DIFFERENCES IN THE NUMBER OF ANTENNAL SENSORY STRUCTURES OF MALES OF THREE HONEY BEE TYPES

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(With 3 figures)

ABSTRACT

The number of sensilla campaniformia and sensilla coeloconica + sensilla ampullacea of flagellomeres 2 to 11 of the antennae of three types of males (Italian, African and Africanized) was determined by scanning electron microscopy. Comparison of the three male types showed that Italian males did not differ from African males in number of sensilla coeloconica + sensilla ampullacea and that both differed from Africanized males in terms of flagellomere 11. With respect to flagellomeres 3 and 10, Italian males were similar to Africanized males and both differed from African males. No differences between the three male types were detected in the other flagellomeres. In relation to the number of sensilla campaniformia Italian males differed of the African and Africanized males with respect to flagellomere 11.

Key words: antennae, flagellomeres, sensilla, *Apis mellifera.*

RESUMO

Diferenças no número de estruturas sensoriais antenares de machos de 3 tipos de abelhas melíferas

O número de sensilla campaniformia e sensilla coeloconica + sensilla ampullacea dos flagelômeros 2 ao 11 das antenas de 3 tipos de machos (italianos, africanos e africanizados) foi estudado através do microscópio eletrônico de varredura. As comparações dos 3 tipos de machos mostraram que, em relação ao número de sensilla coeloconica + ampullacea, os italianos não diferiram dos africanos e ambos eram diferentes dos africanizados em termos do flagelômero 11. Em relação aos flagelômeros 3 e 10, os italianos eram semelhantes aos africanizados e ambos diferiram dos africanos. Nos outros flagelômeros não foram verificadas diferenças entre os três tipos de machos. Em relação ao número de sensilla campaniformia, os italianos diferiram dos africanos e dos africanizados quanto ao flagelômero 11.

Palavras-chave: antenas, flagelômeros, sensilla, *Apis mellifera.*

INTRODUCTION

The Africanized bees of Brazil, which originated from crosses of African bees (*Apis mellifera scutellata*) with European bees (Italian, *Apis mellifera ligustica*, and German, *Apis mellifera mellifera*), have been studied in terms of the most diverse aspects such as defensive behavior (Stort, 1971), flight activity (Kerr *et al*., 1970), communication (Gonçalves, 1969), mating competition (Martinho, 1979), hygienic behavior (Message, 1979), foraging behavior (Beig *et al.*, 1972; Malaspina & Stort, 1987; Neves-Fermiano & Stort, 1985) and also in terms of outer morphology (Gonçalves, 1970; Daly & Balling, 1978; Cosenza & Batista, 1972; Stort, 1979; Stort & Bueno, 1985). Informations has also been obtained about this new type of bee in terms of the antennae, which are

organs rich in sensory structures (Stort & Barelli, 1981; Stort, 1979; Moraes, 1988; Rebustini, 1995; Stort & Rebustini, 1998). The antennae of Africanized males have also been studied in terms of number of sensilla placodea (Stort & Malaspina, 1980; Stort & Moraes-Alves, 1998), flagellomere size (Moraes, 1988) and size of the cuticular depressions of the antennal flagellomeres (Dietz, 1978).

However, little is still known about the antennal sensory structures of Africanized bees, especially in males and in comparison to the typical African and European subspecies that gave origin to them. The objective of the present investigation was to determine the differences in number of sensilla campaniformia and sensilla coeloconica + sensilla ampullacea in males of three types of honeybees: African (*Apis mellifera scutellata*), Italian (*Apis mellifera ligustica*) and Africanized.

