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POPULATION FLUCTUATION OF *TRIGONA SPINIPES* (FABRICIUS, 1793) IN PEACH TREE AT THE EXPERIMENTAL STATION OF EPAMIG, MARIA DA FÉ, MG

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Abstract: The peach tree is a crop that depends on cross-pollination, with the bee *T. spinipes* being one of the pollinators. While considered a pest in some crops, such as passion fruit, mango, coconut, cashew and guava, this species plays a crucial role as a pollinator in others, such as apple trees, acerola, pumpkin, some citrus cultivars and the peach tree itself. Given the importance and presence of this bee in peach trees, this research was carried out at the EPAMIG Experimental Station, in Maria da Fé, MG, from May 2016 to February 2018, with the aim of investigating population fluctuation and the influence of climatic factors occurrence of this insect. Collections were carried out fortnightly using "Pet" traps containing a Bio Anastrepha® hydrolyzed protein solution and Pantrap traps. During 21 months, a total of 6,721 insects were collected. In 2016, the highest occurrence was recorded in September, with an average population peak of 127.0 insects, coinciding with peach blossom. In 2017, there was a population increase, with peaks of 168.0 and 143.0 insects in July and November, respectively. There was a reduction in the number of insects collected during the months of intense rain, coinciding with the end of flowering of the crop and the beginning of fruit formation. Graphic data revealed that temperature and precipitation exerted influence on bee occurrence, presenting a negative correlation with population density of *T. spinipes*. High rainfall reduced the population peaks from September 2016 to April 2017, and this trend was also confirmed in 2017/2018.
Keywords: Native bee, pollination, population dynamics, agricultural crops, ecological importance.

INTRODUCTION

In Brazil, the agricultural and agribusiness sector plays a key role in the economy, contributing 23.5% of the Gross Domestic Product (GDP) in 2017, according to the Confederation of Agriculture and Livestock of Brazil (CNA) (BOADLE, 2017). This sector has shown significant growth over the years, standing out as one of the main economic bases of the country. Parallel to this increase in productivity, there is a growing concern with the conservation of artificial ecosystems, which has led to the emergence of agroecology. This approach seeks to reconcile the increase in agricultural productivity with the preservation of native forests and the promotion of the presence of pollinating insects in these cultivation areas (FAO/INRA, 2023).

The preservation of local biodiversity in cultivated areas and close to conserved areas plays an important role in reducing climate change and the human impacts associated with these artificial ecosystems, in addition to contributing to the sustainable conservation of vital resources for the survival of insects in agricultural environments. (FAO/INRA, 2023). Many cultivated plants, especially fruit trees, depend on pollination by insects, especially bees (GALLAI et al., 2009; KLEIN et al., 2006). Bees are highly efficient insects due to their specific morphological characteristics and dependence on floral resources, such as nectar, pollen, oils and essences, to reproduce and raise their young (TAUTZ, 2010; WINSTON; OSOWSKI, 2003). The interaction between bees and plants is essential for the success of both species, as insects perform pollination when seeking resources, while plants are pollinated by providing attractive substances in exchange for pollination services (KLEIN et al., 2006; OLIVEIRA, 2020; SIQUEIRA et al., 2009; VASQUES; DE MATOS COSTA; LEITE, 2023).

The benefits of pollination by bees go beyond agricultural production, also contributing to the conservation of native plant

diversity (KEVAN; VIANA, 2003; KLEIN et al., 2006). Even in autogamous crops, such as coffee, the presence of honeybees and native bees can significantly increase production (DE MARCO; COELHO, 2004; RICKETTS et al., 2008). Other autogamous crops, such as rapeseed and soybean, also benefit from bee pollination (BOMMARCO; MARINI; VAISSIÈRE, 2012; DE MARCO; COELHO, 2004).

The peach tree (*Prunus persica L.)* is a fruit that has a significant dependence on pollinators, with about 48% dependent on this service in the crop (GIANNINI et al., 2015). Pollination is essential for fertilization and subsequent fruit and seed formation, usually occurring within 24 to 48 hours after pollination (RASEIRA et al., 2011). This plant requires adaptation to temperate subtropical climatic conditions, with lower temperatures, and its harvest occurs between the months of August and February, about 80 to 180 days after complete flowering (BARBOSA et al., 2010).

