Botanical Preferences of Africanized Bees (*Apis mellifera)* on the Coast and in the Atlantic Forest of Sergipe, Brazil

by

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ABSTRACT

Pollen analysis in honey can be used as an alternative method to research into flowers visited by bees in an area. This study aimed to indentify the main floral families in honey from apiaries in the Atlantic Forest and Sergipe state coast. Honey samples from these apiaries were studied, as well as plants that grow around them, which can be used as a source of foraging for bees. The palynological technique was used to compare the pollen content of honey samples with the pollen grains from leaves of plants found in the vicinity of the apiaries to assess whether they had been visited by bees. The results of studies in both sites were similar in terms of incompatibility of families found in the apiary vicinity and honey. Thus, it was possible to observe that in honey samples from the coast and in the remaining Atlantic forest, the number of families was greater than the number of families found in the apiary vicinity, which highlights the diversity of plants visited by bees and a possible expansion of the visited area for food search. This diversity suggests an adaptive foraging behavior to plant resources available in the environment, which may facilitate the pollination of these botanical families and consequently improve their genetic quality.

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INTRODUCTION

Bees visit plants searching for pollen, nectar and resins to maintain their colonies. The workers of *Apis mellifera* L. move from flower to flower collecting food for the larvae and adults of the colony (Wcislo & Cane 1996).

The pollen is the only protein source in the bees' diet, and it contains lipids, vitamins and minerals necessary for their development (Day 1990). The nectar, a substance secreted by glands called nectaries, is a sugary compound that attracts animals (Raven *et al*. 1992), which may contain varying amounts of sugars, according to the species and other environmental factors (Crane 1999). There are other substances such as organic acids, ethereal oils, polysaccharides – mainly dextrin, proteins, enzymes, boron and alkaloids – provided by the nectar (Percival 1965).

The visited plants are an essential resource for the bees and knowing them constitutes a basic tool for the development of apiculture (Pearson & Braiden 1990). The composition of the bee flora of a region is the main factor for the installation and development of an apiary, as it influences the number of hives to be installed and the honey production of the apiary (Ashman *et al*. 2004; Biesmeije*r et al*. 2006; Williams 1994; Westerkamp & Gottsberger 2000).

Pollen analysis in honey can be used as an alternative to identify the flowers visited by bees in an area (Ramírez-Arriaga & Martínez-Hernández 1998). One way to identify species visited by bees is through palynology, as the pollen spectrum obtained through this analysis shows the distribution of pollen sources and honey plants where the apiary is installed (Durkee 1971).

The flora of a site is composed of different species at distinct levels of importance; therefore, studying them is crucial as it provides information that enables the adoption of an optimal apiary management. This study aimed to identify the main floral families present in honey and apiaries located in biomes in the Atlantic Forest and on the coast of the state of Sergipe – Brazil.

MATERIAL AND METHODS

Experimental area

The study was conducted in the municipality of Pacatuba (11º36'15" S

and 37º26'34 W) at the "Tigre" apiary, representing the coastal area and in Japaratuba (10° 35' 34" S 36° 56' 24" O) at the "Treze de Maio" apiary, representing the Atlantic Forest area.

Honey samples from these apiaries were studied, as well as plants that grow in their vicinity, which can be used as a source for bee foraging.

Collection of samples

The samples were collected during the harvest season of honey, which corresponded to the period from November 2009 to January 2010. A honey sample was obtained from each apiary, and at the same time, plants in full bloom were collected from a radius of one kilometer around the apiaries. Considering the four quadrants, a sample in each 100 meters was collected to represent the tree, shrub and/or herbaceous extracts of plants in full flower (Fig. 1).