MATERIAL AND METHODS

The samples used in the present study were 10 adult males from colonies of African honey bees (*Apis mellifera scutellata*) collected from the Kosmos apiaries in Pretoria (South Africa), 10 adult males from Italian honey bee colonies (*Apis mellifera ligustica*) originating from queens imported from the United States, and 10 adult males from colonies of Africanized honey bees maintained in the apiaries of the Biosciences Institute of UNESP, Rio Claro. The specimens were collected live, anesthetized and killed in an ether chamber and then fixed in modified Karnovsky (2% glutaraldehyde and 2% paraformaldehyde in 0.1 M phosphate buffer, pH 7.2) for 24 hours. The samples were then transferred to and stored in 70% alcohol. The antennae were removed from the head, submitted to ultrasound for 1 minute to remove dirt particles, then glued to metal supports, sputtered with a fine gold layer using an Edwards $S_{150\text{-}B}$ sputter and observed with the scanning electron microscope (JEOL, model $T_{330\text{-}A}$) of the Chemistry Institute, UNESP, Araraquara. The numbers of sensilla campaniformia and sensilla coeloconica + sensilla ampullacea were counted in the cuticular depressions (Fig. 1) of antennal flagellomeres 2 to 11. Flagellomere 11 is the most distal one and flagellomere 1 does not have these structures. The data obtained were first submitted to analysis of variance and the differences between the means for the three male types and referring to the flagellomeres that did not present homogeneous variances were compared by the Tukey test.

RESULTS AND DISCUSSION

The mean counts of sensilla coeloconica + sensilla ampullacea per antennal flagellomere in the three male types studied are illustrated in Fig. 2. Only flagellomeres 3, 10 and 11 presented significant F values when the data were submitted to analysis of variance. The Tukey test showed that only African and Italian males did not differ in terms of flagellomere 11. In contrast, only African and Italian males differed from one another in terms of flagellomeres 3 and 10. It has been reported that the number of antennal sensilla placodea and sensilla trichodea of workers is larger in Italian than in Africanized bees (Stort, 1978; Stort & Barelli, 1981) and that the number of sensilla coeloconica and sensilla ampullacea is larger in Caucasian than in Africanized bees (Stort & Malaspina, 1997). It was also observed that the number of antennal sensilla placodea and sensilla trichodea is larger in Italian and German workers than in African workers (Stort, 1979).

The present data show that this is not the case for males. In contrast to workers, the number of sensilla coeloconica + sensilla ampullacea on flagellomere 11 is identical in African and Italian males and lower in Africanized males. In flagellomeres 3 and 10, the number of these sensilla is identical in Italian and Africanized males and lower in African males.

These differences in number of antennal sensilla coeloconica + sensilla ampullacea between males and workers parallels general body morphology. Most morphometric traits of the different parts of the body of workers are larger in European than in African and Africanized bees and the latter two are closer to each other than to European workers (Gonçalves, 1970; Stort, 1979). However, Carvalho (1982) showed that 20 of 49 general outer morphology traits analyzed differed between African males (*Apis mellifera scutellata*) and Italian males (*Apis mellifera ligustica*) and that 35% of these 20 traits were larger in African males.

