

Efficiency of n-Octyl-Acetate, 2-Heptanone and Citronellal in Repelling Bees from Basil (*Ocimum sellowii* - Labiatae)

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ABSTRACT

The objective of this study was to test repellent substances for honey bees, *Apis mellifera*, for basil, *Ocimum sellowii*, and to study the most frequent insects in this crop as well as its behaviors. The frequency of honey bees did not decrease with the application of n.octyl.acetate, citronellal and 2.heptanone, used as repellents, in the concentrations 2.5, 5.0, 7.5 and 10.0% diluted in water. However, when the products (20%) were diluted in water (75%) and glycerine (5%) were effective in repelling those bees of the basil flowers for a period of 20 minutes. The flower lasted, on average, 30 h from the bud phase until the flower withered. The flowers number opened by inflorescence was, on average, 5.65 flowers, and the inflorescence presented, on average, 160 flowers-buds. The basil was visited mainly for the honey bee (98.0%), followed by *Augochloropsis electra* bee - Halictidae (2.0%) and visits sporadics of Diptera and Lepidoptera, collected only nectar. The honey bee frequency increased during the day to 14:00, decreasing soon after, accompanying the curve of the temperature sets registered in the experiment days.

Key words: Repellent, *Apis mellifera*, basil, *Ocimum sellowii*, pollination, insects

INTRODUCTION

There are several means to attract bees for the cultures that need cross pollination (Free, 1962; Weaver et al., 1964; Free, 1968; Butler and Calum, 1969; Waller, 1970; Woyke, 1981; Ohe and Praagh, 1983; Mayer et al., 1989; Currie et al., 1992; Naumann et al., 1994; Ambrose et al., 1995; Malerbo-Souza, 1996) In some cases the presence of the honey bees becomes an uncomfortable one. As example can be mentioned the culture of the yellow passion fruit (*Passiflora edulis f. flavicarpa* Deg.) where these bees are considered as plague in certain areas. In these cases would be necessary substances that repel the bees for a time (Salis, 1987). Several substances have been studied to repel the

bees (Harpaz and Lensky, 1959; Grout, 1963; Atkins Jret al., 1975ab, 1978; Attri and Singh, 1978; Bocquet et al., 1982; Stark, 1982; Wimmer, 1983; David and Somasundaran, 1985; Moreti, 1989). Blum et al. (1978) observed that the concentrate mixture of n.octyl.acetate and benzil acetate tested in sunflower flowers were much more effective in repelling bees than the mixture of iso-pentil-acetate and 2.heptanone. High concentrations of iso-pentil-acetate and 2.heptanone, sprayed in colza and bean stonemasons reduced the foraging of the bees 80% and 40%, respectively; however, after 30 minutes, the repellence had disappeared (Free, 1987). Free et al. (1989) concluded that component n.octyl.acetate was the best repellent to the bees than the benzil acetate, 2.nonanol, fenol and iso-pentil-acetate.

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In this work a *Ocimum* culture was used to attract the honey bees. In Brazil, this culture is cultivated as aromatic plant and its flowerage extends for practically the whole year. Thus, the aim of the present trial was to test repellents for the honey bees, *Apis mellifera*, in the culture of basil, *Ocimum sellowii*, and to study the frequency and behaviour of insects on these flowers as well as determination of the collection time and type of most frequent bees.

MATERIALS AND METHODS

The present experiment was carried out at Faculdade de Ciências Agrárias e Veterinárias (FCAV), UNESP, Jaboticabal, SP, Brazil. The experimental site is located at an altitude of 595 m with the following geographical coordinates: 21°15'22" S and 48°18'68" W and the mean temperature of the region is 21°C. The climate is subtropical with average annual precipitation of 1.431 mm. A basil stonemason of 20.0 x 1.0 m located in the Horticulture Section of FCAVJ/UNESP was used.

REPELLENTS

In first stage, *n*-octyl-acetate, 2.heptanone and *citronellal* (SIGMA) in concentrations of 2.5, 5.0, 7.5 and 10.0% diluted in water were sprayed at two different times (10:00 h and 14:00 h) with manual sprayer of gardening. In a second stage the products (20%) were diluted in water (75%) and glycerol (5%) and sprayed at 9:00 o'clock.

