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Melliferous flora and pollen characterization of honey samples of *Apis mellifera* L., 1758 in apiaries in the counties of Ubiratã and Nova Aurora, PR

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ABSTRACT

The aim of this study was to carry out a survey of the flora with potential for beekeeping in the counties of Ubiratã and Nova Aurora-PR through the collection of plants and pollen analyses in honey samples collected monthly. 208 species of plants were recorded, distributed in 66 families. The families that showed the major richness of pollen types were: Asteraceae, Myrtaceae and Solanaceae. Approximately 80 pollen types were found in honey samples, most of them were characterized as heterofloral. Cultivated plants, such as *Glycine max* (soybean) and *Eucalyptus* spp., were representative in some months of the year. Exotic species, such as *Ricinus communis* and *Melia azedarach*, were also frequent. However, over than 50% of the pollen types belong to native species of the region, such as *Schinus terebinthifolius*, *Baccharis* spp. *Alchornea triplinervia*, *Parapiptadenia rigida*, *Hexaclamys edulis*, *Zanthoxylum* sp. and *Serjania* spp., indicating the importance of the native vegetation for the survival of the colonies.

Key words: beekeeping, bee plants, floral resources, floristic survey.

INTRODUCTION

Brazil is a country of great beekeeping potential due to its diverse flowerings and adequate climate conditions making possible the management of beehives during the entire year. Beekeeping is an interesting activity to the rural producer because it requires little initial investment (Nogueira-Couto and Couto 2006).

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Plants and their associated insects present interdependence in their evolutionary history and tropical regions have greater diversity of plants with flowers than temperate regions. Therefore, bees from tropics with a rich diversity of food resources demonstrate fast answer to the changes in the availability of the food items and lesser constancy than species of temperate regions (Crane 1990). The mutual benefits between bees and plants depend on the interaction with factors such

as phenology and biogeography. In general, these factors are specific of each place and depend on the seasonal patterns (Hill and Webster 1995).

As the honey production and the parameters of honey depend on the vegetal species available to the beekeeping use, many studies have been carried out for the identification of the plants used by *A. mellifera* in different regions of the country. The authors employ mainly techniques based on the analysis of the pollen content of honey samples and/or analysis of pollen loads from corbicula of bees (Carvalho and Marchini 1999, Moreti et al. 2000, Silva and Absy 2000, Bastos et al. 2003, Viana et al. 2006, Luz et al. 2007, Mendonça et al. 2008, Sodré et al. 2008) and analysis of visiting bees in plants (Marchini et al. 2001, Santos et al. 2006, Vieira et al. 2008).

The knowledge of the regional flora with beekeeping potential possibilities the better use of the floral resources and stimulate the utilization of species of plants with apiarist value in the restoration of the vegetation of rural areas.

This research was carried out to obtain a floristic survey in the surroundings areas of apiaries in rural area in the counties of Ubiratã and Nova Aurora (PR) to identify the floral sources used by *Apis mellifera* for honey production and to evaluate the pollen spectrum of the honey samples during the year.

MATERIALS AND METHODS

Area of Study

The collection areas (Figure 1) are located between 24°20' to 24°40' S and 52°52' to 53°26' W parallels, distributed in three rural areas in the counties of Ubiratã in the Central-Western meso-region of Paraná State and Nova Aurora in the Occidental-Centre meso region of Paraná State.

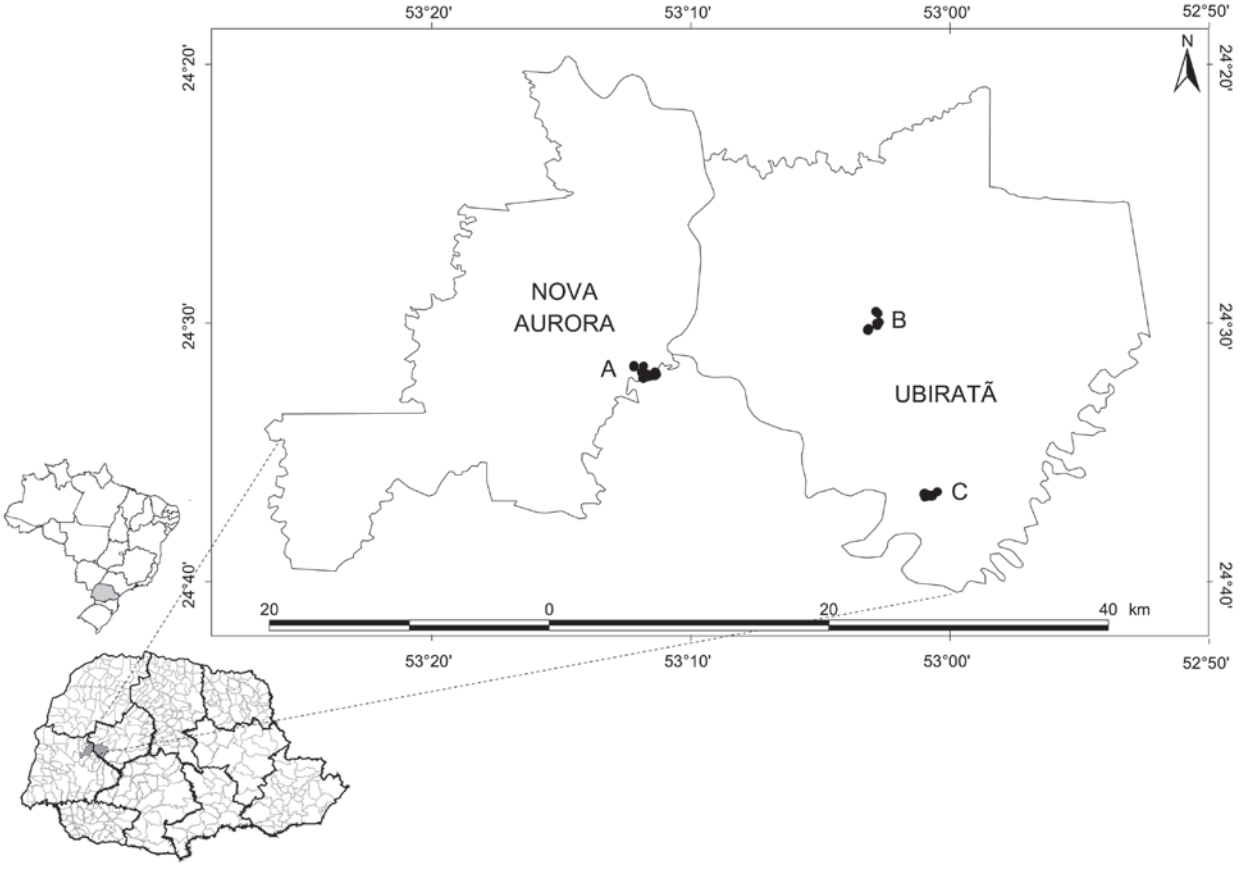

Figure 1 - Location of the collection points in the counties of Nova Aurora (Point A) and Ubiratã (Points B and C) in Paraná state.

These counties are located in the phytogeographical domains of Submontane Semidecidous Tropical Forest (IBGE 1992). The predominant soil is Red Latosol (Brazilian classification: Latossolo Vermelho distroférrico, Embrapa 1999) and the region presents a softly waved relief, located in the third plateau of Paraná State at 550 m of height above sea level.

The climate in the region is CwB, humid subtropical, with noticeable dry winters and very rainy summers by Köppen's classification. The mean annual temperature is higher than 22°C in the warmest month and lower than 18°C in the coldest months. The pluviometric precipitation varies from 1,600 mm to 1,900 mm and the relative humidity of the air remains close to 80% (IAPAR 2009).

