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Artículos Científicos

Los abejorros *Bombus impatiens* y *Bombus ephippiatus* pueden copular, pero no generan descendencia

***Bumblebees *bombus impatiens* and *bombus ephippiatus* can copulate but
do not generate offspring***

***Os abelhões *Bombus impatiens* e *Bombus ephippiatus* podem copular, mas
não produzem descendentes***

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Resumen

El objetivo del estudio fue demostrar que bajo condiciones de laboratorio se puede producir cópula híbrida entre reina *Bombus impatiens* con machos *Bombus ephippiatus*. Un total de 25 reina *Bombus impatiens* fueron expuestas a 40 machos *Bombus ephippiatus* para posible apareamiento dentro de una caja de acrílico durante 38 días. El 8 % (2/25) de las reinas copularon con alguno de los abejorros *Bombus ephippiatus*, pero ninguna de ellas generó descendencia. Una de las reinas copuladas murió a los 3 días postconcepción y la otra anidó, pero abortó en la etapa de pupa. Se concluye que en sí es posible que se presente la cópula entre reinas *Bombus impatiens* y machos *Bombus ephippiatus*, pero sin que esto genere un híbrido.

Palabras claves: cruzamiento de abejorro, etapa de pupa, nativas y desequilibrio ecológico, reinas.

Abstract

The objective of the study was to demonstrate that under laboratory conditions hybrid copula can be given between queen *Bombus impatiens* and males *Bombus ephippiatus*. A total of 25 queen *Bombus impatiens* were exposed to 40 *Bombus ephippiatus* males for possible mating within an acrylic box for 38 days. 8% (2/25) of the queens copulated with one of the bumblebees *Bombus ephippiatus*, but none of them generated offspring. One of the copulated queens died 3 days after conception and the other nested but aborted in the pupa stage. It is concluded that in it is possible that copulation occurs between queens *Bombus impatiens* and males *Bombus ephippiatus*, but without this generating a hybrid.

Keywords: bumblebee cross, pupa stage, native and ecological imbalance, queens.



Resumo

O objetivo do estudo foi demonstrar que em condições de laboratório a cópula híbrida pode ocorrer entre a rainha *Bombus impatiens* com o macho *Bombus ephippiatus*. Um total de 25 *impatiens* Queen *Bombus* foram expostos a 40 machos de *Bombus ephippiatus* para possível acasalamento dentro de uma caixa de acrílico por 38 dias. 8% (2/25) das rainhas copularam com uma das abelhas *Bombus ephippiatus*, mas nenhuma delas gerou descendência. Uma das rainhas copuladas morreu 3 dias após a concepção e a outra aninhada, mas abortou na fase pupal. Conclui-se que é possível que ocorra cópula entre rainhas *Bombus impatiens* e macho *Bombus ephippiatus*, mas sem que isso gere um híbrido.

Palavras-chave: zangão, estágio pupal, desequilíbrio nativo e ecológico, rainhas.

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Introduction

Bombus bees are social insects distributed in different regions of Mexico (Dunnes, Lozier, Hines and Cameron, 2012); In total, 25 species have been differentiated in the country, of which the most common is *Bombus ephippiatus*, although it should be mentioned that there are not many studies on its biology. This species is a viable option for commercial use and to avoid the introduction of non-native bumblebee species that could generate an ecological imbalance if they get out of control (Montemayor-Fuentes and Madrid-Cuevas, 2003).

Bombus ephippiatus is a homogeneous species in its body structure, but it exhibits a striking intraspecific color pattern polymorphism, leading to uncertainty about its genealogical limits (Dunnes et al., 2012). Additionally, it is characterized by the careening head in the temporal zone and central rows in the pronotum that contain between 5 and 8 scores (Márquez, Asiain and Navarrete-Heredia, 2018). These bumblebees are distributed from northern Mexico to western Panama, and are found above 800 m s. n. m. (Ayala and Ortega-Huerta, 2009).

Given these characteristics, they have the potential to be used as pollinators in greenhouses, an activity that has been growing in recent years. Thus, the abundance of this bumblebee could prevent the introduction of non-native bumblebees, such as *Bombus*



impatiens, which is abundantly marketed by transnational companies at quite high prices (Vergara and Fonseca-Buendía, 2012). In addition, even though it has been mentioned that these male bumblebee *Bombus impatiens* mate with female bumblebee *Bombus ephippiatus*, they produce hybrid and infertile offspring, and so far it has not been shown that the cross can occur inversely (Vergara and Fonseca- Buendía, 2012).

The distribution of bumblebees *Bombus impatiens* ranges from North America (Canada and the United States), from Ontario to Maine and southern Florida (Yuya et al., 2009). The introduction of bumblebees could favor the transmission of pathogens and competitiveness for food (Morales, 2007).

Having explained the above, the objective of this study is to demonstrate that there is mating between the bumblebee *Bombus ephippiatus* and *Bombus impatiens* under laboratory conditions.