The plant material collected was dried in an oven at 60±2°C for 48 hours to assemble the exsiccates and sampling of flower buds to make a comparative slide collection, using the acetolysis technique, by removing anthers and breaking pollen sacs, which were placed in test tubes and combined with 2mL of acetic acid.
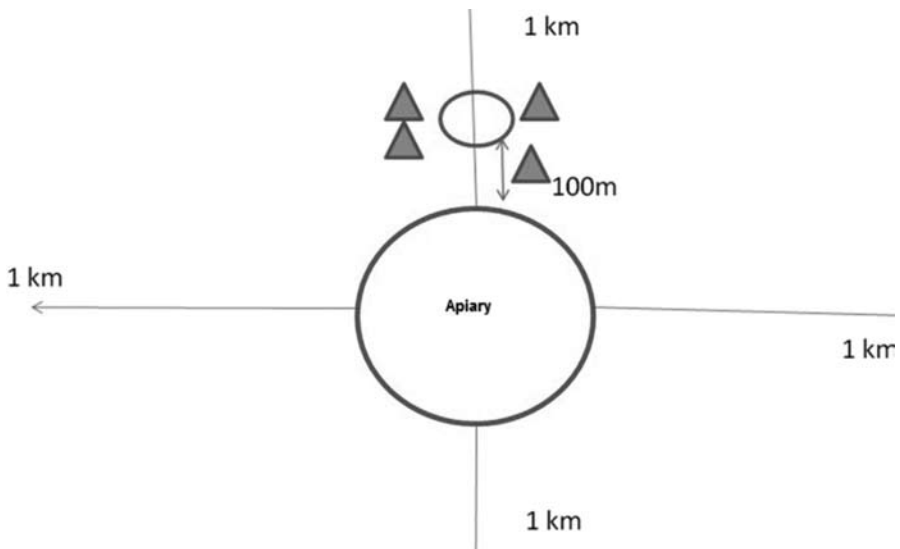

Fig, 1: Representation of the method of collection of botanical samples selected in apiaries.

Pollen Analysis

This analysis consists of fossilizing the pollen grains for comparison with images on the database and botanical identification of plants that bees visited for nectar and pollen collection. Slides with samples of honey and anthers were made using the acetolysis technique and mounted in glycerol gelatin (Erdtman 1960; Barth & Luz 1998; Terrab *et al.* 2003). The pollen analysis was carried out in the Laboratory of Agricultural and Forest Pests of the Federal University of Sergipe and the slides were sent to the Laboratory of Useful Insects of the College of Agriculture Luiz de Queiroz (ESALQ\USP) where they were micrographed by a digital system of photo documentation coupled to an optical microscope with 40x objective. The qualitative assessment was carried out with the identification of the botanical families and botanical genera. The quantitative analysis was performed by counting 900 pollen grains per sample. The pollen species classified as dominant accounted for 46 %, accessory between 15 to 45% and occasional lower than 15%. The pollen type identification was carried out following image database and specialized bibliography.

After, the pollen content of the honey samples were compared with the pollen grains of plants collected in the vicinity of the apiary to assess whether they had been visited by bees.

RESULTS

Despite the representation of the Mimosaceae family as dominant, it had four different types of pollen grains, in other words, the pollen contained four different botanical species, *Mimosa caesalpiniifolia* 41%, an unidentified species with 6%, *Mimosa scrabella* with 5% and *M. pudica* with 3% altogether amounting 55% of the pollen in the honey. Although the Mimosaceae pollen grains are dominant, the honey is considered wild, once no species showed isolated dominance, i.e., presence greater than 45% of pollen grains (Figure 7).

DISCUSSION

Both the coastal area and in the remaining Atlantic Forest showed that in the honey samples, the number of flower families was greater than the number of families found in the apiary vicinity, which highlights the diversity

of plants visited by bees and their possible expansion of the visited area to search for food.

The expansion of the area to collect pollen is related to the preference for a specific botanical family and for the cost-benetif to search for available sources to maintain the hive, a behavior that is transmitted to the workers. By finding the ideal source, of forage, bees may recruit nestmates and indicate the direction to these sources, increasing, therefore, the number of recruited bees (Queller and Strassmann 2002; Brockmann *et al.* 2003; Breed *et al.* 2004; Billen 2006; Pianaro *et al.* 2007).

The botanical families found in this study corroborate reports that Africanized bees in the neotropical region use primarily Asteraceae, Anacardiaceae, Euphorbiaceae, Lamiaceae, Fabaceae, Melastomataceae, Moraceae, Myrtaceae, Arecaceae, Rubiaceae and Solanaceae plant families (Almeida-Muradian *et al.* 2005; Barth & Luz 1998; Ramalho *et al,* 1990). The families visited by *Apis mellifera* are important sources of nectar and pollen. Moreover, the pres-