Location of the Apiaries

The collections were carried out in three apiaries, one in the county of Nova Aurora (24°31'50" S and 53°11'50" W – Apiary A) and two in the county of Ubiratã -PR (24°29'41" S and 53°02'43" W – Apiary B and 24°36'40.8" S and 53°00'52.6" W – Apiary C). The sampled areas embrace forest remnants, gardens, pastures, agricultural cultivations (predominance of soybean and corn) and reforestation areas (predominance of Eucalyptus). Apiary A has a legal reserve area of 13.65 ha, Apiary B of 2.4 ha and Apiary C of 15.64 ha.

Collection and Identification of the Botanical Material

The collections were carried out biweekly from October 2008 to November 2009, totalizing 13 months. Considering that the radius of the forest remnants in the surrounding area of the apiaries did not exceed 1,000 meters and the others rural properties were composed by agricultural areas, random collections were determined inside of a radius of approximately 1,000 m around the apiaries. The vegetation survey was conducted with usual techniques of floristic surveys (Fidalgo and Bononi 1989, IBGE 1992).

Five samples of each vegetal specie in blooming were collected and then herborized and identified (Cronquist 1981) at Herbarium of the Universidade Tecnológica Federal do Paraná (HCF) in Campo Mourão. When necessary, these samples were also sent to the Botanical Museum of Curitiba (MBM) and to the Herbarium of the Botanical Department of the Universidade Federal do Paraná (UFPR) in Curitiba. The material was recorded using a digital camera Sony-DSC-H9 (8.1MP-15x of optical zoom).

The classification of the species by the habit was adopted in accordance with HCF: tree – higher than 5 m of height and small tree – lower than 5 m, both forming frustum (trunk); shrub – with woody tissue and until 5 m of height, without forming frustum; herb – with no woody tissue. The classification was done in successional stages (Reitz et al. 1978, 1983, SPVS 1996, Roderjan et al. 1998).

Collection of Honey Samples

In each apiary, three beehives were marked next to the forest remnant and to the agricultural cultures. Empty frame with beeswax foundation in the super was set up monthly to avoid the mixture of the honey produced in different months. Samples were collected from December 2008 to April 2009 and from May to November 2009 when there was honey stored in the combs, even if it was not mature (with minimum 75% of capped cells). The honeycomb was centrifuged separately in plastic packing to avoid the mixture of the different samples.

Reference Slide Collection and Pollen Analyses

Floral buds were collected and packed separately to avoid the pollen mixture. One pollen slide collection was prepared using the acetolysis method (Erdtman 1952). This method is used to eliminate cell contents and enable observations on pollen size, shape, aperture and exine surface. A camera coupled in a microscope and the Motic images 2000 software captured images of the pollen.

To the preparation of the slides of pollen contained in the honey of each month, the samples of the three beehives of each apiary were mixed. To the samples with moisture above 20%, it was used a quantity proportionally higher. An aliquot of 10 g was diluted in 20 mL of distilled water and centrifuged to the acetolysis method. Two slides of each sample were prepared for posterior counting and identification of the pollen types.

The slides were observed in a optical microscope Motic to the qualitative analyses (determination of pollen types) and quantitative (counting of pollen grains). Pollen types were determined by comparing with the reference lamina and also by researches in the specialized bibliography (Barth 1989, Moreti et al. 2002, Melhem et al. 2003, Roubik 2010). To the quantitative analyses, 300 to 500 pollen grains of each slide were counted and the averages of the counting of two slides of each sample were considered. The pollen types were classified in four classes of frequency (Louveaux et al. 1978, Barth 1989): dominant pollen (frequency higher than 45% - D), accessory pollen (16% to 45% - A), important isolated pollen (3% to 15% - I) and occasional isolated pollen (frequency lower than 3% - O).

The Diversity Index of Shannon (H') (Pielou 1975) and Simpson (D) (Poole 1974) were calculated to the pollen data:

$H' = - \Sigma pi \times \ln pi$, where: $pi = ni/N$, ni = number of individuals of the specie i, N = total number of sampled individuals.

$1 - D = 1 - \Sigma \{[ni (ni-1)]/N(N-1)\}$, where: ni = number of individuals of n-th specie, N = total number of sampled individuals.

RESULTS

Survey of the Plants

In the floristic survey, 208 species were recorded and distributed in 66 families (Table I). Six families, Asteraceae (9.48%), Myrtaceae (7.11%), Solanaceae (5.69%), Malpighiaceae (4.27%), Bignoniaceae (5.21%) and Fabaceae (3.79%), concentrate approximately 36% of the richness of the area. Genera with higher richness of species were *Solanum* (seven species) and *Eucalyptus* (four species).

It can be observed in Table I that 162 species (76.8%) are native and 34 species (16.1%) are exotic from identified species. Among them, there were introduced species, cultivated in the areas close to the apiaries and with economical importance, such as *Eucalyptus* spp. and *Glycine max* (soybean).

From the total of the species, 139 (67.0%) were classified as pioneer species and 52 (25.0%) as secondary. 53 arboreal species (25.5%), 41 herbs (19.7%), 40 shrubs (19.2%), 31 climbers (15.0%), 12 sub-shrubs (5.8%) and 12 small trees (5.8%) were collected.

TABLE I
Blooming period of the collected species in the counties of Nova Aurora and Ubiratã (PR) from October 2008 to November 2009.

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
	Acanthaceae																	
7282	*Justicia brasiliana* Roth.		B	N	P		●	●	●	●	●					♦		
	Alstroemeriaceae																	
7528	*Bomarea edulis* (Tuss.)Herb.		ST	N	P		♦	♦								♦		
	Amaranthaceae																	
7820	*Alternanthera ficoidea* (L.) P. Beauv.		H		.				♦									

TABLE I (CONTINUATION)

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
	Amaranthaceae																	
7827	*Chamissoa altissima* (Jacq.) H. B. Kunth		H		.				♦									
7919	*Chamissoa* sp.		B	N	.						♦							
7280	*Hebanthe paniculata* Mart.	ginseng	B	N	P							●	●	♦	●	♦		
	Anacardiaceae																	
7980	*Mangifera indica* L. [4]	mangueira	T	E	P	+					♦			●	♦	●		
7754	*Schinus terebinthifolius* Raddi [2,4,6]	aroeira pimenteira	S	N	P	+	●	●	♦	●	●			●		♦	●	
	Apiaceae																	
7645	*Hydrocotyle leucocephala* Cham. & Schltdl [3,4]	acariçoba	H	N	S	+		♦	●	●	●							
	Apocynaceae																	
7261	*Condylocarpon isthmicum* (Vell.) A. DC.		ST	N	P			●	●						●	♦	●	
7646	*Prestonia coalita* (Vell.) Woodson	Cipo-de-leite	ST	N	P/S			♦										
7507	*Rauwolfia sellowii* Muell. Arg.																	
7243	*Tabernaemontana catharinensis* A.DC	leiteiro	T	N	P					●	●	●			●	♦	●	
	Asclepiadaceae																	
7288	*Asclepias curassavica* L.		H	N	P			♦	♦	♦	●	●	♦	♦	♦	♦	●	●
	Asteraceae																	
7536	*Ageratum conyzoides* L.		H	N	S		♦	●	●	●	●	●						
7531	*Baccharis dracunculifolia* DC. [6,8]	vassoura	B	N	P	+	♦	●	●	●	●					●		
7921	*Baccharis microdonta* DC. [1,2,8]	vassoura	B	N	P	x			●		♦							
7266	*Bidens pilosa* L. [2,3,4]	picão preto	H	N	P	+			●		●				●	♦	●	
8168	*Calea pinnatifida* (R.Br.) Less.		SB	N	P										♦	●	●	
7819	*Calyptocarpus biaristatus* (DC.) H. Rob.		H	N	S				♦		●						●	●
7292	*Centratherum punctatum* Cass.		H	N	P		♦	♦	♦		♦		♦		♦	♦		
7643	*Chromolaena pedunculosa* (Hook. & Arn.)R.M.&H.		H	N	P			♦	●	●	●							
7523	*Conyza bonariensis* (L.) Cronquist [6]	voadeira	H	N	P	x	♦	●				●					●	
7920	*Dasyphyllum brasiliense* (Spr.) Cabr.	sucará	SB	N	Sl				●	♦	♦	♦		●	●			
7291	*Elephantopus mollis* Kunth[6]	sarsuiá	H	N	P	x		♦	●	●	●	●	●			♦		
7267	*Emilia sonchifolia* (L.) DC.[2,3,4]	emilia	H	N	P	+		●						●		♦	●	
8173	*Galinsoga parviflora* Cav.		H	N	P										♦			
8109	*Mikania cordifolia* (L.f)Willd.[4]	cipó-guaco	ST	N	P	+				●				♦				
7752	*Mikania micrantha* Kunth[9]	cipó-guaco	ST	N	P/Si	x		♦	♦	●	●							
7651	*Parthenium hysterophorus* L.[3]	losna-branca	H	N	P	+		♦		●	●		●	●				
7247	*Senecio brasiliensis* (Spreng.) Less.[2,4,6,7]	berneira	H	N	P	+							●		●	♦	●	
8112	*Sonchus asper* (L.)Hill.	Serralha-brava	H	N	P									♦				
8111	*Sonchus oleraceus* L.[4]	serralha	H	N	P	+			●				●	♦	●			
7278	*Wedelia subvelutina* DC.		H	N	P											●		
	Begoniaceae																	
7390	*Begonia cucullata* Willd.	azedinha	H	N	S		♦	♦	♦						♦	●	♦	●
7242	*Adenocalymma marginatum* (Cham.) DC.		CT	N	P			●	●							♦		
7548	*Arrabidaea chica* (Humb. & Bonpl.) B.Verlot		CT	N	P		♦			●					●	●		