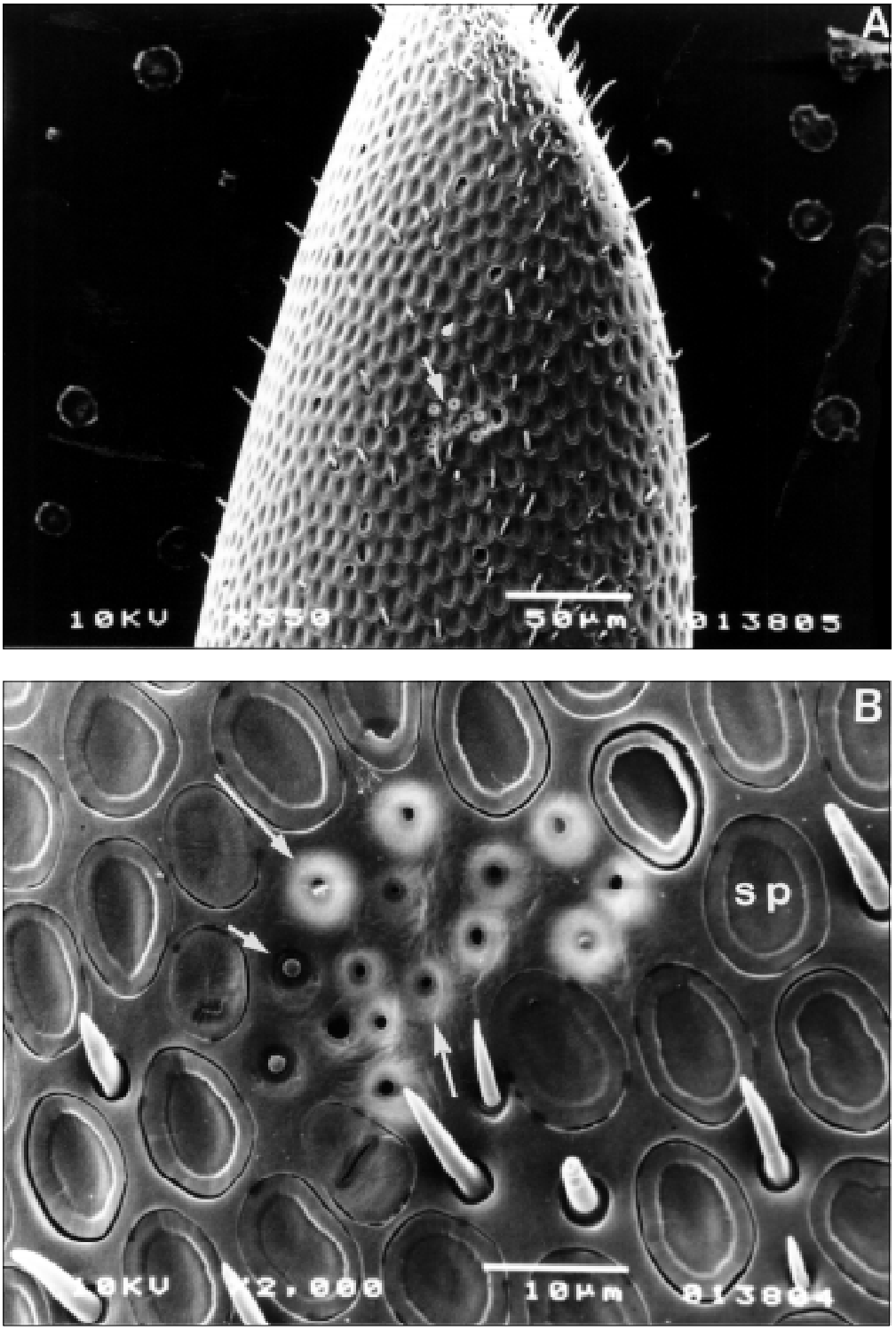

Fig. 1 — Scanning electron microscopy micrographies of the antennal flagellomeres of Africanized males. A: flagellomere 11 showing cuticular depression (arrow) with sensilla campaniformia, sensilla coeloconica and sensilla ampullacea. B: flagellomere 11 of other male showing details of the sensilla campaniformia (short arrow), sensilla ampullacea (median arrow) and sensilla coeloconica (long arrow) of the cuticular depression. SP is sensilla placodea (olfactory disk).

The mean counts of sensilla campaniformia per antennal flagellomere are illustrated in Fig. 3. Only flagellomere 11 presented a significant F value when the data were submitted to analysis of variance. The Tukey test showed that Italian males have larger numbers of sensilla campaniformia than African and Africanized males and also showed that the latter two did not differ from each other. In this case the data obtained for males agree with those obtained for workers.

Apis mellifera males have a larger number of sensilla placodea (olfactory disks) than workers (7.36 times more). This must confer a very high olfactory sensitivity on them, which they use to be able to find the queen during the mating flight. However, workers and males have similar numbers of sensilla campaniformia and sensilla coeloconica + sensilla ampullacea. Since sensilla coeloconica and sensilla ampullacea are considered to be hygroreceptor organs (Kuwabara & Takeda, 1956) and since sensilla campaniformia are temperature and CO_2 receptors (Dietz & Humphreys, 1971), the data suggest that males and workers probably do not differ in sensitivity in terms of perceiving variations in these factors in the environment. Thus, it appears that the degree of environmental humidity and temperature is secondary for the males (in relation to smell sense) in the process of finding a queen and mating.

