

# Tackling Food Insecurity by Redesigning Food Production and Distribution in Upstate New York

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## Food Insecurity in Geneva, NY

• Food insecurity occurs when a group of people do not have access to either the calories or nutrients they need to sustain a healthy diet. In this geographical area, people cannot access the food they need due to it either not existing or being inaccessible (Dasgupta et al, 2022). These areas are referred to as food deserts.

• Food insecurity is a global issue that becomes more pressing every day and it is driven by climate change. Due to changing temperatures and weather patterns, some areas are facing water stress, desertification, and soil degradation, meaning less areas in the world can grow food sustainably (Ahn et al, 2020).

• Geneva, New York is a food desert. 1 in 5 people are living below the poverty level and 1 in 10 households do not have a car (Kaenzig et al, 2023). Considering the lack of public transportation in Geneva and the limited grocery stores, this causes problems for many people in the city.

• One cause of food insecurity is the lack of food supply. Finding ways to supply an area with fruits and vegetables is a key to aiding food deserts. Pollination is one way that food production can be maximized.

## Experimenting with Food Production through Pollinator Usage

- Pollination is essential to a plant's ability to grow fruits and reproduce. Animal pollination, as opposed to wind pollination, is when animals (invertebrates, hummingbirds, and bats) transfer pollen from a male flower to a female flower. Different pollinators work better with certain crops.
- Honey bees are often used as a pollinator for commercial production of vegetable crops. Honey bees are expensive and require extensive labor from workers. Is there an effective pollinator that uses less resources?
- In our experiment, 3 different Cucurbita (winter squash) accessions were chosen to test the efficiency of 3 different pollinators. The 3 pollinator treatments were **honey bees, bumblebees, and flies**. The goal of this experiment is to discover which pollinator is the most effective at producing fruits.
- The seeds for this experiment were sown in a greenhouse. Once they were ready to be transplanted, plants were moved into the field where they were separated into pollination cages (figure 1). Each accession had a tent with bumblebees, one with honey bees, one with flies, one with hand pollinated plants, and one with plants that received no insect or hand pollination (figure 2).
- For data collection, the amount of male and female flowers (figure 3), a total fruit count, fruit weight, fruit size (length, width, area), total seed count, seed size, seed weight, and germination rates were all collected.



Figure 1. The netted tents used to grow each accession with its designated pollinator while keeping other pollinators away from the plants.



Figure 2. A portable beehive used during the pollination trial.

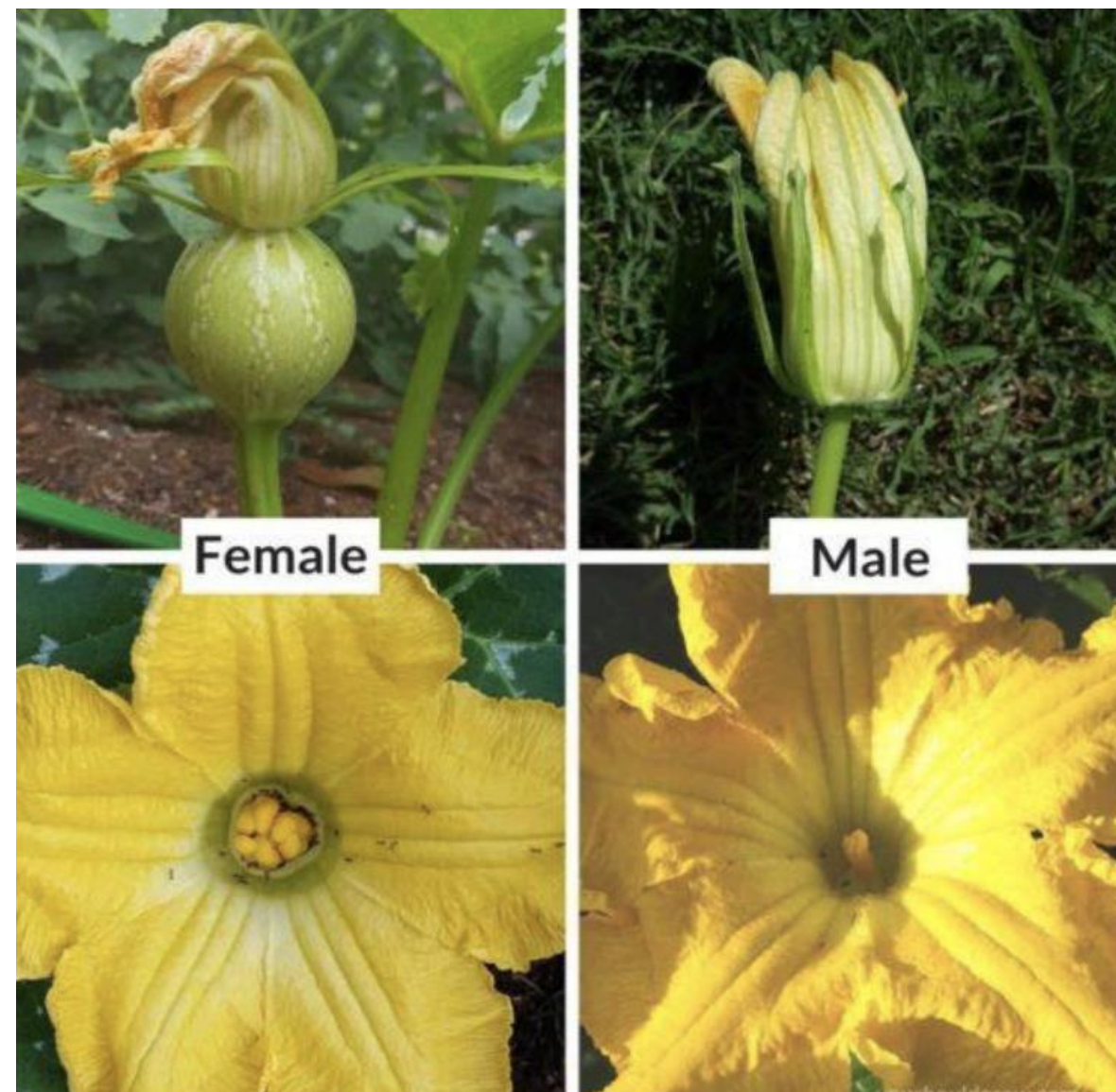


Figure 3. The difference between male and female Cucurbita flowers.