TABLE I (CONTINUATION)

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
	B.Verlot																	
7505	*Arrabidaea selloi* (Spreng.) Sandw.		CT	N	P		♦											♦
8172	*Clytostoma sciuripabulum* Bareau & K.Schum		CT	N	P							♦						
8169	*Jacaranda puberula* Cham.[5]	caroba	T	N	P	x									♦			
7549	*Macfadyena unguis-cati* (L.) A. H. Gentry	unha-de-gato	CT	N	P		♦	●	●	♦				●	●	●	●	
7391	*Mansoa difficilis* (Cham.) Bureau. & K.Schum.[8]	mansoa	CT	N	S	x							●	●	●	●	●	
7276	*Pyrostegia venusta* (Ker Grawl) Miers[4,6,9]	cipó-de-são-joão	CT	N	P	+				♦	♦		♦	♦	♦	♦	♦	
8211	*Tecoma stans* (L.)Adr. Juss. ex Kunth		B	E	P							●				♦		
7253	*Tynanthus micranthus* Mello		ST	N	P/Si										●	♦		
	Bixaceae																	
7530	*Bixa orelana* L.[5]	urucum	T	N	P	+	♦		●		●			●				
	Boraginaceae																	
7527	*Cordia ecalyculata*Vell.	Café de bugre	S	N	P		♦			●						●		
7751	*Cordia trichotoma* (Vell.) Arrab. ex Steud.[4]	óleo-pardo, louro-pardo	T	N	P	+		●	♦	●			●					
7251	*Heliotropium transalpinium* Vell.		H	N	P		♦	♦	♦	♦		♦	♦	♦	♦	♦	♦	
	Brassicaceae																	
8059	*Brassica napus* L.		H		.									♦				
8064	*Raphanus sativus* L.		H		.									♦				
	Cactaceae																	
7400	*Brasiliopuntia brasiliensis* (Willd.) Berg.	cacto	SB	N	P		♦			●							♦	
7644	*Pereskia aculeata* Mill.	ora-pronobilis	SB	N	P/S			♦	●					●				
8105	*Rhipsalis cereuscula* (How)Volguin	Rabo-de-rato	EPI	N	S					●		●		♦	●	●	●	
	Caesalpinaceae																	
7521	*Bauhinia forficata* Link[2,4,5,8]	pata-de-vaca	S	N	P	x	♦	♦	●	●	●					●		
7750	*Phanera microstachya* (Raddi) L.P.		CT	N	.	x			♦									
8217	*Caesalpinia peltophoroides* Benth.[1,2,3,4,5,8]	sibipiruna	T	N	P	+		●			●					♦	●	
7822	*Senna neglecta* (Vogel) Irwin & Barneby[4,5]	chuva-de-ouro	B	N	P	x			♦									
	Caricaceae																	
7525	*Carica papaya* L.[4]	mamoeiro	T	E	P	+	♦	♦	♦	♦			♦	♦	♦			
	Cecropiaceae																	
7509	*Cecropia pachystachya* Trécul.8	embaúba	T	N	P	x	●					●		●		●		♦
	Clusiaceae																	
7399	*Clusia* sp.		B	E	P												♦	
	Combretaceae																	
7538	*Combretum fruticosum* (Loef.) Stunz	escova-de-macaco	TE	N	P		♦	●	●									
	Combretaceae																	
8163	*Terminalia australis* Cambess[4]	amarilho, sarandi	T	N	S	x								♦	♦	●		
	Commelinaceae																	
7534	*Dichorisandra hexandra* (Aubl.) Standl		H	N	Sl		♦	●	●	●								●
7641	*Tripogandra diuretica* (Mart.) Handlos		H	N	P/S			♦	♦	●			●					
	Convolvulaceae																	
7826	*Ipomoea nil* (L.)Roth[4]	corda-de-viola	ST	N	P	x			♦				●					

TABLE I (CONTINUATION)

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
	Convolvulaceae																	
7647	*Ipomoea quamoclit* L.[4]	esqueleto	ST	N	P	x		♦				●						
	Cucurbitaceae																	
7376	*Momordica charatia* L.[4]		CT	E	P	+	♦	●	♦		●		●				♦	
7260	*Wilbrandia longisepala* Cogn.		CT	N	P		●	●	●						●	♦		
	Cyperaceae																	
7386	*Cyperus luzulae* (L.) Retz			N	P					●							♦	
	Ebenaceae																	
8219	*Diospyrus kaki* L.f.	caqui		E	P											♦	●	
	Ericaceae																	
7373	*Rhododendron simsii* Planch.[4]	azaléia	B	E	S	+				●		●					♦	
	Euphorbiaceae																	
8214	*Alcalypha gracilis* Spreng.[3]	tapa-buraco	H	N	S	x		●		●	●				●	♦	●	●
7924	*Alchornea iricurana* Cass.[8]	fruta-de-pombo	T	N	P	x					♦			●			●	
7252	*Alchornea triplinervia* (Spreng.) M. Arg.[8]	tapiá, tanheiro	T	N	P	x				●	●	●		●	♦	♦	●	
7650	*Bernardia pulchella* (Baill.) Muell. Arg.		B	N	S			♦					●		●		●	●
7285	*Dalechampia stipulacea* Muell. Arg.	Cipó-urtiga	ST	N	P											♦		
7979	*Manihot esculenta* Crantz.[6]	mandioca	B	N	P	+					♦							
7262	*Ricinus communis* L.[2,5,6,8]	mamona	S	E	P	+			●	♦		♦	●	♦	♦	♦		♦
7992	*Sebastiania brasiliensis* Spreng.	leiteiro, branquilho	S	N	S	x			●	♦		♦			●		●	
	Fabaceae																	
7504	*Dalbergia frutescens* (Vell.) Britton.	cipó-rabo-de-bugio		N	P/Sl			●	●								●	♦
7392	*Desmodium incanum* DC.[1,2,3]	carrapicho		N	P	x										♦	♦	
7384	*Glycine max* (L.) Merr.[4]	Soja		E	P	+			♦								♦	●
7506	*Lonchocarpus campestris* Mart. ex Benth.	paufarinha	T	N	P		♦	●		●								♦
7378	*Lonchocarpus subglaucescens* Benth.			N	Sl												♦	
7818	*Machaerium stipitatum* (DC.) Vogel[8]	sapuva		N	P/S	x			♦									
8171	*Myrocarpus frondosus* Fr. Allem.		T	N	S										♦	●		
7749	*Vigna venusta* (Piper) Maréchal & al.		ST		P				♦									
	Flacourtiaceae																	
7283	*Banara tomentosa* Clos.		T	N	Sl									♦	●	♦	●	●
8060	*Casearia sylvestris* Sw.	cafezeiro-bravo	T	N	P								●	♦	♦	●	●	
7254	*Prockia crucis* P. Browne ex L.		T	N	S			●								♦	●	
	Iridaceae																	
7289	*Sisyrinchium luzula* Klotzsch		H	N	P										●	♦	●	
	Lamiaceae																	
7245	*Leonurus sibirucus* L.[4]	rubi	H	E	P	x		●	♦	♦		●			♦	♦	●	
7821	*Hyptis mutabilis* (L.C.Rich) Briq.[6,8]	boldo-branco	H	N	P	x		♦	♦	●								
	Lauraceae																	
7397	*Nectandra lanceolata* Nees & Mart. ex Nees	canela-amarela	T	N	S									●	●	♦	♦	●
8065	*Nectandra megapotamica* (Spr.) Mez		T		.									♦				
7918	*Ocotea puberula* (Rich.) Nees		T	N	P		♦	●		♦	♦		●	●	●		●	

