Diversity and Pollination Efficiency of Non-Apis Bees in Horticultural Crops at TNAU, Coimbatore

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ABSTRACT

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| Non-Apis bees play a crucial role in the pollination of horticultural crops, significantly enhancing biodiversity and agricultural productivity. This study, conducted at Tamil Nadu Agricultural University (TNAU), Coimbatore, aimed to assess the diversity and pollination efficiency of non-Apis bees across various horticultural crops. Observations were recorded through visual scanning and sweep net collection methods. A total of eight species were documented, including carpenter bees (*Xylocopa fenestrata*, *Xylocopa pubescens*), dammer bees (*Tetragonula iridipennis*), blue-banded bees (*Amegilla zonata*, *Amegilla spp.*), sweat bees (*Halictus spp.*), and alkali bees (*Hoplonomia ellioti*). These species exhibited distinct foraging behaviors that contributed to pollination success. Findings highlight the importance of conserving native pollinators to ensure sustainable crop yields. Strategies such as habitat preservation and reduced pesticide use can support non-Apis bee populations. The study underscores the need for integrating these pollinators into agricultural practices to enhance productivity and ecological balance. |

*Keywords: Non Apis- bees, pollination, horticulture crop, biodiversity, conservation.*

1. INTRODUCTION

The role of non-Apis bee species in the pollination of horticultural crops has garnered increasing attention due to their significant contributions to agricultural productivity and biodiversity (**Garibaldi et al., 2013**). While the Western honeybee (*Apis mellifera*) has traditionally been the primary managed pollinator, reliance solely on this species overlooks the diverse and efficient pollination services provided by non-Apis bees, including bumblebees, solitary bees, and other native pollinators (**Winfree et al., 2008**).

Non-Apis bees exhibit unique foraging behaviors and morphological traits that enhance their effectiveness as pollinators. For instance, bumblebees are capable of buzz pollination—a technique where they vibrate flowers to release pollen—which is essential for crops like tomatoes and blueberries that are less effectively pollinated by honeybees (**Rader et al., 2016**). Solitary bees, such as the blue orchard bee (*Osmia lignaria*), demonstrate floral constancy, often visiting flowers of the same species consecutively, thereby increasing the likelihood of effective pollen transfer. This specificity can result in higher fruit set and improved crop yields (**Mallinger & Gratton, 2015**).

The decline in honeybee populations due to factors like diseases, pesticides, and habitat loss has raised concerns about the resilience of pollination services (**Klein et al., 2007**). In this context, non-Apis bees serve as vital insurance against pollinator shortages. Their presence can stabilize pollination services, ensuring consistent crop production even when honeybee populations are compromised (**Garibaldi et al., 2013**).

Moreover, non-Apis bees often have different foraging periods and environmental preferences compared to honeybees. This temporal and spatial complementarity means that a diverse pollinator community can provide more comprehensive pollination coverage throughout the growing season and across various habitats (**Winfree et al., 2008**). For example, certain solitary bees are active during cooler temperatures and earlier in the day, pollinating crops that bloom under these conditions when honeybees are less active (**Rader et al., 2016**).

Recognizing the importance of non-Apis bees in horticultural systems necessitates the implementation of conservation and management strategies to support their populations. Practices such as preserving natural habitats, planting wildflower strips, reducing pesticide usage, and providing nesting resources can enhance the abundance and diversity of these pollinators (**Mallinger & Gratton, 2015**). Integrating non-Apis bees into pollination management not only bolsters crop yields but also promotes ecological sustainability by maintaining biodiversity within agricultural landscapes (**Klein et al., 2007**).

In conclusion, non-Apis bee species play a crucial role in the pollination of horticultural crops. Their unique behaviors, resilience to environmental changes, and complementary foraging patterns make them indispensable allies in agriculture. Fostering their populations through targeted conservation efforts is essential for sustainable crop production and the preservation of ecological balance (**Garibaldi et al., 2013**).

2. material and methods

***Study location***

The present study was undertaken during June to August, 2024 at TNAU Orchard and Botanical Garden and observations were made throughout the study period. TNAU is situated in the latitude of 11.0122°N and longitude of 76.9354°E. Orchard at TNAU is a place where a wide variety of fruits and vegetable crops were grown. Botanical garden harbors a wide variety of ornamental and medicinal plants. These places are a hub for various pollinators where non-Apis bee species can be documented at ease.

***Recording of observations (Visual scanning)***

The non-Apis bees visiting different horticultural crops were recorded from 6:30 to 8.00 AM in the morning and during the evening hour from 4.00 to 5.30 PM according to the weather conditions. The bees in the flowers were photographed using Nikon D5600 camera and the closer view of pollinators were taken in the laboratory using optical microscope were also taken on the movement of native bees.

***Sweep net collection of non-Apis bees***

Following a thorough documentation of the flower's characteristics and the pollinator's visit, pollinators were gathered for additional identification, and the specimens were collected from the fields using sweep nets. Following their collection with a sweep net, the specimens were transferred to poison bottle.

