TD 02: Short scientific article study

The Role of Bees in Pollination and Crop Productivity

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Pollination is a critical ecosystem service that directly affects biodiversity, food security, and global agriculture. Among animal pollinators, bees are considered the most efficient due to their specialized body structures and foraging behaviors **(Klein et *al.*, 2007)**. It is estimated that about 75% of the world's leading crops benefit from animal pollination, either through increased yield, quality, or both **(Garibaldi et *al.*, 2013)**. Tomatoes (*Solanum lycopersicum*) are partially self-pollinating, but bee visitation has been shown to increase fruit set and improve fruit quality through buzz pollination, which enhances pollen release. Despite their importance, bee populations are in decline worldwide due to habitat fragmentation, pesticide use, pathogens, and climate change (Potts et al., 2010). Understanding the measurable impact of bees on crop productivity is crucial to highlight their role in sustainable agriculture. The aim of this study was to assess the effect of bee pollination on fruit set and quality of tomato plants grown under Mediterranean conditions.

The study was carried out in June 2024 on a small-scale organic farm located 20 km outside Madrid, Spain. Fifty tomato plants of the same variety were randomly assigned into two treatments: An Open-pollinated group of flowers were left exposed to natural bee visitation. And an Exclusion group of flowers were covered with fine mesh bags to prevent any insect visitation while still allowing air circulation and self-pollination. A total of 100 flowers (50 per group) were marked at the start of the experiment. Observations were conducted daily to confirm bee activity in the open-pollinated group. After three weeks, the proportion of flowers that developed into fruits (fruit set) was recorded. Additionally, harvested fruits were weighed using a digital scale, and seed counts were performed to evaluate quality differences. Statistical comparisons between groups were made using chi-square tests for fruit set and t-tests for fruit weight and seed number, with significance accepted at $p < 0.05$.

The results revealed substantial differences between the two treatments. In the open-pollinated group, 41 out of 50 flowers (82%) developed into fruits, while in the exclusion group, only 17 out of 50 flowers (34%) formed fruits. The chi-square test confirmed that this difference was highly significant ($p < 0.001$). Fruit quality parameters also showed marked improvements in bee-visited flowers. Average fruit weight was 120 g ± 8.5 in the open-pollinated group compared to 96 g ± 7.2 in the exclusion group (t-test, $p < 0.01$). Similarly, seed counts were higher in bee-pollinated fruits, with an average of 64 seeds per fruit, compared to 54 seeds per fruit in the exclusion group ($p < 0.05$). Furthermore, bee-pollinated tomatoes exhibited more uniform shape and fewer deformities, whereas bagged fruits were often irregular and smaller.

This study demonstrates that bees play a crucial role in enhancing both the quantity and quality of tomato production. The significantly higher fruit set observed in the open-pollinated group confirms that bee visitation greatly increases reproductive success compared to self-pollination alone. The increase in fruit weight and seed number suggests that bee-mediated pollination leads to more complete fertilization, which improves fruit development. These findings are consistent with previous research showing that bee pollination boosts yield in tomatoes and other partially self-pollinating crops

(Garibaldi et *al.*, 2011; Klein et *al.*, 2007). The results also support global evidence that pollination by bees contributes not only to agricultural productivity but also to food quality, which has direct economic implications for farmers and markets. However, the ongoing decline of pollinator populations poses a serious risk to crop yields worldwide (Potts et al., 2010). Strategies such as reducing pesticide use, conserving floral habitats, and promoting biodiversity-friendly farming practices are therefore critical to safeguard pollination services. Future research should expand this study to field-scale experiments, evaluate the contribution of wild pollinators versus managed honeybees, and assess long-term impacts on agricultural sustainability.

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Exercise 01:

1) Text analysis questions :

1- Divide the different parts of the text into the principal article sections.

2- Answer the comprehension questions bellow.

3- Analyze the different parts of the article using the table questions for analyzing articles.

4- Indicate the position of the plagiarism and its type.

2) Text comprehension questions :

1. According to the article, what percentage of global crops rely on animal pollinators for improved yield and quality?
2. What was the main objective of the experiment conducted?
3. How were the tomato flowers divided into groups for the experiment?
4. What was the fruit set percentage in the open-pollinated group compared to the exclusion group?
5. How did the average weight of bee-pollinated tomatoes differ from that of bagged tomatoes?
6. Besides fruit quantity, what other quality traits improved in bee-pollinated tomatoes?
7. What global issues are contributing to the decline of bee populations, according to the article?
8. What conservation measures are suggested to protect bee pollination services and ensure long-term food security