Fig. 2. Accessory pollen grains found in a sample of honey from the apiary Tigre, Pacatuba, SE; a. Fabaceae type Macropitilia; b. Leguminosae, Papilionoidae; c. Mimosaceae; d. Arecaceae, 40x magnification.
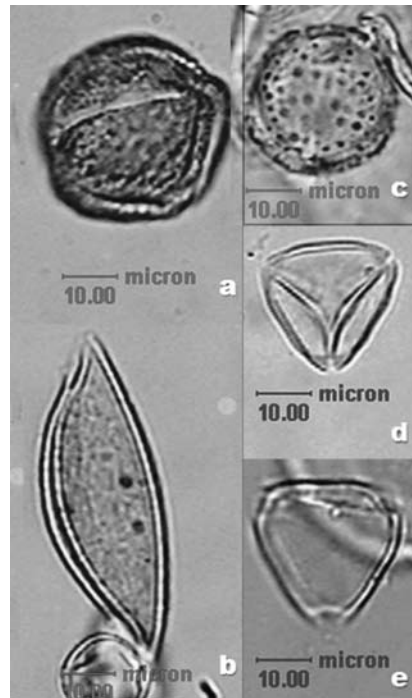

Fig. 3. Isolated pollen grains found in a sample of honey from the apiary Tigre Pacatuba, SE; a. Anacardiaceae; b. Araceae; c.Rubiaceae; d. Sapindaceae; e. Verbenaceae, 40x magnification.

Fig. 4. Pollen of the Poaceae family (higher grain) and bottom right, the pollen of the family Cecropiaceae, 40x magnification.

Fig. 6. Pollen grains in a sample of Pacatuba honey, SE. a. Anacardiaceae; b. Melastomataceae; c. Fabaceae; d. Rubiaceae, 40x magnification.
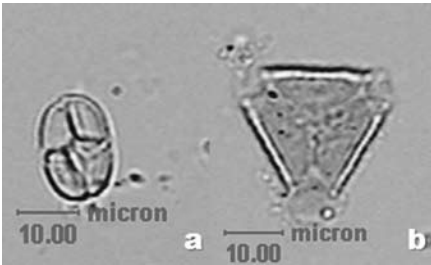

Fig. 5. Pollen grains in a sample of Pacatuba honey, SE. a. Pollen grains of the family Mimosaceae; b. Pollen grains of the family Myrtaceae, 40x magnification.
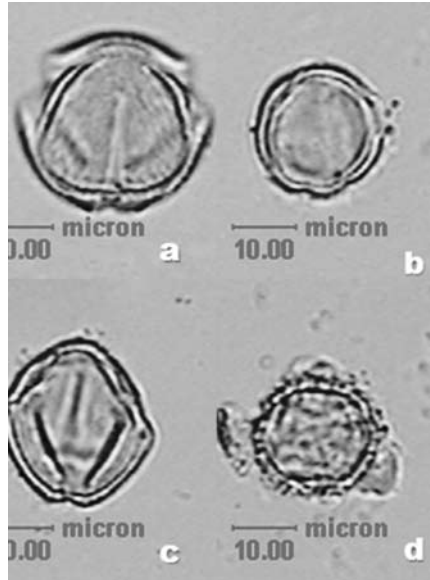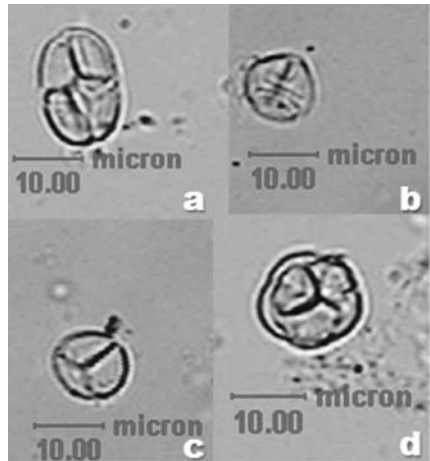

Fig. 7. Pollen types belonging to the family Mimosaceae found in honey samples. a. *Mimosa caesalpiniifolia*; b. *Mimosa pudica*; c. *Mimosa scrabella*; d. *Mimosa* sp. (unidentified species), with 40x magnification.

ence of pollen of these families in the honey may be related to the abundance of available species in the flora (Quiroz-García *et al*. 2001). The presence of pollen of the family Arecaceae can be used as an indicator of geographical origin, since some species such as *Cocos nucifera* are easily found in the coastal or in cultivated areas.

The number of families visited by *Apis mellifera* is linked to their general characteristics, because they visit a large number of spices of plants, mainly small flowers, with dense and longer-lasting inflorescences and flowers with corollas long and wide or enough to allow access to the nectar (Heard 1999).

The pollen diversity found in the samples can be used as an indicator of wild honey, which can favor honey producers because of the diversity of aromas and flavors that they may have, due to a mixture of various nectars. This diversity suggests an adaptive behavior of plants to resources available in the environment, which may facilitate the pollination of these botanical families and consequently improve their genetic quality.

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