The irapuá bees (*Trigona spinipes*) belonging to the Meliponidae family, have generally smaller populations compared to the Africanized bee *Apis mellifera*. However, these bees have a wide distribution in the Neotropics and can form colonies with up to 180,000 individuals (RIBEIRO; RODRIGUES; FERNANDES, 2009). Although they are considered pests in some crops, such as blueberry, passion fruit, mango, coconut, cashew, guava, banana, melon, watermelon and sugar apple, due to the damage caused to plant tissues during the construction of their nests, in other crops, such as squash , eggplant, pomegranate, acerola, rapeseed, pepper, orange and tangerine, these bees are mentioned as pollinators due to their methodical frequency and ease of handling (RIBEIRO; RODRIGUES; FERNANDES, 2009; SILVA et al., 1997; SILVEIRA et al. , 2010).

This study was carried out in the region of Maria da Fé, MG, from May 2016 to February 2018, with the objective of analyzing the population fluctuation of irapuá bees (*T. spinipes*) and investigating the influence of climatic factors on the occurrence of these bees in peach orchards.

MATERIAL AND METHODS

This study was conducted at the EPAMIG Experimental Station, located in Maria da Fé, MG, in the Serra da Mantiqueira region. The geographical coordinates of the region are latitude 22°18'46" S and longitude 45°23'5" W, with an average altitude of 1,276 meters. The area has a subtropical altitude climate, characterized by dry winters and mild summers, classified as mesothermal Köppen Cwb. The average annual temperature is 17 °C and the average annual precipitation is 1,738 mm (OLIVEIRA et al., 2014).

The data collection period occurred from May 2016 to February 2018, with biweekly collections. To capture the bees, three "Pet traps (2L)" with 3 holes (2 cm x 1 cm) 18 cm from the base of the bottle were used. These traps were filled with 500 mL of Bio Anastrepha® hydrolyzed protein solution, diluted in water at 5% v/v. The traps were placed at a height of 1.50 m from the ground, in the peach tree region. In addition, Pantrap-type traps were installed at just four points, with a set of three yellow Pantraps at each point. Each Pantrap had a diameter of 20.0 cm at the top, 10.0 cm at the bottom and a height of 4 cm, placed 2 m apart and suspended from bamboo poles at a height of approximately 50 cm from the ground. Each Pantrap trap was filled with saline solution (10% NaCl) and neutral detergent.

After collection, the specimens were labeled and stored in bottles containing 70% alcohol. Subsequently, they were sent to the

Bee Laboratory of the ``Universidade Federal de Lavras`` for assembly and identification (SILVEIRA; MELO; ALMEIDA, 2002).

The population fluctuation of *T. spinipes* was analyzed using the R Studio software (RSTUDIO TEAM, 2016). The number of individuals collected over time were related to the average temperature (°C) and rainfall (mm). Temperature and precipitation data were recorded on the day of collection and obtained from the automatic meteorological station located at the EPAMIG experimental unit.

RESULTS AND DISCUSSION

During the evaluation period, a total of 6,721 specimens of *T. spinipes* were collected in the traps, demonstrating a consistent presence of this species throughout the study (JEAVONS; LE LANN; VAN BAAREN, 2023; OLIVEIRA, 2020). Insects were observed in all months of collection, indicating that they are present throughout the year in the studied environment.

In 2016, the highest occurrence of this species ($\overline{x}$ = 127.0) was recorded in September, coinciding with the flowering period of the peach tree. In the following year, in 2017, there was a population increase from June, and two more expressive population peaks ($\overline{x}$= 168.0; 143.0) were observed in July and October, respectively, with a sharp reduction from November (Figure 1) (Johnson et al., 2018).

Data analysis revealed a significant correlation between the abundance of *T. spinipes* and the flowering period of the peach tree, indicating that favorable climatic factors may have contributed to the permanence of these insects in the field (BEZERRA, 2018; OLIVEIRA et al., 2020). During the flowering phase, when resources such as pollen and nectar are available, the species presented a higher frequency of occurrence (RASEIRA et al., 2011).

This trend is in line with previous studies carried out by (MOTA; NOGUEIRA-COUTO, 2002), who also observed an increase in visits by *T. spinipes* during peach flowering. Preference for floral resources in the morning was observed, with a collection peak around 1 pm, and a reduction in activity in the afternoon. In addition, no visits to flowers were observed after 6 pm, indicating a pattern of diurnal activity for this species (VILANOVA, 2011).