***Killing, pinning and processing of specimens***

During the survey time, a killing jar containing chloroform was employed, and the bottle was recharged as needed. Following their capture and killing, the bees were pinned through the thorax and all of their body parts including their legs, antennae, and wings were appropriately stretched. These taxonomically significant features enable rapid and simple identification. The bees were adequately dried to eliminate any moisture that would have obscured in their body hairs and other distinguishing characteristics that are crucial to their taxonomy. The bees' hairs stiffened and stood up as a result of this procedure, making identification simpler. Every specimen was labelled with their common name, scientific name, family and order. Every specimen was housed in a unique insect box equipped with naphthalene balls to enable long storage to get rid off pest damage and foam plates for pinning.

3. results and discussion

The non-Apis bee pollinators were assessed in different horticultural crops during peak flowering density and the pollinators of the particular crops were collected through sweep net catches, photographed, dried and preserved for pollinator identification and display. In total 8 species of non-Apis bees were documented in 26 different horticultural crops. 2 species of carpenter bee (*Xylocopa fenestrate* *F*. and *Xylocopa pubescens L*.) were documented. *Xylocopa fenestrate F.* was found in crops like brinjal, vegetable cowpea, Bhendi and Thuthuvelai whereas *Xylocopa pubescens L.* was found in sponge gourd and Turkey berry. Dammer bee (*Tetragonula iridipennis* Smith) played a major role in pollination in almost all type of horticultural crops including ornamental and medicinal plants. Incase of vegetable crops, it was found in sponge gourd and ivy gourd. Fruit crops like dragon fruit and banana were pollinated by dammer bee. Flower crops like yellow bell, marigold, pinwheel jasmine, firebrush, pink racenia plant, thunbergia, rose and jasmine were visited by dammer bee. Indian shot and periwinkle were some of the medicinal plants pollinated by them. A few species of blue banded bees (*Amegilla zonata* and *Amegilla* spp.) were documented in the study location. *Amegilla* spp. was found in vegetable cowpea, sponge gourd and turnera whereas *Amegilla zonata* was found in brinjal. *Halictus* spp., a species of sweat bee was identified in sponge gourd and cockscomb. Alkali bee (*Hoplonomia ellioti*) was identified in Brinjal. Other hymenopterans like yellow banded wasp was also found in brinjal.

Table 1 : List of bee pollinators

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| **Common name** | **Family** | **Sub family** | **Tribe** | **Genus** | **Sub genus** | **Species** | **Reference** |
| Blue banded bee | Apidae | Anthophorinae | Anthophorini | *Amegilla* | Zonamegilla | *zonata* | Sandeep and Muthuramn(2018) |
| Blue banded bee | Apidae | Anthophorinae | Anthophorini | *Amegilla* | Zonamegilla | spp. | Sandeep and Muthuramn(2018) |
| Sweat bee | Halictidae | Halictinae | Augichlorini | *Halictus* |  | spp. | Richards (2000) |
| White banded bee | Halictidae | Nomiinae | Anthophorini | *Nomia* | Hoplonomia | *ellioti* | Carril etal. (2023) |
| White banded bee | Halictidae | Nomiinae | Anthophorini | *Nomia* | Hoplonomia | *westwoodi* | Carril etal. (2023) |
| Carpenter bee | Xylocopidae | Xylocopinae | Xylocopini | *Xylocopa* |  | *pubescence* | Farook et al.(2022) |
| Carpenter bee | Xylocopidae | Xylocopinae | Xylocopini | *Xylocopa* |  | *fenestrata* | Farook et al.(2022) |
| Dammer bee | Apidae | Meliponinae | Trigonini | *Trigona* | Tetragonula | *iridipennis* | Sharma et al.(2023) |

**4. DISCUSSION**

The study demonstrates the critical role of non-Apis bees in enhancing pollination efficiency across diverse horticultural crops. The presence of species like carpenter bees, dammer bees, and blue-banded bees indicates their adaptability to various floral structures, ensuring effective pollen transfer. Their foraging patterns, including early morning and late evening activity, complement traditional pollinators, promoting stable pollination services. The findings reinforce the need for conservation strategies such as habitat protection and minimizing pesticide exposure. Supporting these pollinators can significantly enhance crop productivity, highlighting their ecological and agricultural importance in sustainable farming systems.

5. Conclusion

This study highlights the significant role of non-Apis bees in the pollination of horticultural crops at TNAU, Coimbatore. The diversity and foraging behaviors of species such as carpenter bees, dammer bees, blue-banded bees, sweat bees, and alkali bees contribute to enhanced pollination efficiency and crop productivity. Their presence ensures stable pollination services, especially amidst declining honeybee populations. Conservation measures, including habitat preservation and reduced pesticide use, are essential to sustain these pollinators. Integrating non-Apis bees into agricultural practices can improve crop yields and biodiversity, reinforcing their importance in sustainable horticultural systems.

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