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Original Articles

The use of smoke in the control of the defensive behavior of tiuba bees

O uso da fumaça para o controle do comportamento defensivo de abelhas Tiúba

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A R T I C L E I N F O

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A B S T R A C T

The aim of the study was to evaluate the effect of smoke from different plant products on the defensive behavior of tiuba bees (*Melipona compressipes fasciculata* Smith, 1854). The experiment was carried out in a meliponary with 12 colonies with equity regarding the biological development. The following treatments were applied to the colonies weekly: smokeless, sawdust (100% of the smoker), eucalyptus (50%) + sawdust (50%) and sawdust with 2 suber fragments, the dry bark of *Amburana cearensis* (Allemão) A.C.Sm.. Regarding the development of the colonies, it was observed that the use of smoke did not change the number of brood cells nor the number of pollen and honey storage cells in the colonies. Regarding the number of bees adhering to gloves and headband, it was observed that colonies managed without smoke were more defensive compared to the other ones ($p \leq 0,05$). It was concluded that the use of smoke (100% sawdust in the smoker) decreased the defensive behavior of tiuba bees, being an alternative in the meliponiculture management since it does not interfere negatively in the colonies development of the colonies.

Palavras-chave:
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R E S U M O

O objetivo do trabalho foi avaliar o efeito da fumaça de diferentes produtos de origem vegetal na defensividade de abelhas tiuba (*Melipona compressipes fasciculata* Smith, 1854). O experimento foi realizado em um meliponário com 12 colmeias selecionadas a partir da condição de equidade em relação ao desenvolvimento biológico. Semanalmente aplicou-se os seguintes tratamentos: sem fumaça, serragem (100% do fumegador), eucalipto (50%) + serragem (50%) e serragem com 2 fragmentos de umburana (*Amburana cearensis* (Allemão) A.C.Sm.). Quanto ao desenvolvimento das colônias, observou-se que a utilização da fumaça não alterou o número de discos de crias, tampouco o número de potes de alimento das colônias. Em relação ao número de abelhas aderidas às luvas e à bandana, observou-se que as colônias manejadas sem fumaça se apresentaram mais defensivas em comparação aos demais tratamentos ($p< 0,05$). Concluiu-se que o uso da fumaça diminuiu a defensividade da abelha tiúba, demonstrando ser uma alternativa no manejo na meliponicultura, já que não interfere negativamente no desenvolvimento das colônias.

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INTRODUCTION

Regarding the number of species and behavior, bees are the most diverse group among the insects of the order Hymenoptera. According to Michener (2007), there are approximately 20,000 species that can be classified into three distinct categories: solitary, parasite and colony bees.

The most popular species of bees in Brazil are the ones belonging to the subtribe Meliponina, the species of this subtribe are usually known as stingless bees, indigenous bees, native bees, or meliponines. There are about 200 species of stingless bees cataloged in the country (SOUZA et al., 2007).

Meliponines, as well as bees belonging to the Apis genus, such as *Apis mellifera*, sting bees (the workers of this species have strategies for the defense of colonies such as the use of a barbed stinger with a poison gland), are able to efficiently fend off threats to the colony. Although these mechanisms are distinct, the defense behavior is essential for the survival of the colony. According to Oliveira et al. (2013), despite having the stunted sting (vestigial) and having lost the ability to sting, the meliponines have different defense mechanisms such as: entering the intruders' noses and ears, depositing plant resins or caustic substances on their hair, and even cause injuries, biting parts of the body such as arms, eyes and legs .

For *A. mellifera* L., the use of smoke during the management of colonies stands out among the practices that contribute to the success of beekeeping, since the smoke does not directly hinder the sting, but induces the behavior that hinders the sting, as well as masking the released alarm pheromones, such as isopentylacetate (LOMELE et al., 2010).

However, this technique is not usual in meliponiculture and few studies have aimed at proving the efficiency of smoke to control the defensive behavior of native bees, even though there are reports that some species tend to be highly defensive (SOUZA et al., 2007).

Therefore, the aim of this study was to evaluate the effect of smoke from different plant products on the defensive behavior of tiuba bees (*Melipona compressises fasciculata* Smith, 1854).

MATERIAL AND METHODS

The research was carried out in a meliponary of tiuba bees, located in the rural area of the municipality of Teresina, Piauí. For the experiment, 12 hives were selected (wooden boxes model Fernando Oliveira), using the number of brood cells and the number of pollen and honey storage cells to guarantee equity in the development of the colonies.

To evaluate the effect of smoke resulting from the combustion of different plant products in the control of the defense behavior of tiuba bees, a smoker was used: sawdust, eucalyptus leaves (*Eucalyptus* spp.), and suber fragments, bark of *Amburana cearenses* (Allemão) A.C.Sm.. The choice of these products was based on reports from beekeepers who practiced this technique for the management of some native bees species.