These results highlight the importance of synchronization between peach flowering and the presence of *T. spinipes* as a pollinator. The occurrence of these bees during the flowering phase can contribute significantly to the efficient pollination of flowers, thus increasing the potential for producing quality fruits (GIANNINI et al., 2020; IMPERATRIZ-FONSECA; NUNES-SILVA, 2010; OLIVEIRA et al, 2020).

Studies carried out by (KHALIFA et al., 2021) in different fruit crops also reported an increase in pollination activity by bees during flowering, evidencing the relevance of the presence of *T. spinipes* as a pollinator in agricultural systems.

In addition to flowering, the influence of climatic factors, such as precipitation and temperature, is also shown in Figure 1, where it is possible to observe the fluctuation of *T. spinipes* abundance in relation to these variables (KLEIN et al., 2006). This relationship between climatic factors and the presence of pollinators has been widely studied in the literature (BOMMARCO; MARINI; VAISSIÈRE, 2012; D'AVILA; MARCHINI, 2005; FREITAS; NUNES-SILVA, 2012; GALLAI et al., 2009; MOTA; NOGUEIRA-COUTO, 2002; RIBEIRO; RODRIGUES; FERNANDES, 2009; RICKETTS et al., 2008; SOUZA; EVANGELISTA-RODRIGUES; DE CALDAS PINTO, 2007). For example,

(BEZERRA, 2018) observed a preference for floral resources in the morning in bees of the genus Xylocopa in an Atlantic Forest fragment, highlighting the importance of considering not only flowering, but also climatic conditions when studying pollinator population dynamics.

The relevance of the presence of bees in the pollination of agricultural crops has been highlighted in several studies (COSTA-MAIA; LOURENÇO; TOLEDO, 2010; D'AVILA; MARCHINI, 2005; FREITAS; IMPERATRIZ-FONSECA, 2005; GAGLIANONE et al., 2010; IMPERATRIZ-FONSECA; NUNES-SILVA, 2010; ROCHA, 2022; SOUZA; EVANGELISTA-RODRIGUES; DE CALDAS PINTO, 2007). However, some specific studies have observed contradictory results regarding the contribution of bees of the genus Trigona, such as *T. spinipes*, to fruit production in certain crops.

For example, the study carried out by (BOIÇA JR; SANTOS; PASSILONGO, 2004) investigated the population fluctuation of T. spinipes bees in seven varieties of passion fruit and found that the presence of these insects resulted in a significant decrease in the number of fruits produced. Similar results were observed in the planting of dragon fruit (*Hylocereus undatus* and *Hylocereus polyrhizus*) (ALVES et al., 2018). These studies suggest that the role of T. spinipes in pollination may vary according to the specific crop and its interactions with other species.

Despite these contradictory observations, it is important to emphasize that several studies reinforce the importance of conservation and promotion of pollinators, including *T. spinipes*, for the productivity and sustainability of agricultural systems (COSTA-MAIA; LOURENÇO; TOLEDO, 2010; D'AVILA; MARCHINI, 2005; GIANNINI et al., 2020; IMPERATRIZ-FONSECA; NUNES-SILVA, 2010; OLIVEIRA et al., 2020; VASQUES; DE MATOS COSTA; LEITE, 2023). Pollination carried out by bees plays a fundamental role in the reproduction of many cultivated plants, contributing to the increase in the production of quality fruits and seeds.

In this study, a positive correlation was observed between the abundance of *T. spinipes* and the peach flowering period (Figure 2). This synchronization between flowering and the presence of pollinators is essential to ensure efficient pollination, resulting in an increased potential for producing quality fruit. This information is relevant to understanding the population dynamics of this species and its importance as a pollinator in peach orchards (FREITAS; IMPERATRIZ-FONSECA, 2005; FREITAS; NUNES-SILVA, 2012). And these results are in line with other studies that report an increase in pollination activity by bees during the flowering of several agricultural crops (GIANNINI et al., 2015; KLEIN et al., 2006; RICKETTS et al., 2008; SOUZA; EVANGELISTA -RODRIGUES; DE CALDAS PINTO, 2007).

It is important to emphasize that the presence of bees in the pollination of agricultural crops must not be analyzed in isolation. It is necessary to consider the complex interaction between pollinators, plants and environmental factors such as the availability of floral resources and climatic conditions. Additional studies are needed to deepen our knowledge of these interactions and to better understand the specific effects of *T. spinipes* and other bee species on fruit production in different crops.