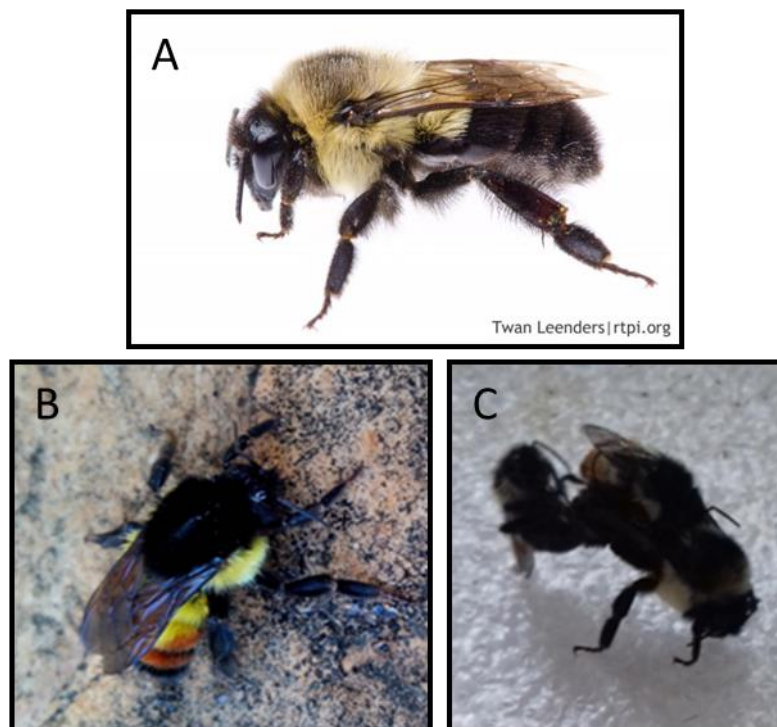
Materials and methods

The study was carried out in the bumblebee laboratory located at the University Center of the South Coast, University of Guadalajara, based in the city of Autlán de Navarro, Jalisco, Mexico (Daniel Cauas, 2015). 25 newborn *Bombus impatiens* queens (Figure 1A) and 40 adult *Bombus ephippiatus* males (Figure 1B) were placed inside an acrylic box (32 x 20 x 27 cm) for a period of 38 days. At the beginning, enough pollen and syrup were put in the box to guarantee their feeding during the study period. In addition, they were constantly monitored by direct observation daily to determine courtship and mounting activity. Courtship was considered when the males chased the queens and managed to position themselves on the back of them, while copulation was considered when it was observed that the female exposed the stinger and the male penetrated her. The measured study variable was percentage of copulated females, and it was analyzed dividing the number of copulated females by the total number of exposed females.

Results

It was observed that only 2 of the 25 queens (8%) copulated (Figure 1C). The first queen copulated on day 2, while the other on day 3 of the experimental period. None of the copulated females produced offspring, as one of them died on the third day postconception without developing a nest, and the other did develop a nest, but aborted in the pupal stage.

Figura 1. Abejorros *Bombus impatiens* (imagen A), *Bombus ephippiatus* (imagen B) y abejorros copulando (imagen C)



Fuente: Figura 1A Naturalista (2014); 1B Lewisboro Field Guide (2018), 1C Ambriz-Trujillo (2017)

Discussion

These results coincide with those reported by Yuya et al. (2009), who did not obtain hybrids when mating bumblebees of the *Bombus hypocrita* and *Bombus ignitus* species. In another study where they made interspecific copulations between terrestrial *Bombus* and some native Japanese species, the production of fertile eggs was obtained as a result (Yuya et al., 2009).

In contrast, Hyung, et al. (2009) found a 70.3% offspring with the mating between *Bombus gynes* and *Bombus terrestris* males. In general, the results of the present study show that there is a possibility that *Bombus impatiens* females can be copulated by *Bombus ephippiatus* males.

However, and although no offspring were generated, attention must be paid to this, since a problem of reduction in the population reproductive rate of the native species (*Bombus ephippiatus*) could be generated by the decrease in intraspecific matings, or even by a greater queen mortality in heterospecific matings (Morales, 2007).

Finally, the fact of the copulated female that aborted is highlighted, which could be due to embryogenesis. This considering that Natsuko et al. (2008) observed aborted embryogenesis in the initial stage of development. Therefore, such mating could disrupt the normal reproduction of native bumblebees.

Conclusions

The results found in this research serve to affirm that copulation between these two species of bumblebees *Bombus impatiens* and *Bombus ephippiatus* was completed, and the result was that of the two queens that copulated, one died on the third day and the second queen did nest development. , but in the pupal stage it aborted, therefore, none of them generated offspring.

This inhibition of offspring in these bumblebees may have as a future consequence the decline of the native species and, therefore, a lack of offspring, which would cause a fragile competition for food and territorial space between individuals, as well as the possible loss of identity. of the species by genetic recombination between the species *Bombus ephippiatus* and *Bombus impatiens*.

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