Potential bee pollinators on the Cedar Crest College campus in Allentown, PA

Abstract

Bees and flowering plants have a mutualistic relationship; bees collect nectar and pollen from flowers and contribute to the spread of pollen, which eventually helps the plants to reproduce. However, bees often collect pollen to feed their larvae. Thus, depending upon where on the bee's body the pollen is collected, it may or may not be distributed to another flower, it may, instead, be groomed off and fed to young. In the fall of 2019 and fall of 2020 we collected bees visiting flowering plants that were in a garden on the Cedar Crest College campus. We collected samples of pollen from three body parts of each bee (abdomen, leg, head) in 2019 and (head, abdomen and the entire body) in 2020. We also collected the pollen from flowering plants to identify which species of pollen the bees had on their bodies. Bees could be divided into four major groups: honey bees (Apis mellifera), bumble bees (Bombus spp.), carpenter bees (Xylocopa virginica) and native sweat bees (several different species of Halictidae). Most of the pollen on their bodies was from flowers open in the garden at the time of the study. Information from this study can be used to determine which bees may be the most effective pollinators for plant species in our campus gardens.

Methods

- Duration of Study: Fall 2019, Spring 2020, Fall 2020
- Study site: Cedar Crest College garden campus in Allentown, Pennsylvania
- Each individual bee was captured with a sweep net or with an aspirator and a plastic vial. Each collected bee was placed into a plastic vial to keep them alive in a cooler on ice to chill
- The bees were placed on their backs while a 2mm x 2mm x 2mm fuschin gel cube was used to collect pollen
- The cube was dabbed three times on each different body part (either on the abdomen, leg, or the head) of the bees
- We recorded the date, time, weather conditions, and bee species identifications in a notebook
- We used different cubes to collect pollen directly from flowers that were blooming at the time of bee collection
- In the lab the fuschin gel cubes were melted using a hotplate to make them into microscope slides
- For the pollen collected from the open flowers, photos were taken of these pollen grains on the Olympus BH2 microscope using the Spot Camera software to help identify the pollen grains found on the bees
- A Kruskal Wallis (SPSS IBM 26) tests were done to compare the number of pollen grains found on each body part (head, abdomen or leg) or the total amount of pollen on the bee's body (summing the pollen collection from three body parts) among the different bee groups
- Though not analyzed statistically, the amount of pollen collected from each plant species for each bee group was also graphed



Figure 1. Bumble bee (Bombus sp.) on daisy flower (Leucanthemum sp.) (left) and pollen grains collected from daisey flower 400x (right). Image by Razan Alanazi

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Figure 4. Mean number of pollen grains collected from the leg compared among the four bee groups. The mean (± SE) amount of pollen grains for each group of bees sampled are shown. There were not significant differences among the four bee groups (p < 0.018).



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Research Questions

• What part of the bee body had the greatest number of pollen grains? • What plant species pollen were different bee species carrying? Which bee species had the potential to be the best pollinator based upon amount and diversity of pollen carried?



Figure 2. Mean number of pollen grains collected from the head compared among the four bee groups. The mean $(\pm SE)$ amount of pollen grains for each group of bees sampled are shown. There were not significant differences among the four bee groups (p = 0.058).







Figure 5. Mean number of pollen grains collected from the sum of all body parts (in 2019: head, abdomen, rest of body) but (in 2020: head, abdomen, leg) compared among three bee groups. The mean $(\pm SE)$ amount of pollen grains for each group of bees sampled are shown. There were not significant differences among the three bee groups (p=0.08).

Figure 6. Shows the sum of individual bee's body parts(Bumble/Native/Honey) in flowers vs. mean number of pollen grains. The mean (± SE) amount of pollen grains for each group of bees sampled are shown.

Figure 3. Mean number of pollen grains collected from the abdomen compared among the four bee groups. The mean (± SE) amount of pollen grains for each group of bees sampled are shown. There were not significant differences among the four bee groups (p = 0.022).

Results & Discussion

- pollen grains?
- highest amount of pollen.
- carrying?
- species after the daisy.
- pollinator?
- pollinate more than honey bees per minute.





Figure 7. Honey bees (left), bumble bee (center), a native bee (right). Image credit: A. Faivre

Literature Cited

Tong, Z., & Huang, S. (2018). Safe sites of pollen placement: A conflict of interest between plants and bees? Oecologia, 186(1), 163-171. doi:10.1007/s00442-017-3999-9 Wahengbam, Johnson & Raut, Ankush & Pal, Satinder & Banu, Najitha. (2019). Role of Bumble Bee in Pollination. Annals of biology. 35. 290-295.

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• What part of the bee body had the greatest number of

• Our data indicated that both the leg and abdomen had much higher amounts of pollen for most species compared with the head. Both the bumble bees and honey bees are species that have "pollen baskets" or corbiculae (see honey bee in the center of the dish in Figure 7, and the bumble bee in Figure 7). Thus, even though the legs are fairly small in area compared with the abdomen, the corbiculae hold quite a bit of pollen. Many bees struggle to reach and groom some parts of their body (e.g., thorax and abdomen) (Tong and Huang 2018), so we might expect some of these areas to have the

• What plant species pollen were different bee species

• All bee groups show a high amount of daisy pollen in the samples (Figure 6). Earlier in the season bumble bees and native bees carried quite a bit of aster pollen, whereas honey bees carried Russian sage pollen as their second highest

• What bee species had the potential to be the best

• In our study the bumble bee always carried the most pollen grains of all bee groups. For the abdomen and leg they were significantly different from the other bee groups, but there were no significant differences among the sum of body parts sampled of the three bee groups (p=0.08). Bumble bees have a large, hairy surface area allowing them to collect a number of pollen grains (Wahengbam et al. 2019).

• Bumble bee species also carry a diversity of pollen plant grains. Wahengbam et al. (2019) stated that bumble bee species are widespread in temperate areas and visit plants to