FLIGHT ACTIVITY OF *Tetragona clavipes* (FABRICIUS, 1804) (Hymenoptera, Apidae, Meliponini) AT THE SÃO PAULO UNIVERSITY CAMPUS IN RIBEIRÃO PRETO

ATIVIDADE DE VÔO DE Tetragona clavipes *(FABRICIUS, 1804) (Hymenopetra, Apidae, Meliponini) NO CAMPUS DA UNIVERSIDADE DE SÃO PAULO EM RIBEIRÃO PRETO*

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ABSTRACT: The *Tetragona clavipes* (Fabricius, 1804) bees, knowing as "borá", is found in all Brazil country until south of Parana state. However in the São Paulo state, this species is not very common. Our main aim was, in São Paulo University Campus at Ribeirão Preto, to realize the characterization of the flight activity of this bee, showing possible relations some environmental factors, such as temperature, relative humidity and "A" type ultraviolet radiation. Data were obtained during September and October months (Spring) and showed that there is a high correlation between the start and finish of the flight activity and environmental temperature. However the UVA radiation and specially air relative humidity did not show relevant role on this behavior and they were considered secondary factors.

KEYWODS: Flight activity. *Tetrágona.* Meliponini. Temperature. Ultraviolet radiation. Relative humidity.

INTRODUCTION

The Apini and Meliponini (MICHENER, 2000) are highly eusocial bees because they live in colonies built by a number of workers on different age (division of labor), with a queen, male and care with brood (WILSON, 1971; MICHENER, 1974). Therefore, they represent the social evolution top in the social insects (SAKAGAMI, 1982).

The Meliponini are flower visitors by excellence and thus, responsible for up to 90% of the native trees pollination (KERR et al., 1994; RAMALHO et al., 2004). When these insects leave their colonies, they become susceptible to the weather variations which may interfere in the amount of individuals that fly from their nests (RAMALHO et al., 1991).

The flight activity, or external activity, of bees is influenced both by internal conditions of the colonies and environment (HILÁRIO et al., 2001), which modify in the among of bees that enter or leave the nest during the foraging for harvest food. For the stingless bees it was verified that abiotic factors such as temperature, light intensity, relative humidity, pluviometric precipitation, wind and solar radiation influence the flight activity (IWAMA, 1977; HEARD; HENDRIKZ, 1993; PICK; BLOCHTEIN, 2002; CONTRERA et al., 2004). Therefore, knowing the Meliponini flight activity is essential for the understanding of the foraging patterns of these bees, as well as to obtain subsidies for the use of these insects on the crop pollination (PICK; BLOCHTEIN, 2002).

The *T. clavipes* (Fabricius, 1804) bee (Figure 1) belongs to Meliponini tribe and Apidae family (MICHENER, 2000), it's popularly known as "Borá" (indian name from Tupi language) and was chosen as the target of our study because there is few studies about this species.

The *Tetragona* genus is virtually restrict to the Amazonian basin, however the *T. clavipes* bee is widely distributed in Brazil, bordered in the south of Paraná state (SILVEIRA et al., 2002) and found in the São Paulo state (PEDRO; CAMARGO, 1999), but it is not a very common species (NOGUEIRA-NETO, 1970).

Despite Pedro e Camargo (1991) had not found nests of this bee in a Cerrado (Brazilian savannah) area in Cajuru, SP, close to Ribeirão Preto, but it was the third more abundant species (8.7%) collected in the flowers. Freitas (2001, 2006) initially found a significant amount of this bee (21 natural nests) in an urbanized area of the São Paulo University Campus in Ribeirão Preto/SP, that gradually expanded and reached 37 nests in 2006.

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Figure 1-*T. clavipes* worker with 7.0mm large (lateral view); detail of the head (frontal view). The bars represent 2.0mm.

These bees nest preferentially in hollows of live trees with average diameter measured at the chest height (DAP=2.26m) at an average height of 3.36m (FREITAS, 2001). They do not build wax tubes in the entrance, which is a hardened propolis saliency (NOGUEIRA-NETO, 1997) (Figure 2).

Figure 2. *T. clavipes* natural nest entrance on the tree.