The treatments were: i) treatment 1 (T1): smokeless - Control; ii) treatment 2 (T2): only sawdust in 100% of the smoker; iii) treatment 3 (T3): 50% eucalyptus leaves and 50% sawdust in the smoker; iv) treatment 4 (T4): two suber fragments of *Amburana cearenses* in the sawdust in 100% of the smoker.

One treatment was applied to 12 hives for 4 weeks, *i.e.*, one treatment per week. It is important to state that the colonies were spread throughout the property and thus, they were far from each other. The execution of the treatments consisted of two applications of smoke, except the control treatment: one at the entrance of the colony and the other superficially just after its opening. Care was taken so the smoke did not reach the brood cells nor the honey and pollen storage cells.

The experiment was carried out from the simulation of a routine inspection where the observer was wearing a pair of gloves made of black felt covering the entire arm and a headband of the same material. The inspections lasted one minute and were standardized for all colonies. The same pair of gloves and headband was used throughout the experiment, being washed after each use to avoid the influence of marking pheromones.

Defensive behavior was evaluated through some parameters: i) Number of bees (NB) adhered to gloves and headband; ii) Time for the first sting (seconds) with the use of a stopwatch, (TFS); and iii) Distance, in meters, traveled by the bees (DTB) after the observer.

The results were analyzed using the Systat statistical program (version 2011). The verification of difference between treatments was performed using ANOVA and, with significant differences, the Tukey's test at 5% probability was used to compare the treatments that are more efficient in reducing the defensive behavior of bees at the time of management.

RESULTS AND DISCUSSION

It was observed that the defensive behavior in tiubas bees was significantly higher ($p \leq 0.05$) in colonies where there was no smoke application (control) with an average number of bees adhered (NB) to the observer's gloves and felt headband of 38.58%. The number of bees adhered per treatment was: T4 (21%), T3 (13.83%) T2 (13.25%).

Amburana cearensis (Allemão) A.C.Sm is considered to be devoid of toxicity in usual doses (MELO et al., 2014). The presence of a pleasant odor is one of the most peculiar characteristics of this plant and worth using in popular medicine in the form of inhalation, in the treatment of respiratory problems. In the honey producers' reports, the low defensive behavior of bees is

attributed to the pleasant odor of the plant. However, in the present study, the inclusion of the suber of this plant influenced less than the sawdust 100% in the defensive behavior of the bees.

Table 1. ANOVA result for comparing the treatments of the parameters used to evaluate the effect of smoke resulting from the combustion of different plant products in the control of the defensive behavior of tiubas bees.

PARAMETERS	ANOVA RESULT		
	P	D.F.	R^2
Number of bees adhered to the felt	0.04*	3	0.26
Time to the first sting	0.32	3	0.08
Distance traveled by the bees after the observer	0.18	3	0.10

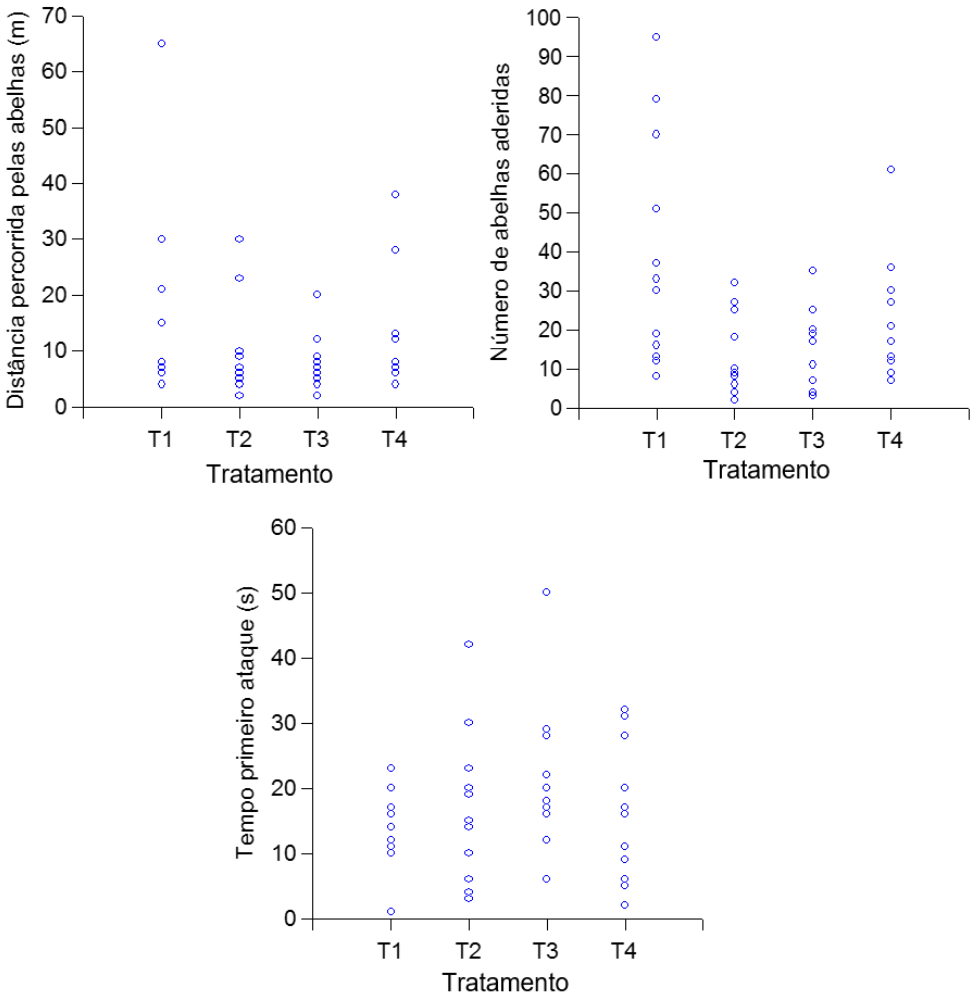
*Significant values at p≤0.05.