The frequency of the honey bees, *Apis mellifera* in the flowers was obtained through counting every five minutes before and after the application of the repellents with four replications for each product in each used concentration. Two treatments were used for each product to observe the repellence for honey bees: T1 = area of 5.0 x 1.0 m no sprayed and T2 = area of 5.0 x 1.0 m sprayed with the repellent. Throughout the flowering period the culture was kept under observation and the following parameters were studied:

FLOWERS

- (1) development period of 100 flowers (three replications) from the bud phase until the flower withered;
- (2) average number of flowers opened in 20 inflorescences, counted at 12:00 h with four

replications;

- (3) quantity of total soluble carbohydrates (average values – µg/flower) in the nectar of flowers collected at 8:00, 10:00, 12:00 and 14:00 h with four replications, in flowers of the same age, according to the Roberts method (1977).

INSECTS

- (1) the frequency of visits of more frequent insects was obtained through counting during first five minutes each interval (8:00 to 17:00 h) with four replications;
- (2) time and type of visit (for pollen and or nectar collection) of more frequent insects with thirty replications;
- (3) the relationship occurrence between temperature sets with the frequency of visits during the day.

The data were analyzed by means of Analyses of Variance in the program ESTAT that includes Tukey Test for comparison of averages of whole variables and Analyses of Regression, to test each variable in the time. The data were considered at the level of 5% of significance.

RESULTS AND DISCUSSION

REPELLENTS

The frequency of the visits of the honey bees did not decrease when sprayed repellents *n*.octyl.acetate, 2.heptanone and *citronellal* diluted in water in concentrations 2.5, 5.0, 7.5 and 10.0% independent of the hours (at 10:00 and 14:00 h). When the products (20%) were diluted in water (75%) and glycerol (5%), it was observed that *citronellal* repelled larger number of honey bees significantly (29.40%) followed by *n*.octyl.acetate (19.35%) and 2.heptanone (16.45%) compared to the control treatment. Free et al. (1989) observed that *n*.octyl.acetate was the most effective repellent for honey bees. *Citronellal*, *n*.octyl.acetate and 2.heptanone were effective in repelling honey bees of the basil flowers for a period of 20 minutes (Fig. 1).

FLOWERS

The basil flowering lasted on average 30 h from the bud phase until the flower withered. The number of flowers opened by inflorescence was on average 5.65 flowers and the inflorescence presented 160

flowers-buds, on average. The mean quantity of total soluble carbohydrates in the nectar of the basil flower was on average $10.68 \pm 2.6 \mu\text{g}$ of sucrose per flower increasing during the day: $8.73 \pm 3.4 \mu\text{g}$ at 8:00 h, $8.17 \pm 2.2 \mu\text{g}$ at 10:00 h, $12.26 \pm 1.5 \mu\text{g}$ at 12:00 h and $13.55 \pm 1.1 \mu\text{g}$ of sucrose per flower at 14:00 h.

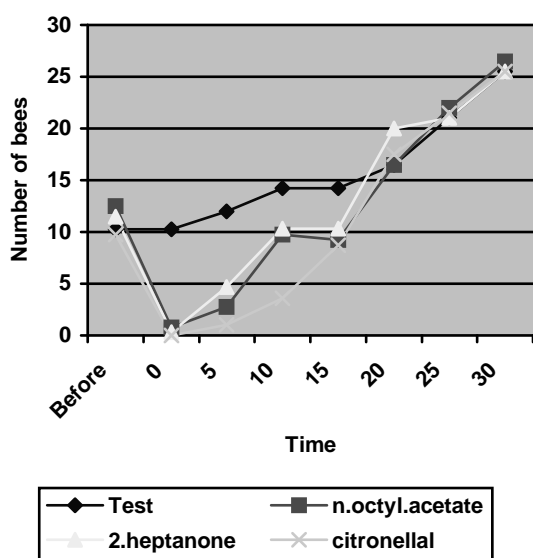


Figure 1 - Mean frequency of the honey bees, *Apis mellifera* L., during the day in basil flowers, *Ocimum sellovii*, with the application of n.octyl.acetate, citronellal and 2.heptanone diluted in water and glycerine at 9:00 h in Jaboticabal, 1997.