TABLE I (CONTINUATION)

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
8110	*Persea americana* Mill.[4,6,8]	abacateiro	T	E	P	+								♦	♦			
	Liliaceae																	
7916	*Asparagus setaceus* (Kunth.) Jessop.	aspargo-ornamental	ST	E	P					♦		●						
	Loganiaceae																	
7290	*Strychnos brasiliensis* (Spr.) Mart.	anzol-de-lontra	B	N	P/Si			●	●	●			●			♦	●	
	Lythraceae																	
7377	*Lagerstroemia indica* L.	Resedá	T	E	P		♦		●								♦	●
7372	*Punica granatum* L.	romã	B	E	P									●	♦		♦	●
	Malpighiaceae																	
7526	*Banisteriopsis adenopoda* (Adr.Juss) B.Gates		SB	N	P		♦											
7522	*Banisteriopsis parviflora* (Adr.Juss.) Gates[6]		SB	N	P	x	♦											
7503	*Dicella nucifera* Chodat		SB	N	P		♦	♦	●	●								♦
7533	*Heteropterys intermedia* (Adr. Juss.) Griseb		ST	N	P		♦		●		●							●
7244	*Mascagnia ovatifolia* (Kunth.) Griseb.				.											♦		
7540	*Stigmaphyllon jatrophifolium* Adr. Juss.		ST	N	P		♦											
7753	Indeterminada sp.[5]				.				♦									
	Malvaceae																	
7375	*Abutilon striatum* Dicks ex Lindl.	lanterna-japonesa	B	N	P			♦				♦			♦		♦	
7978	*Bastardiopsis densiflora* (Hook. & Arn.) Hassler		T	N	P						♦	●	●	●				
7264	*Malvastrum coromandeliam* (L.) Garcke[4]	guanxuma	SB	N	P	+								●	●	♦		
7287	*Sida rhombifolia* L.[3,6]	guanxuma	H	N	P	+		●		●						♦	●	
7381	*Wissadula subpeltata* (OK)R.E.Fries[4]	malva-estrela	B	N	P	+		♦	♦	♦							♦	
	Marantaceae																	
7539	*Maranta sobolifera* L. Anderss.		H	N	Si		♦	♦										
	Melastomataceae																	
7274	*Ossaea amygdaloides* (DC.) Triana		B	N	.											♦		
	Meliaceae																	
8213	*Cabralea canjarana* (Vell.) Mart.	canjarana	T	N	P		●					●		●	♦	♦	●	
8113	*Melia azedarach* L.	santa-bárbara	T	E	P			●	●					♦	♦		●	
7257	*Trichilia elegans* A.Juss		B	N	S											♦		
	Meliaceae																	
8004	*Trichilia pallida* Swartz.		B	N	S								♦	♦				
	Mimosaceae																	
8164	*Calliandra foliolosa* Benth.[4]	esponjinha	S	N	S	+	●					●		●	♦	●		
7265	*Enterolobium contorstisiliquum* (Vell.) Morong	orelha-de-nego,	T	N	Si	+									●	♦		
7277	*Leucaena leucocephala* (Lam.) de Wit.[1,2,3,4]	leocena	S	E	P	+	●		♦							♦	●	
7394	*Mimosa pudica* L.[1,4,6,8]	dormideira	T	N	P	+											●	
7268	*Parapiptadenia rigida* (Benth.) Brenan	angico-vermelho	T	N	P			●	●	●	●					♦	●	

TABLE I (CONTINUATION)

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
	Moraceae																	
7284	*Maclura tinctoria* (L.) D.Don ex Steud.	amora-branca	T	N	S			●					●		●	♦	●	
	Myrtaceae																	
7990	*Calycorectes psidiiflorus* (O.Berg) Sobral		B	N	Si					♦		♦					♦	
7250	*Campomanesia guazumifolia* (Camb.) O. Berg.	sete-capotes	T	N	P											♦		
7371	*Campomanesia xanthocarpa* O Berg.	guabiroba	T	N	S									♦	●		●	
7993	*Casearia gossypiosperma* Briq (Salicaceae)				.							♦						
	(Salicaceae)																	
7828	*Eucalyptus saligna* Smith.[3,4,6,8,9]	eucalipto	T	E	P	+			♦	♦								
7529	*Eucalyptus viminalis* Labill.[3,4,6,8,9]	eucalipto	T	E	P	x	♦											
7547	*Eucalyptus* sp.[1 3,4,6,8,9]	eucalipto	T	E	P	x	♦											
7395	*Eucalyptus* sp.[2 3,4,6,8,9]	eucalipto	T	E	P	x											●	
7914	*Eugenia hiemalis* Cambess.[4]	jabuticabeira	T	N	P	x			●	♦		●		●				
8099	*Eugenia* sp.[2,4,5]			N	P	x								♦				
7270	*Hexaclamys* edulis (O. Berg) Kausel & D. Legrand	pêra-do-mato	B	N	P									●	●	♦		
8167	*Myrcia laruotteana* Cambess[6,9]	guamirim	B	N	.	x									♦			
7273	*Psidium guajava* L.[1,3,4]	goiabera	S	N	P	+					●					♦	●	
8166	Indeterminada sp.1				.										♦			
8215	Indeterminada sp.2				.											♦		
	Onagraceae																	
7823	*Ludwigia octovalvis* (Jacq.) Raven	Cruz-de-malta	SB	N	P					♦	●						●	●
7855	*Ludwigia* sp.	Cruz-de-malta	SB	N	P						♦							
	Orchidaceae																	
8114	*Dendrobium* nobile Lindl.	orquidea	EPI	E	P									♦	♦			
	Oxalidaceae																	
7915	*Averrhoa carambola* L.	carambola	T	E	P					♦		♦	♦	♦	♦			●
8100	*Oxalis* sp 1.[4]	trevo	H	N	P	x								♦				
8103	*Oxalis* sp 2.	trevo	H		P									♦				
	Passifloraceae																	
7913	*Passiflora amethystina* Mikan	Maracujá-de-raposa	CT	N	P					♦	●							
	Pedaliaceae																	
7917	*Sesamum indicum* L.[4]	gergelim	H	E	P	+			●				♦					
	Phytolaccaceae																	
7532	*Seguieria guaranitica* Spegazzini		ST	N	P		♦			●								
	Piperaceae																	
7246	*Piper amalago* L.[8]	parapiroba	B	N	P	x	●	●	●		●	●				♦		
7255	*Piper gaudichaudianum* Kunth.[8]	parapiroba	B	N	P	x										♦		
	Polygonaceae																	
7824	*Polygonum punctatum* Elliot.		H	N	P				♦									
7293	*Ruprechtia laxiflora* Meissn.		B	N	.											♦		
	Polypodiaceae																	
8107	*Pleopeltis angusta* Humb. & Bonpl. Ex Willd.		H	N	S									♦				