Their colonies are very crowded, with very aggressive habits and in most of the nests the brood combs are compact with peripheral real cells (NOGUEIRA-NETO, 1997), helicoidally built and covered with a cerumen involucre. Their honey and pollen pots present a mean height size of 3.0 cm (MONTEIRO, 2001).

This study aimed the determination of the *T. clavipes* flight activity pattern and its possible relation to temperature, relative humidity and ultraviolet radiation intensity in the nest entrance.

MATERIAL AND METHODS

The study was developed during the Spring station in September (7 days-91 hours) and October (10 days-130 hours) months in 2003 at São Paulo University (USP) Campus in Ribeirão Preto city, in the Northeast of São Paulo state, with a mild humid subtropical weather, annual mean temperature of 21°C, annual mean pluviometric precipitation of 250 mm, area of 574,638 ha and maximum altitude of 653 m.

The only one *T. clavipes* colony used in this flight activity study was located in a only natural

nest with easy access and located in the meliponary of the Department of Genetics at the Faculty of Medicine of Ribeirão Preto - USP.

Using manual counters (by KW–triO® counter, model 2410), at each hour of the day, beginning right after the first worker left the natural nest, all the bees that left the colony during 10 minutes (by timer Amersham Pharmacia Biotech) were counted and in the next 10 minutes all individuals that returned to the colony were counted. Before the beginning of each counting, temperature (T), relative humidity (RH) and ultraviolet radiation incidence (UVA) were measured in the nest entrance by a hygrothermometer (TFA®) and ultraviolet radiation measurer (Erythema UV & UVA Intensity Meter®, model 3D V2.0 - Solar Light CO) equipment, respectively.

Data were analyzed using the Microsoft Excel® (1997) program and the statistical analyses were performed using the BioStat® 2005 (version 4.0) program for Principal Component Analysis (PCA) and Pearson Correlation.

RESULTS AND DISCUSSION

The bees external activities usually started around 6:00 a.m, with a high relative humidity (around 65%). The ultraviolet radiation incidence in this moment was near to zero and the temperature reached around 22°C. However, the highest flight activity occurred between 8:00 and 10:00 a.m., when the temperature ranged from 25 to 31°C. It is interesting to observe that although the temperature had gradually elevated to approximately 35°C between 7:00 a.m. and 2:00 p.m., when it diminished the flight activities, there was no bee movement increase, which remained constant until 5:00 p.m., when it decline to end, which occurred around 7:00 p.m. (Figure 3). Such observations are similar to *Melipona bicolor bicolor* (HILÁRIO et al., 2000) and *Plebeia saiqui* (PICK; BLOCHTEIN, 2002), who reported a daily flight amplitude from 6:00 a.m. to 7:00 p.m.

The temperature in the beginning of the *T. clavipes* flight activity corroborates to the *P. saiqui* and *Plebeia remota* information, which presented an ideal temperature for activity of 18°C, and also to others species information such as *Plebeia droryana*, *Plebeia emerina*, *Tetragonisca angustula*, *Trigona carbonaria*, *Melipona marginata marginata* and *M. m. obscurior*, with ideal temperatures that varied from 16 to 19°C for the beginning of the activities (TAURA; LAROCA, 2004). However, the *T. clavipes* results seemed superior to the *M. quadrifasciata quadrifasciata, Partamona helleri* and *P. pugnax* with temperatures in the beginning of the activities of 13, 14 and 15°C respectively (OLIVEIRA, 1973; KLEINERT-GIOVANNINI, 1982; IMPERATRIZ-FONSECA et al., 1985; KLEINERT-GIOVANNINI; IMPERATRIZ-FONSECA, 1986; AZEVEDO, 1992; HILÁRIO et al., 2001). Borges & Blochtein (2005) reported that, during spring and summertime, the beginning of the activities occurred at 14.3°C and they were more intense between 16 and 21°C for *M. m. obscurior* being both limits lower than those found for *T. clavipes.*