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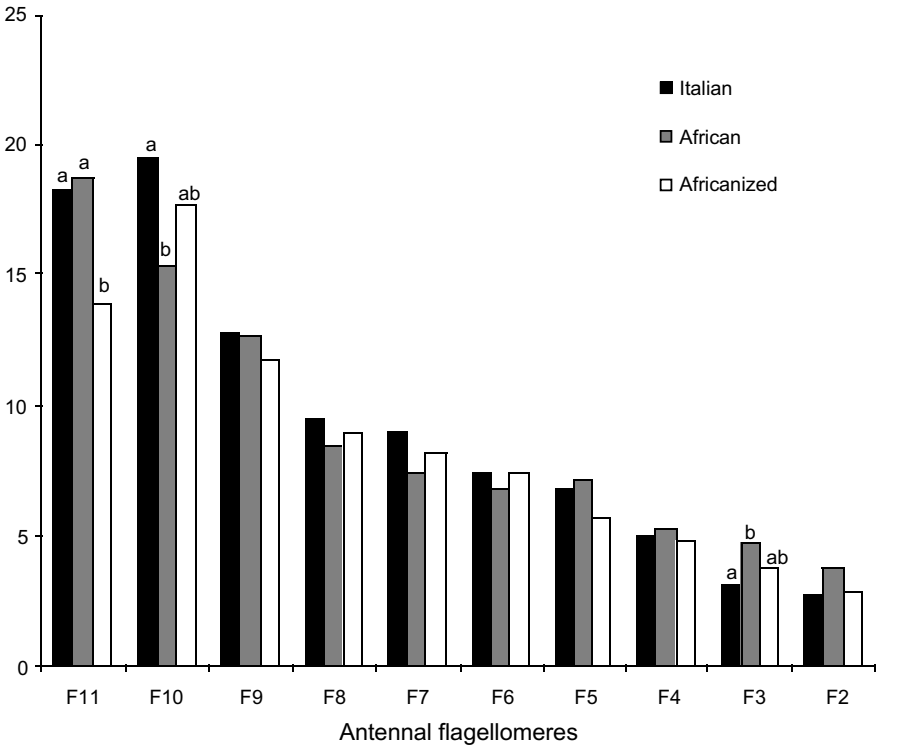

Fig. 2 — Mean number of sensilla coeloconica + sensilla ampullacea per antennal flagellomere in 3 types of honey bee males. An equal letter for two males types means that they are not different.

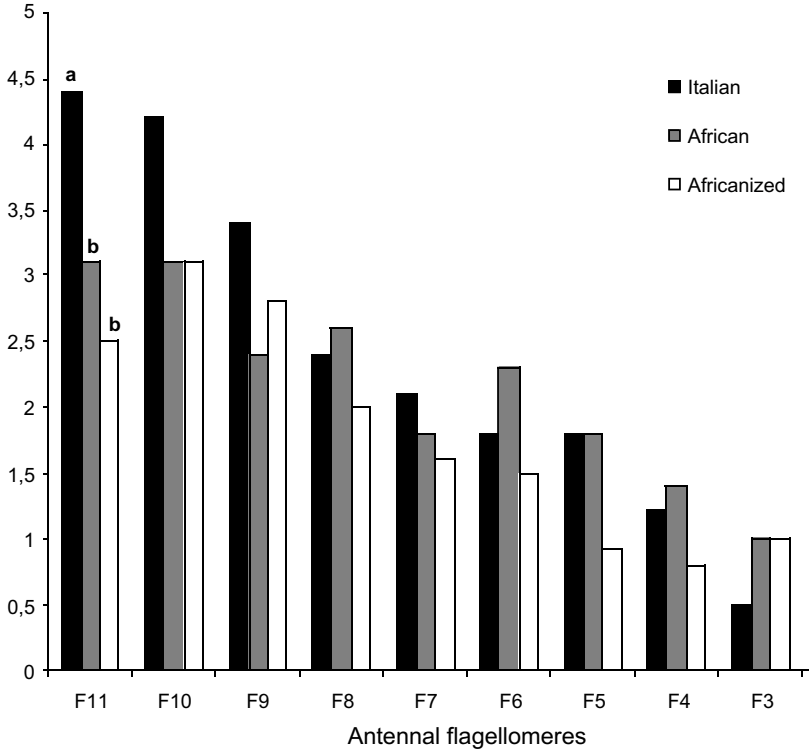

Fig. 3 — Mean number of sensilla campaniformia per antennal flagellomere in 3 types of honey bee males. An equal letter for two males types means that they are not different.

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