TABLE I (CONTINUATION)

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
	Portulacaceae																	
7398	*Talinum paniculatum* (Jacq.) Gaertn.		H	E	S			●	♦								♦	●
	Rhamnaceae																	
7825	*Gouania ulmifolia* Hook. et Arn.		CT	N	P		●		♦	●	●	●						
7272	*Hovenia dulcis* Thunberg[4]	uva-japão	T	E	P	+	●	●								♦	●	
	Rosaceae																	
7649	*Eriobotrya japonica* Lindley	nespera; ameixa-amarela	T	E	P			♦	♦		♦	●				●		
8005	*Prunus mume* Sielbold & Zucc.	umê	T	E	P	x							♦					
7829	*Prunus persica* (L.) Batsch.[4,5]	pessegueiro	T	E	P	+			♦	●	●			●				
7275	*Prunus sellowii* Koehne	pessegueiro-bravo	T	N	P	+			♦	●	♦	●		●	●	♦	●	
8218	*Rubus ulmifolius* Schott	groselha	B	N	P							♦				♦	●	
7295	*Rubus urticaefolius* Poiret	amora-silvestre	B	N	P		♦	♦	♦	●					♦	♦		
	Rubiaceae																	
7396	*Manettia luteo-rubra* (Vell.) Benth.			N	P		●	●		●	●			●			♦	
7258	*Psychotria carthagenensis* Jacq.[3]	café-de-bugre	AB	N	Si	+		♦	♦	●	●	●	●	●	●	♦	●	
	Rutaceae																	
8001	*Citrus limonia* Osbeck[3,4,5,9]	limão-rosa	S	E	P	+			♦	♦		♦	♦		♦			
8006	*Citus sinensis* (L.) Osbeck[1,4,6,9]	laranja	T	E	P	+							♦	♦				
8002	*Pilocarpus pennatifolius* Lemaire		S	N	S				●	●		♦	♦	♦	♦	●		
8165	*Zanthoxylum caribaeum* Lam.[14,8]	mamica-de-porca	T	N	P	x						♦						
8174	*Zanthoxylum fagara* (L.) Sarg.[4,8]	Mamica-de-porca	T	N	P	x									●			
	Sapindaceae																	
8102	*Allophylus edulis* (St.Hil.)Radlk. [4,8]	vacum, chau-chau	S	N	S	+			●					♦	♦	●		
7544	*Cardiospermum grandiflorum* Sweet.	saco-de-padre	CT	N	P								♦	●	♦			
7923	*Cupania vernalis* Camb.	camboatá	T	N	Si				♦	♦	♦		●	●	●	●		
8212	*Matayba elaeagnoides* Radlk.	camboatá-branco	T	N	Si	+				●	●		●		●	♦	●	●
7271	*Paullinia meliifolia* Adr.juss.			N	P											♦		
7854	*Serjania acoma* Radlk	cipó-timbó	CT	N	P					♦								
7922	*Serjania multiflor*a Camb.[6,9]	cipó-timbó	CT	N	Si	x				♦	♦		●	●	●			
	Sapindaceae																	
7524	*Serjania reticulata* Cambess.	cipó-timbó	CT	N	Sl											♦		
	Scrophulariaceae																	
7981	*Paulownia tomentosa* (Thunb.)Steud.	kiri	T	E	P					●	♦	♦	♦		●			
	Simaroubaceae																	
7991	*Castela tweedii* Planchon		B	N	P					♦		♦	♦	●				
	Solanaceae																	
7537	*Brugmansia suaveolens* (Willd.) Bercht. & Presl.	copo-de-leite	B	E	Si		♦							●	●			
7379	*Capsicum baccatum* L.	pimenteira	B	N	P				●	●							♦	
8062	*Cestrum corymbosum* Sch.	coerana	B	N	Si									♦				
7502	*Cestrum strigillatum* Ruiz & Pavón	coerana	SB	N	P		●		●	●	●			●	♦	●	●	♦
7249	*Solanum americanum* Mill. [4]	maria-preta	H	N	P	+	♦	●	●		●		●	●		♦	●	
7387	*Solanum atropurpureum* Schrank[2,3]	jurubeba	H	N	P	x			●								♦	

TABLE I (CONTINUATION)

HCF	Family/Specie	Ordinary name	Hb	O	SE	B	Months											
							J	F	M	A	M	J	J	A	S	O	N	D
7279	*Solanum mauritianum* Scop.[2,3]	fumo-bravo	T	N	Si	x	♦	●	♦	●				●		♦		
7545	*Solanum paniculatum* L.[2,3]	jurubeba	B	N	Si	x	♦					●					●	
7543	*Solanum sanctae-catharinae* Dunal. [2,3]	juá-manso	S	N	P	x	♦		●					●		●		
7248	*Solanum sisymbriifolium* Lam.[2,3]	juá	SB	N	P	x		●		●					♦	♦	●	●
7551	*Vassobia breviflora* (Sandtn.) A.T. Hunziker			N	P		♦											
8063	Indeterminada sp.[1]				.									♦				
	Symplocaceae																	
8216	*Symplocos uniflora* (Pohl.) Benth.	Orelha-de-onça	T		.											♦		
	Tiliaceae																	
8003	*Heliocarpus americanus* L.[5]	jangada	B	N	P	+						●	♦	●				
7642	*Luehea divaricata* Mart. [4]	açoita-cavalo	T	N	P	+		♦	♦	●	●							
	Ulmaceae																	
7263	*Trema micrantha* (L.) Blume[4]	pau-de-polvora	B	N	P	+	●	●	♦	●	●			●	♦	♦	●	●
	Urticaceae																	
7259	*Boehmeria caudata* Sw.		B	N	P			●	●	●					●	♦		
7501	*Urera baccifera* (L.) Gaudich ex Wedd.	urtiga-mansa	B	N	P			●		●							●	♦
	Verbenaceae																	
8061	*Aegiphila mediterranea* Vell.	tamanqueiro	T	N	P									♦		●		
7389	*Aegiphila* sp.		T	N	P												♦	
7269	*Aloysia virgata* (R. & P.) A.L. Juss.[3,4]	lixeirinha	B	N	P	+				♦		●		♦	♦	♦		
7374	*Clerodendron x speciosum* Tiejism. & Binn.[4]	lágrima-de-n. senhora	ST	E	P	x		♦		●	●					●	♦	
7382	*Duranta repens* L.[4]	pingo-de-ouro	B	N	P/Si	+	♦	♦	●	●	♦		●				♦	
7256	*Lantana camara* L.[4]	lantana	B	N	P	+	♦	●	♦	●	●			●	♦	♦	●	
8162	*Petrea subserrata* Cham.[4]	petrea	B	N	Sl	x		●	●					●	♦	●		
7294	*Stachytarpheta cayennensis* (L.C.Rich)Vahl.		H	N	S				●					●		♦	●	
	Violaceae																	
7550	*Hybanthus bigibbosus* (A. St. Hil.)Hassl.	canela-de-veado	B	N	Si		♦	●		●	●	●	●	●	●		●	
7546	*Hybanthus communis* (A. St. Hil.)Taub.	canela-de-veado	H	N	Si		♦	♦	♦	●	●					●	●	

Plants of apiarist importance in the South and southeast regions: [1]Cortopassi-Laurino and Ramalho (1988); [2]Ramalho et al. (1990); [3]Carvalho et al. (1999); [4]Marchini et al. (2001); [5]Agostini and Sazima (2003); [6]Bastos et al. (2003); 7Barth (2004); [8]Luz et al. (2007); [9]Mendonça et al. (2008). Hb = Habit: B = bush, CT = climber with tendrils, Ep = epiphyte, H = herb, S = small tree, SB = sub-bush, ST = stem twiners, T = three; O = origin place: N = native species; E = exotic species; SE = Ecological succession: P = pioneer, S= secondary, Si = initial secondary, Sl = late secondary; B = bee plant: species (+) or genera (×) reported in the literature as with apiarist importance; ♦ = Plants photographed and collected in this work; ● = Plants collected to Paraná state, with Register at the Herbarium of the Universidade Tecnológica Federal do Paraná in Campo Mourão (HCF).

