in Luiz Antônio, State of São Paulo. Perioto *et al.* (2005) studied the fauna of parasitic Hymenoptera in the Atlantic Rainforest of the State of São Paulo and observed a large frequency of Braconidae, Ichneumonidae, Diapriidae and Scelionidae when using Moericke traps. According to Abrahamczyk *et al.* (2010), in Tropical Rainforests of Bolivia, nine families of Hymenoptera were the most frequent in collections carried out using yellow and blue Moericke traps; Halictidae, Pompilidae, Ichneumonidae and Apidae were the most abundant in the yellow pan traps. Missa *et al.* (2009) observed that among the Hymenoptera, Ceraphronidae and Encyrtidae were the most abundant taxa caught with Moericke traps in Tropical Rainforests of Gabon.

The number of families of parasitic Hymenoptera found by this study in the Brazilian Savannah fragment (26) is close to that found by Perioto *et al.* (2008) who observed 27 families of parasitic Hymenoptera in the Savanna Woodland vegetation (Cerradão vegetation), 25 in Riparian Forests and 24 in a Brazilian Savannah area in Luiz Antônio, State of São Paulo. Similar results were found by Alencar *et al.* (2007) (28 families of parasitic Hymenoptera) for the Atlantic Rainforest in Domingos Martins, Espirito Santo State and by Fernandes *et al.* (2014), (32 families) in area of Xeric Shrubland (Caatinga vegetation). In the orange orchard 22 families were found, reflecting a lower diversity of hosts found in the agroecosystems and corroborating what was found by Perioto *et al.* (2002a, 2002b, 2004) who counted 15, 22 and 21 families of parasitic Hymenoptera in a soybean agroecosystems in Nuporanga, cotton in Ribeirão Preto and coffee in Cravinhos, all of them in State of São Paulo.

Except for the Megaspilidae, Eucharitidae, Tanaostigmatidae, Torymidae and Monomachidae, which occurred sporadically and only in the Brazilian Savannah fragment, the other families occurred in the two studied environments. It is important to note that the presence of those families, as well as Aulacidae and Gasteruptiidae (Evanioidea) and Pelecinidae (Proctotrupoidea), also rarely collected in agroecosystems, seems to work as an indicator of a large diversity in the environment. Such fact can be explained by their biology: their hosts occur almost exclusively in wild environments; the presence of those families in wild environments was reported by Azevedo *et al.* (2002); Amaral *et al.* (2005); Alencar *et al.* (2007); Perioto *et al.* (2008) and Garcia (2003) tested the efficiency of four different collection methods (Moericke, Malaise, flight interception and vegetation sweeping traps) in a study carried out in two altitudinal levels in Venezuela (above 1,750 m) and reported that Moericke traps were responsible for the capture of about 70% of the Hymenoptera collected, followed by the Malaise and flight interception.

In spite of the differences observed among the quantities of parasitic Hymenoptera sampled through the different techniques (Malaise trap, 1,739 specimens collected, 33.8% out of the total collected; Moericke, 3,281; 63.7% and pitfall 128; 2.5%), the combined use is recommended because different sampling techniques allow a better characterization of the diversity present in the environments, as reported by Hanson (1995). If different types of traps are not used, the result could be sub-representative in taxonomic, ecological and biodiversity studies.

The results obtained by this study showed that the diversity of families of Hymenoptera in the Brazilian Savannah fragment was larger than in the orange orchard, expressing the largest diversity of hosts in that environment. The combined use of different kinds of traps allows the capture of a large diversity of Hymenoptera groups.

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