Regarding the time to the first sting (TFS), it was observed that the treatment that presented the longest average time for the sting was T4 (16.75s), followed by T2 (n = 16.33s), T3 (n = 15.50s) and with the shortest time, the T1 treatment (n = 14.58s). Thus, without the use of smoke the bees responded faster to the invader.

Regarding the distance traveled by the bees after the observer (DTB), the longest average distance was achieved using the treatment 1 (n = 16.75 m), followed by T4 (n = 12.08 m), T2 (n = 9 , 42m) and the shortest distance was when treatment 3 was used (n = 7.08m). The results showed that there was no significant difference at 5% probability by Tukey's test regarding this parameter. However, when the smoke was not used, the bees chased the observer for a distance, on average, 7.23m greater than in the other treatments.

Thus, it was observed that except for the number of bees adhering to the materials used by the observer, there were no statistically significant differences for the other parameters. However, the results indicate a tendency in reducing the relevant defensive behavior from the management point of view (Figure 1).

Figure 1. Distribution of data by treatment (T) in each parameter used to evaluate the effect of smoke resulting from the combustion of different plant products in the control of the defensive behavior of tiuba bees.



Regarding the number of bees adhered to the material used, it was found that the highest average number corresponded to T1 (n = 38.58), followed by treatments T4 (n = 21), T3 (n = 13.83) and T2 (n = 13.25). The results showed a statistical difference and it can be said that the use of sawdust smoke was only effective to control the defensive beahvior of tiuba bees.

Despite presenting stunted stinger, according to Shackleton et al. (2015), native bees present a wide variety of behaviors used in the defense of the colony. Nogueira-Neto (1997) states that, at the time of colonies inspections, it is advisable to use a veil and long-sleeved shirt with elastics over the cuffs in order to protect parts of the body that bees usually attack.

Lomele et al. (2010), testing the use of smoke from different combustion materials in Africanized bees, observed a reduction in the Number of Stingers in the Ball (NSB), with the use of smoke (39.7 ± 25.0 stingers), in comparison with the absence of smoke (62.4 ± 20.6 stingers). However, the use of smoke containing plant materials showed a significant reduction in NSB when compared to treatment containing only sawdust smoke (39.7 ± 25.0 stingers). The authors used castor seeds and coffee husk as plant materials.

However, there are no studies related to the use of eucalyptus in reducing the defensive behavior of native bees. In the present study, the effectiveness of eucalyptus in relation to tiuba bees was not statistically proven. From this evaluation it was possible to observe that there were no negative impacts regarding the use of smoke. Therefore, there was no decrease in the number of brood cells, nor the observation of dead larvae. There was no reduction in the number of honey and pollen storage cells in the hives evaluated. Thus, it appears that the use of this practice can be used for the management of stingless bees.

The knowledge of the defensive behavior of bees is of great importance for the management in meliponiculture and represents an important advance for the consolidation of the activity.

CONCLUSIONS

The use of smoke resulting from 100% sawdust helped to reduce the defensive behavior of tiuba bees. It was found that fewer bees adhered to the gloves and headbands during the management of the colonies in relation to the non-use of smoke. Although the results were not statistically significant for the other parameters, differences were observed in the distances traveled by the bees after the observer in treatments with and without smoke. Therefore, the use of smoke in the management of tiuba bees can be used as an alternative for controlling their defensive behavior since no negative impacts on the development of colonies were observed.

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