Pollen Analyses

Considering the three areas, a total of 30 samples of honey were analyzed and 80 pollen types distributed in 31 families were identified. Three pollen types were not identified (Table II). Microscopic images of some pollen types verified in this work are shown in Figure 2. From the *taxa* present in the samples, 42 (52.5%) are of native species collected in the surrounding areas of the apiaries. Asteraceae and Fabaceae were the most frequent pollen types with 11 and 6 types, respectively. Euphorbiaceae and Sapindaceae presented five types each one and Mimosaceae and Myrtaceae, four types.

TABLE II

Pollen spectrum and frequency classes in honey samples of Africanized honeybee *Apis mellifera* in three apiaries (A; B; C) in Nova Aurora (A) and Ubiratã –PR (B and C) collected from December 2008 to April 2009 and from May to November 2010. *Native species collected in the area.

Family	Pollen type	Dec	Jan	Fev/ Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	FO
		A B	A B C	A B C	A B C	A B C	A B C	A B	A C	A B C	A B C	A B C	
Amaranthaceae	Amaranthaceae type 1		O						O	O I	I	O	20
	Amaranthaceae type 2				O O				O			O	10
Anacardiaceae	**Schinus terebinthifolius*	O	O	I			O			O O I	I O A	A	37
	Mangifera indica									O			3
Arecaceae	Arecaceae type	O	A I I	I O I	O O I		I I	I	I A	A O	A O A	A O I	77
Asteraceae	**Baccharis* spp.		I I O	I	O I I	O	O O	O					37
	**Bidens* spp.		O O										7
	**Centratherum punctatum*									O			3
	**Calyptocarpus biaristatus*			O	O								7
	**Conyza bonariensis*		O										3
	**Chromolaena pedunculosa*				I O		I O	I	I O				23
	**Mikania* spp.			I I						O O I	I		20
	**Senecio brasiliensis*	O									I		7
	**Sonchus* sp.								O O	O O	O		17
	Asteraceae type											O O	7
	Vernonia sp.				I O	O O	O O	O O					27
Araceae	Araceae type					O A O		O					13
Bignoniaceae	Bignoniaceae type									I			3
Boraginaceae	**Cordia ecalyculata*		O										3
	**Cordia trichotoma*				O			I	I				10
Brassicaceae	Brassicaceae spp.		I I	O	O	O	O A O	I D	A I	A A A	O A I		60
Caesalpinaceae	**Bauhinia forficata*		O	O O	O								13
	**Bauhinia* sp.									O	O		7
Combretaceae	**Combretum fruticosum*		O O										7
	**Terminalia australis*									I I	O I		13
Convolvulaceae	Convolvulaceae type			O			I O O						13
Euphorbiaceae	**Alchornea iricurana*					A	A I						10
	**Alchornea triplinervea*	A O	O O	O O								A I O	30

TABLE II (CONTINUATION)

Family	Pollen type	Dec		Jan			Fev/ Mar			Apr			May			Jun			Jul		Aug		Sep			Oct			Nov			FO
		A	B	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	C	A	B	C	A	B	C	A	B	C	
Euphorbiaceae	**Bernardia pulchela*			O				O																								7
	Ricinus communis	O	O						I			O		I			O			O							O					27
	**Sebastiania brasiliensis*			I	I		O									O										O						17
Fabaceae	*Glicyne Max*	I	D	A	D	A	O	A		O	A									O									I			37
	**Lonchocarpus* sp.	I	I	I		O	O	I																								20
	Fabacea type																					O		O					O			10
	**Machaerium stipitatum*									A		D	O	I			O															17
	**Myrocarpus frondosus*																						I	O	I							10
	Stylosanthes sp.									I			O									O		I								13
Flacourtiaceae	**Casearia sylvestris*	O		I		O													O		A	I	I									23
Lamiaceae	*Leonurus sibiricus*	O				O													O	O	O		O	I	O		O			O		33
	**Hyptis mutabilis*						O																									
Malpighiaceae	Malpighiaceae type								O																							3
Malvaceae	**Wissadula subpeltata*				O		O				O								O													13
Meliaceae	*Melia azedarach*	O																			A	D	I	O		O						20
Mimosaceae	** Acacia type*		O	O		O	I	O	I		I							I			O								I			30
	**Parapiptadenia rigida*	O	O	O	O	D	I	I			I					O											A		A	D	D	43
	**Mimosa* sp.					O	O			I	O		O	O				O														23
	Leucaena leucocephala	O		O						O	O	O			O				O				O				O					30
Moraceae	Tipo Moraceae															O				O												7
Myrtaceae	*Eucalyptus* spp.	O	O	O	I	O	O	I	D	A	A	A	D	D	D	A	D	D	A	A	I		I	I	I	I	I	I		O		90
	**Campomanesia* spp.	I																					O						O			10
	**Hexaclamys* edulis	I	O			I																				I	O	I	I	I	O	30
	** Myrcia* type									O	O		I			O			A		O	O				A	I					30
Oleaceae	*Ligustrum* sp.		O		O			O			O																					13
Piperaceae	**Tipo Piperaceae	A	O	O	O		A	I		I		O				I										O						33
Rhamnaceae	**Gouania*																				I			I								7
	Hovenia dulcis	O	O			O																									O	13
	Rhamnaceae type						I	A			A					O																13

TABLE II (CONTINUATION)

Family	Pollen type	Dec	Jan			Fev/ Mar			Apr			May			Jun			Jul		Aug		Sep			Oct			Nov			FO
		A	B	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	A	C	A	B	C	A	B	C	A	B	C	
Rosaceae	Rosaceae type	O																														3
	Eriobotrya japônica			O			I									I																10
	**Prunus sellowii*						O																O	I		I	I	O				20
Rubiaceae	*Borreria* sp.									O						O																13
	**Psychotria carthagenensis*							O																								7
Rutaceae	*Citrus* sp. 1						O																									7
	Citrus sp. 2																				O						O					13
	**Zanthoxylum* sp.	O			I												O		O							I		I	I	O	I	30
Sapindaceae	**Allophylus edulis*																						O	I	O		I					13
	**Cardiospermum grandiflorum*															O																7
	**Cupania vernalis*															O																7
	**Matayba elaeagnoides*																									O	O					13
	**Serjania* spp.									I	O	O	I	O		O	I	O	I	O	O	O				I		O				47
Solanaceae	**Solanum sanctae-catharinae*		O																													3
	Solanaceae type									O																						3
	**Solanum mauritianum*									O																						3
Tiliaceae	**Luehea divaricata*						O																									3
	**Heliocarpus americanus*																		I	O												7
Ulmaceae	**Trema micrantha*				O											O										I						10
	Non identified 1							I																								3
	Non identified 2																						I			I						7
	Non identified 3																							A			A					7

Five pollen types identified in the samples are not present in the list of the plants collected in the area: Arecaceae sp. 1, Araceae sp. 1, *Stylosanthes* sp., *Lygustrum* sp, *Borreria* sp., *Acacia* type and *Vernonia* sp. Plants of Arecaceae family and of the Herbarium.

Microscopic images recorded of same pollen types are show in Figure 2.