In summary, although some studies present contradictory results regarding the contribution of bees of the genus Trigona, such as T. spinipes, to fruit production in certain crops, most studies emphasize the importance of conservation and promotion of pollinators for productivity and sustainability of agricultural systems. In this study, the

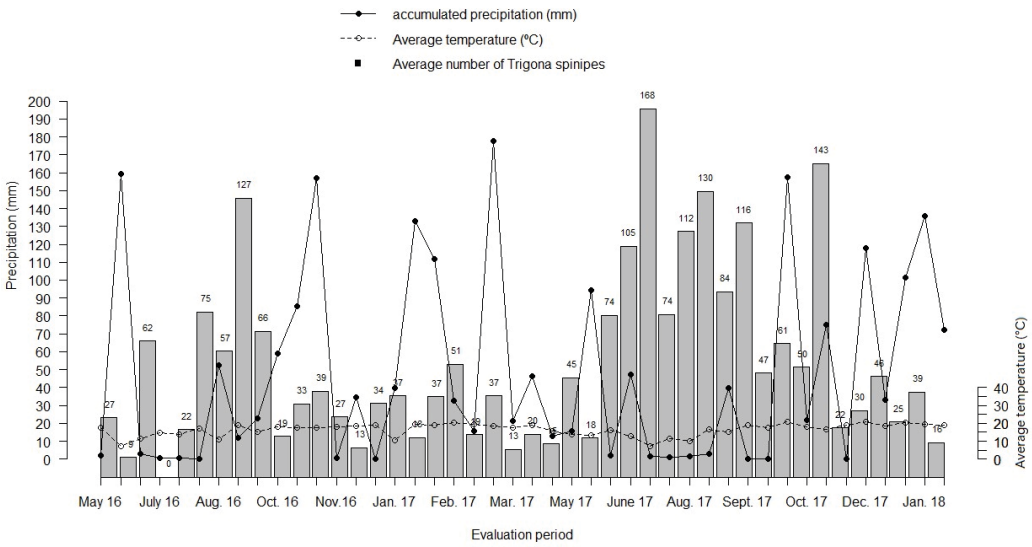

Figure 1: Variation of *T. spinipes* abundance, minimum and maximum temperature, and precipitation over the study period.

Figure 2: Resource collection activity by *T. spinipes* bees (a), (b), (c), (d) on peach blossoms at the EPAMIG Experimental Station, located in Maria da Fé, MG.

synchronization between peach flowering and the presence of *T. spinipes* as a pollinator was observed, highlighting its relevance in obtaining quality fruits. However, more research is needed to understand the complex interactions between pollinators, plants and environmental factors in order to develop effective management strategies for pollinator conservation and agricultural enhancement.

CONCLUSIONS

Based on the results obtained in this study, we can conclude that the presence of *T. spinipes*, a species of solitary bee, is directly related to the flowering period of the peach tree and favorable climatic conditions. During flowering, when resources such as pollen and nectar are available, there was a significant increase in the frequency of occurrence of these insects.

The synchronization between peach flowering and the presence of *T. spinipes* as a pollinator is extremely important, as this species can contribute significantly to the efficient pollination of flowers, resulting in a greater potential for the production of quality fruits.

The results of this study corroborate previous research that also highlighted increased pollination activity by bees during flowering in different agricultural crops. Furthermore, the influence of climatic factors, such as precipitation and temperature, on the abundance of *T. spinipes* was also evidenced.

This relationship between climatic factors and the presence of pollinators has been widely studied, emphasizing the importance of considering not only flowering, but also environmental conditions when analyzing the population dynamics of these insects.

The presence of bees, including *T. spinipes*, in the pollination of agricultural crops has been recognized as a crucial factor for the productivity and sustainability of agricultural systems. Additional studies, such as that by Santos et al. (2019), highlight the significant role of honey bees in the pollination of specific crops, such as yellow passion fruit, resulting in a significant increase in the number of fruits produced.

Therefore, understanding the population dynamics of *T. spinipes* and the factors that influence its occurrence, such as synchronization with flowering and climatic conditions, is essential to implement adequate management strategies aimed at conserving and promoting pollination in peach and other agroecosystems.

In short, this study provides relevant information on the abundance and behavior of *T. spinipes* as a pollinator in peach orchards, highlighting its importance for the production of quality fruit.

These results can contribute to decision-making in sustainable agricultural practices, helping to conserve and promote pollinators and to maximize orchard productivity.

However, more research is needed to deepen our understanding of the interaction between *T. spinipes*, plant flowering and climatic factors, in order to develop even more effective strategies for pollinator conservation and agricultural improvement.

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