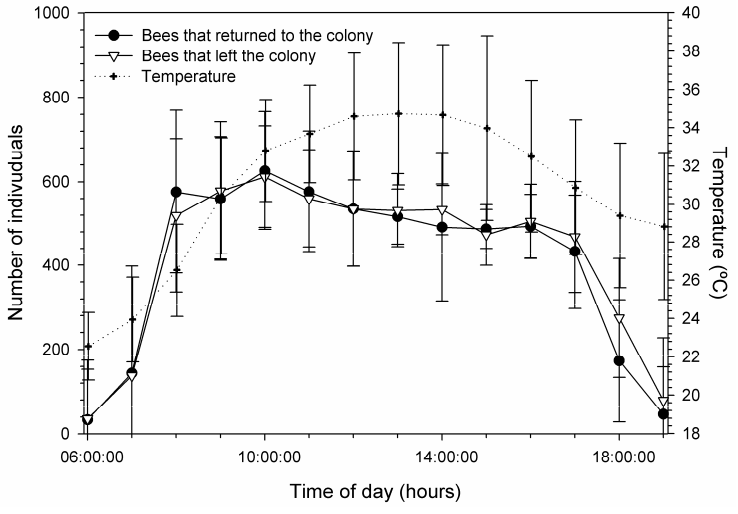

Figure 3. *T. clavipes* flight activity in relation to temperature variation (°C) during the day (average values and SD).

The *T. clavipes* movement in the colony entrance began with relative humidity close to 62% (Figure 4) but the highest flight activity occurred when the relative humidity varied from 43 to 65%, determined as ideal values. At the end of the day (5:00 p.m.) the relative humidity was constant, around 40%, and remained until the end of the bees flow into the colony.

The ideal RH values favorable to the *T. clavipes* flight activity were within intervals reported in the literature, such as Oliveira (1973) and Hilário et al. (2000) which found 25-90%, Kleinert-Giovannini (1982) 40-70%, Imperatriz-Fonseca et al. (1985) 60-84%, but lower than Hilário et al. (2001) and Borges e Blotchtein (2005) studies which reported relative humidity around 80-89% and 81-90% respectively. However, there was no evidence that the decrease in the relative humidity interferes in the *T. clavipes* flight activity, once humidity ranged from 34 a 65% and the bees movement remained constant with the hight activity between 10 am–17 pm.

Iwama (1977), Hilário et al. (2001), Pick & Blochtein (2002), Borges e Blochtein (2005) observed the bees flight activity behavior in relation to luminosity and solar radiation incidence and concluded that there is a positive correlation between the flight activity and solar irradiation.

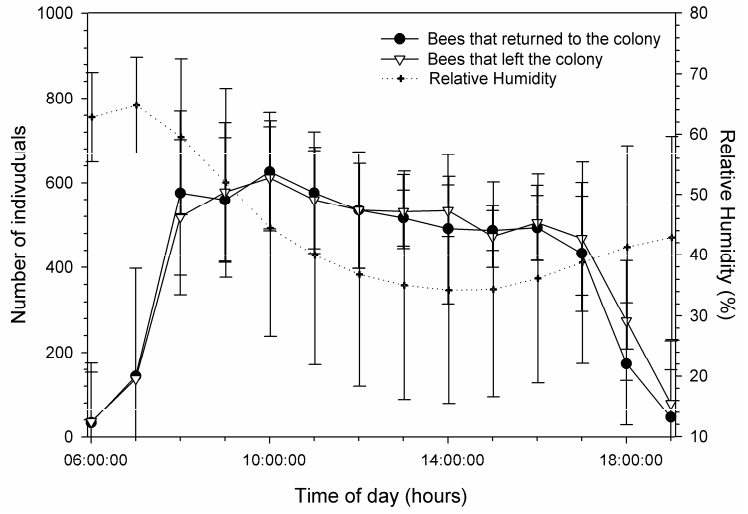

Figure 4. *T. clavipes* flight activity in relation to relative humidity variation during the day (average values and SD).

The *T. clavipes* flight activity peak corresponded exactly to the highest UVA radiation incidence that presented values between 0.2 and 0.3 mW/cm². After this period, there was a gradual decrease in the UVA radiation incidence not followed by reduction in the bees movement that remained constant (Figure 5). Thus, we can infer that UVA radiation was more influent only in what concerns to the bees flight activity peak.