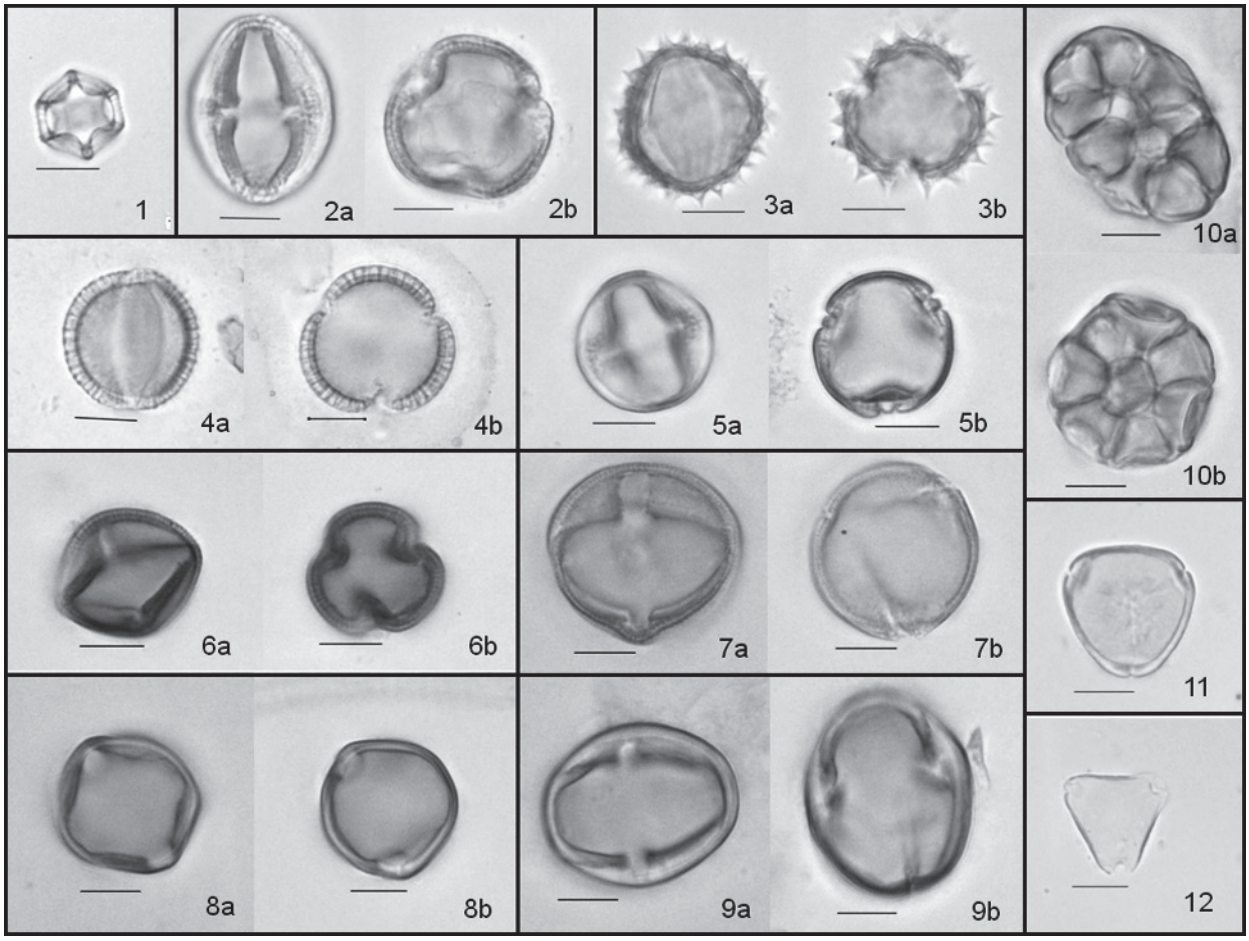

Fig 2 - Pollen types from honey samples collected in counties of Nova Aurora and Ubiratã -PR from December 2008 to May 2009. **1-** Amaranthaceae sp. 1; **2-** Anacardiaceae *Schinus terebinthifolius*; **3-** Asteraceae *Conyza bonariensis*; **4-** Brassicaceae – *Raphanus sativus*; **5-** Euphorbiaceae *Alchornea* sp.; **6-** Euphorbiaceae *Bernardia pulchella*; **7-** Euphorbiaceae *Ricinus communis*; **8-** Fabaceae *Glycine max*; **9-** Flacourtiaceae *Casearia sylvestris*; **10-** Mimosaceae *Parapiptadenia rigida*; **11-** Myrtaceae *Campomanesia* sp.; **12-** Myrtaceae *Hexaclamys edulis*. Scale: 10 µm.

Dominant pollen types were observed in 14 (47%) of 30 honey samples, *Glycine max* (soybean) in December/January, Eucalyptus spp. in February/ March, May and June, *Machaerium stipitatum* in April, Brassicaceae sp1. in July, *Melia azedarach* (santa-bárbara) in August and *Parapiptadenia rigida* in November. Only one of the samples of the apiary A, with the largest forest area, presented the dominant pollen type of *Eucalyptus* in May.

The dominant pollen types *G. max*, *Eucalyptus* spp. and Brassicaceae, cultivated or ruderal plants, were found in the months with the lowest number of species collected, December, January, May, June and July (Figure 3).

The frequency of occurrence (FO) indicates that only three pollen types were present in more than 50% of the samples: Eucalyptus sp, Arecaceae sp and Brassicaceae sp. Among them, Eucalyptus

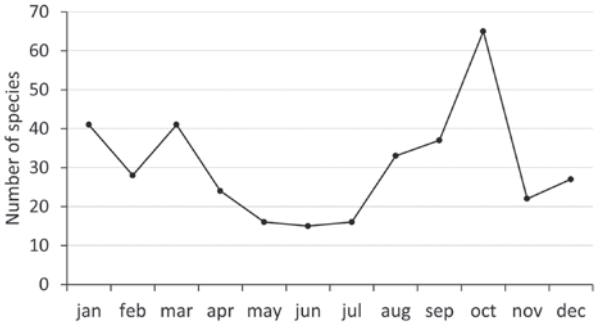

Figure 3 - Number of floristic species collected in the surrounding areas of three apiaries in the counties of Nova Aurora and Ubiratã (PR) from October 2008 to November 2009.

spp. was present as accessory or dominant pollen from February to July in 12 (40%) of the samples.

Twelve other pollen types were also frequent, present in 30 of 50% of the samples: *Schinus terebinthifolius*, *Baccharis* spp., *Alchornea triplinervea*, *Glycine max*, *Leonurus sibiricus*, type *Acacia*, *Parapiptadenia rigida*, *Leucaena leucocephala*, Hexaclamys edulis, type Myrcia, Piperaceae sp1., *Zanthoxylum* sp. and *Serjania* spp.

Only 14 (17.7%) of the total species showed frequency of more than 15% (accessory or dominant pollen) at least in one sample.

Pollen diversity calculated by the Index of Diversity of Shannon (Table III) indicates that the samples of the apiaries A and B presented higher diversity in relation to the samples of the apiary C.

TABLE III
Index of Diversity of Shannon and Simpson based on pollen data from samples of three apiaries located in the counties of Nova Aurora (A) and Ubiratã-PR (B and C).

Index	Apiary A	Apiary B	Apiary C
Shannon	**3.893_a**	3.770_a	3.603_b
Simpson	**0.975**	0.971	0.967

Values followed by the same letters, in the same line, did not differ among themselves at the level of 5% of significance.

DISCUSSION

The area of study embraces rural areas that present different types of landscape, including pastures, cultivated areas and forest remnants. The results were similar to Sakuragui et al. (2011) in a Semidecidous Tropical Forest modified by the anthropic action, in which it was observed predominance of Asteraceae, Rubiaceae, Solanaceae and Fabaceae; and Gasparino et al. (2006) that noted Asteraceae, Leguminosae and Solanaceae among the predominant families in the seeds banks of areas with riparian vegetation in a county of the west region of Paraná State.

From 34 exotic species collected in the area of study, seven were classified as exotic invader species in accordance with the administrative rule 125/2009 of the Environmental Institute of Paraná (PARANÁ 2009) that recognizes the official list of the exotic invader species to Paraná State. These species are: *Leucaena leucocephala* (leucena), *Melia azedarach* (santa-bárbara), *Psidium guajava* (goiaba), *Ricinus communis* (mamona), *Tecoma stans* (amarelinho), *Eriobotrya japonica* (nêspera) and *Hovenia dulcis* (uva-japão). Some of them, such as *R. communis*, *M. azedarach* and *L. leucocephala*, were representative in the pollen spectrum of the honey collected in the region.