INSECTS

The basil was visited mainly by the honey bee *A. mellifera* (98%), followed by the native bee *Augochloropsis electra*-Halictidae (2%) and sporadic visits of Diptera and Lepidoptera. Those insects collected only nectar in the culture and delayed of 1 to 3 seconds in each flower. In São Paulo, Brazil, the bees observed in this plant species were *A. mellifera*, *Trigona spinipes*, *Tetragonisca angustula*, *Nannotrigona testaceicornis* and *Paratrigona subnuda* collecting nectar and pollen (Pirani and Cortopassi-Laurino, 1993). The frequency of the honey bee increased in elapsing of the day until 14:00 h decreasing soon after accompanying the curve of the temperature sets registered in the experiment days (Fig. 2) and also accompanying the increase in nectar concentration

of the flowers.

The floral essences can present the same function of the nectar in the attraction of the pollinators. The basil, *Ocimum basilicum* (L.), has as main components of its essential oil, estragol and linalol. Another basil species, *Ocimum gratissimum* (L.) has eugenol as main component (Ladeira 1983). The essential oils of the basil (*Ocimum sellovii*) contain estragol, linalol, lineol, ancanfor, eugenol, cineol, pineno and timol (Teske and Trentini, 1995).

From the results it can be concluded that the citronellal, n.octyl.acetate and 2.heptanone were effective in repelling honey bees for a period of 20 minutes when diluted in water and glycerol. The basil culture were highly attractive for the honey bees, *Apis mellifera*, and the insects visited basil flowers for nectar collection only.

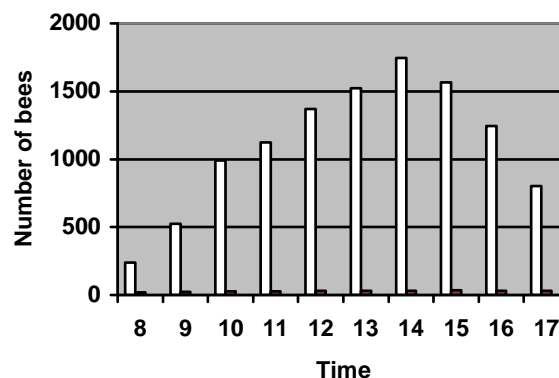


Figure 2 - Mean frequency of the honey bees, *Apis mellifera* L., during the day of 8:00 at 17:00 h in basil flowers, *Ocimum sellovii* in Jaboticabal, 1997.

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RESUMO

O objetivo do experimento foi estudar a polinização em manjeriço (*Ocimum sellovii*), a fim de verificar

sua atratividade para as abelhas *Apis mellifera*, os insetos mais freqüentes, bem como seus comportamentos e testar substâncias repelentes para as abelhas *A. mellifera*. A flor durou, em média, 30 horas, desde sua abertura até o murchamento. O número de flores abertas por inflorescência foi, em média, 5,65 flores, sendo que a inflorescência possuía, em média, 160 botões florais. O manjeriço foi visitado quase que exclusivamente pela abelha *A. mellifera* africanizada (98,0%), seguida pela abelha *Augochloropsis electra*-Halictidae (2,0%) e visitas esporádicas de dípteros e lepidópteros, sendo que todos coletavam apenas néctar. A freqüência da abelha africanizada aumentou no decorrer do dia até às 14 horas, diminuindo em seguida, acompanhando a curva da temperatura ambiente registrada nos dias do experimento. As abelhas africanizadas demoraram de 1 a 3 segundos em cada flor. A freqüência das abelhas africanizadas não diminuiu com a aplicação dos produtos *n*.octyl.acetato, citronellal e 2.heptanona, usados como repelentes, nas concentrações 2,5, 5,0, 7,5 e 10,0%, diluídos apenas em água. Entretanto, quando os produtos (20%) foram diluídos em água (75%) e glicerina (5%), foram efetivos em repelir essas abelhas das flores de manjeriço, por um período de 20 minutos.

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