The temperature is the most important factor for the bees to perform their functions normally (MICHENER, 1974). Because they are relatively small organisms, their surface/volume relation is high and there is an intense heat exchange to the environment. Therefore, they are very dependent of the ambient temperature. Low temperatures decrease the metabolism hampering flight and other movements. Very high temperatures lead them to decrease external activities and induce the colony ventilation behavior. The literature indicates that temperature is really decisive in the beginning of the stingless bees flight activity. Kleinert-Giovannini (1982) observed that *P. emerina* did not leave the colony when the ambient temperature is low, even with adequate luminosity and humidity conditions. In their studies with *T. carbonaria*, Heard & Hendrikz (1993) verified that, in the winter, the beginning of the flight activity was regulated by temperature, while in the warm months solar radiation was the determinant factor.

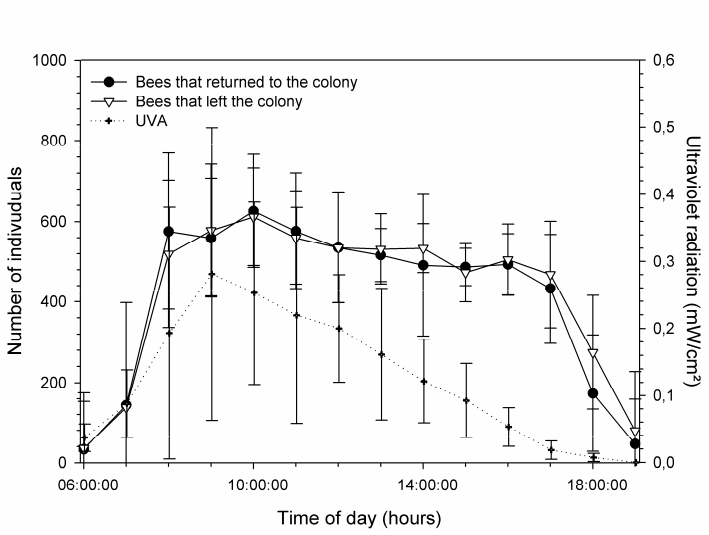

Figure 5. *T. clavipes* flight activity in relation to UVA radiation variation during the day (average values and SD).

According to our data, the environmental temperature was the main factor influencing the *T. clavipes* flight activity representing 65.5108% (PCA) of variance observed with a significant value in the Pearson correlation (r=0.7056; r^2=0.4979; p=0.0048). Ultraviolet radiation was a secondary determinant, with an also significant correlation value (r=0.7574; r^2=0.5737; p=0.0017) with lower percentage of variance (PCA= 0.1325%). There is not significant value of Pearson correlation between flight activity and relative humidity (r= -0.4249; r^2=0.1805; p=0.1299) with high percentage of variance (PCA= 34.3568%). This data is in agreement with those of Hilário *et al*. (2001; 2002) and Teixeira e Campos (2005) for another species of bees.

Thus, we believe that the temperature is the most important factor used by the workers bees for start the flight activities in *T. clavipes*. However, RH and specially the UVA were secondary factors influencing this behavior.

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RESUMO: A abelha *Tetragona clavipes* (Fabricius, 1804), também conhecida como Borá, é encontrada em todo Brasil, até os limites sul do estado do Paraná. Embora ocorra no estado de São Paulo, ela não é uma espécie muito comum. Nosso principal objetivo foi realizar, no Campus da USP em Ribeirão Preto, a caracterização das atividades de vôo dessa abelha, mostrando suas possíveis relações com alguns fatores climáticos, tais como temperatura, umidade relativa do ar e radiação ultravioleta do tipo A. Após coleta e análise dos dados durante os meses de Setembro e Outubro (primavera), pôde-se afirmar que existe uma alta correlação entre o início e o término das atividades de vôo e a temperatura ambiente. Porém, os índices de radiação UVA e principalmente a umidade relativa do ar não apresentaram papel relevante neste tipo de comportamento e foram considerados como parâmetros secundários.

PALAVRAS-CHAVE: Atividade de vôo. *Tetrágona.* Meliponini. Temperatura. Radiação ultravioleta. Umidade relativa.

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