Families with higher number of species in an area are also the main sources of nectar and pollen (Ramalho et al. 1990). Asteraceae and Labiatae species are very numerous in open vegetation areas in South America. Solanaceae, Euphorbiaceae, Palmae and Myrtaceae families are common in neotropical regions.

Asteraceae is one of the families that have the greatest number of species of apiarist importance, as this is one of the families with more species and more widely distributed among the angiosperms (Locatelli and Machado 2001).

The families of plants with better representation in honey samples analysed in this research are similar to Asteraceae, Caesalpiniaceae (Fabaceae), Malvaceae and also Myrtaceae, observed by Carvalho et al. (1999) in São Paulo State as the best representatives; and Asteraceae, Myrtaceae, Mimosaceae and Verbenaceae found by Marchini et al. (2001) as the most representative families in São Paulo State.

Bastos et al. (2003) reported the predominance of pollen of Asteraceae, Euphorbiaceae and Leguminosae (nowadays this one is divided into Caesalpiniaceae, Fabaceae and Mimosaceae) in an area of Cerrado in Minas Gerais State. Luz et al. (2007) reported the predominance of pollen types of Arecaceae, Asteraceae, Mimosaceae and Myrtaceae in honey samples of Rio de Janeiro State. Euphorbiaceae and Myrtaceae were also found as dominant or accessory pollen types in organic honey samples collected in islands located in the frontier of Paraná, São Paulo and Mato Grosso do Sul states, and Mimosaceae, Myrtaceae and Solanaceae in non-organic honey samples (Sereia et al. 2011).

In general, the most representative families observed in honey samples of this study are similar to those verified in samples collected in other regions of the country that have similar vegetation.

From dominant pollen types, *G. max* (soybean) and *Eucalyptus* are from plants cultivated in the area. The two counties are located in agricultural regions where the main crops are corn and soybean. In 2008, the soybean harvest in these counties was 79,950 ha (Ipardes 2010). Chiari et al. (2005, 2008) studied the pollination in soybean by *A. mellifera* and concluded that the visiting of flowers by these honeybees increases the production of this crop in some varieties.

Eucalyptus species are efficient sources to the formation of one type of honey approved by the customers and is the most frequent in the Brazilian market (Komatsu et al. 2002, Sodré et al. 2003). The contribution of *Eucalyptus* as dominant pollen in honey samples was verified in others researches developed in the southeast region by Bastos et al. (2003) in Cerrado in the State of Minas Gerais; by Barth et al. (2005) in samples of the states of São Paulo and Minas Gerais; by Luz et al. (2007) in samples of the State of Rio de Janeiro and by Mendonça et al. (2008) in samples of the State of São Paulo. Pollen grains of *Eucalyptus* and *Baccharis* are among the cited types as geographical indicators of honey of the south of Brazil (Ramalho et al. 1991).

Highly eusocial bees, such as *A. mellifera*, collect resources preferentially in plants that exhibit a mass-flowering syndrome, with numerous flowers opening in short time (Wilms et al. 1996). This feature can be observed in many cultivated plants and invader species, explaining the occurrence of these pollen types in various samples, even as dominant pollen in some months.

In this research, only 17.7% of the pollen types showed frequency higher than 15% at least in one honey sample. Cortopassi-Laurino and Ramalho (1988), analyzing samples of pollen collected by *Apis mellifera* on the outskirts of São Paulo city, also observed a low percentage of plants whose pollen accounted for more than 10% in the samples.

Sources of pollen with representativeness between 1% and 10% are resources with little attractiveness, corresponding to potential or secondary sources. These sources supplement the nutritional needs of the colony and may be important in environments where food resources suffer seasonal variations (Ramalho and Kleinert-Giovannini 1986).

The large number of pollen types with low frequency in the samples shows the importance of these plants in total honey production, representing a significant resource for the beekeeping of the region.

Bees have a highly developed sense of smell and they can be trained to look for a flavor or a particular mix of aromas. Once they become conditioned to seek a kind of plant, they will continue to get it (Free 1993). Bees exhibit floral constancy, as a tendency to use fewer species than would be expected considering the number of flowering plants at the site (Cane and Sipes 2006). However, according to Wilms et al. (1996) Africanized bees are also quite general in the exploitation of floral resources, representing a wider niche than other eusocial bees.

The high values verified by the application of the Simpson Index indicate the probability of diversity of the sampled pollen, due to the dominance of one or a few species.

Samples of honey of this state are strongly heterofloral, and reported as frequent pollen types *Allophylus*, *Baccharis*, *Campomonesia*, *Cecropia*, *Citrus*, *Eucalyptus*, *Matayba* and *Mimosa scabrela*, *Paspalum* e *Vernonia*, with greater incidence of *Eucalyptus* (Ramalho et al. 1991).

Pollen grains of the type *Baccharis* (Asteraceae), of Euphorbiaceae and Asteraceae and type *Eupatorium*, were common in samples from Paraná State. *Mimosa scabrela* is typical from the region of Curitiba and pollen of the type Brassicaceae was also common in the samples (Carpes et al. 2009).

Approximately 52.5% of the pollen types verified in the honey samples are from native species of the region. Native species with bee value can be used in programs of recuperation of degraded areas. Although studies about this theme are not very common, Pegoraro and Ziller (2003) conducted a survey of species with bee value to provide subsidies to the restoration of a legal reserve. These authors reported some genera identified in this research, such as *Mimosa*, *Eugenia* and *Zanthoxylum*, as important to this purpose. Baggio (1988) and Wolff et al. (2007) indicated the application of aroeira, *Schinus terebinthifolius*, in agroforestry systems for beekeeping.

The use of native species by the bees was confirmed by the diversity of species found in this study, highlighting the importance of preserving native vegetation for the survival of the colonies during periods of supply scarcity of the floral resources of introduced species such as *G. max* and *Eucalyptus* spp.

CONCLUSION

In general, the honey collected in the region was heterofloral. Pollen types of cultivated crops were very representative, and the dominant pollen like *Glycine* max in December and January and Eucalyptus spp. in May and June. From the native species, *Parapiptadenia rigida* was dominant in November and February and *Machaerium stipitatum* in April.

Pollen types of other native species, such as *Alchornea iricurana*, *A. triplinervea*, *Baccharis* spp., *Casearia sylvestris*, *Hexaclamys edulis*, *Schinus terebinthifolius*, *Serjania* spp. and *Zanthoxylum* sp. were found as accessory pollen. If other pollen types, found as isolated pollen, were considered in group, they were very representative in the samples, highlighting the importance of the native vegetation for the survival of the colonies.

RESUMO

O objetivo deste trabalho foi realizar um levantamento da flora com potencial apícola nos municípios de Ubiratã e Nova Aurora-PR, por meio da coleta de plantas e análises polínicas em amostras de mel coletadas mensalmente. Foram registradas 208 espécies de plantas, distribuídas em 66 famílias. As famílias que apresentaram maior riqueza de tipos polínicos foram Asteraceae, Myrtaceae e Solanaceae. Aproximadamente 80 tipos polínicos foram encontrados nas amostras de mel e, na maioria, foram caracterizados como heteroflorais. Plantas cultivadas, como *Glycine max* (soja) e *Eucalyptus* spp. foram representativas em alguns meses do ano. Espécies exóticas, tais como Ricinus communis and Melia azedarach também foram frequentes. No entanto, mais de 50% dos tipos polínicos pertencem a espécies nativas da região, tais como *Schinus terebinthifolius*, *Baccharis* spp., *Alchornea triplinervea*, *Parapiptadenia rigida*, *Hexaclamys edulis*, *Zanthoxylum* sp. and *Serjania* spp., indicando a importância da vegetação nativa para a sobrevivência das colônias.

Palavras-chave: apicultura, plantas apícolas, recursos florais, levantamento florístico.

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