## Pollinator Results

- Fruits grew from all the pollinator treatments (bumblebees, honeybees, flies, and hand pollination). No fruits grew on the plants that received no pollination treatment.
- Pollinator treatment, so which insect pollinated the fruits, caused a significant difference ( $P < 0.05$ ) in the number of fruit produced ( $P = 0.01734$ ), but accession did not cause a significant difference ( $P = 0.4555$ ), meaning that the type of squash did not cause a difference in how much fruit was produced. Honey bees produced the most fruit (figure 4).
  - Treatment also impacted how much the average fruit weighed ( $P = 0.002316$ ). Flies produced the smallest fruits (grams) (Figure 5).
- Flies produced the lowest number of seeds per fruit, in comparison to bumblebees, honey bees, and hand pollinated fruits (Figure 6). Additionally, the total weight of the seeds produced by flies was the lowest compared to the other pollinator treatments (Figure 7).

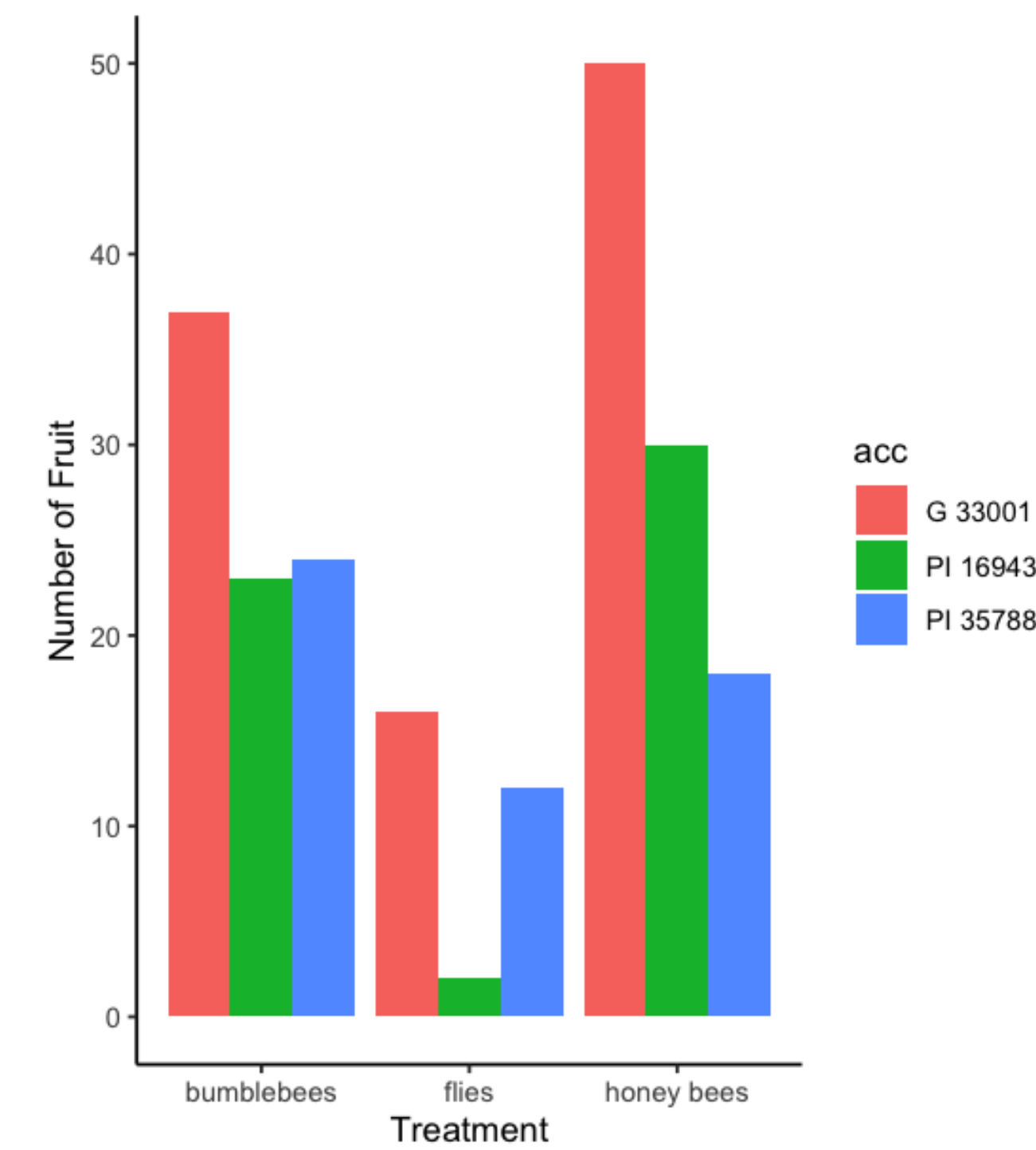


Figure 4. The number of fruit found in each plot, combined by accession and organized by pollinator treatment. Hand pollinated fruits were excluded from this graph because there was a controlled amount of hand pollinated fruits.

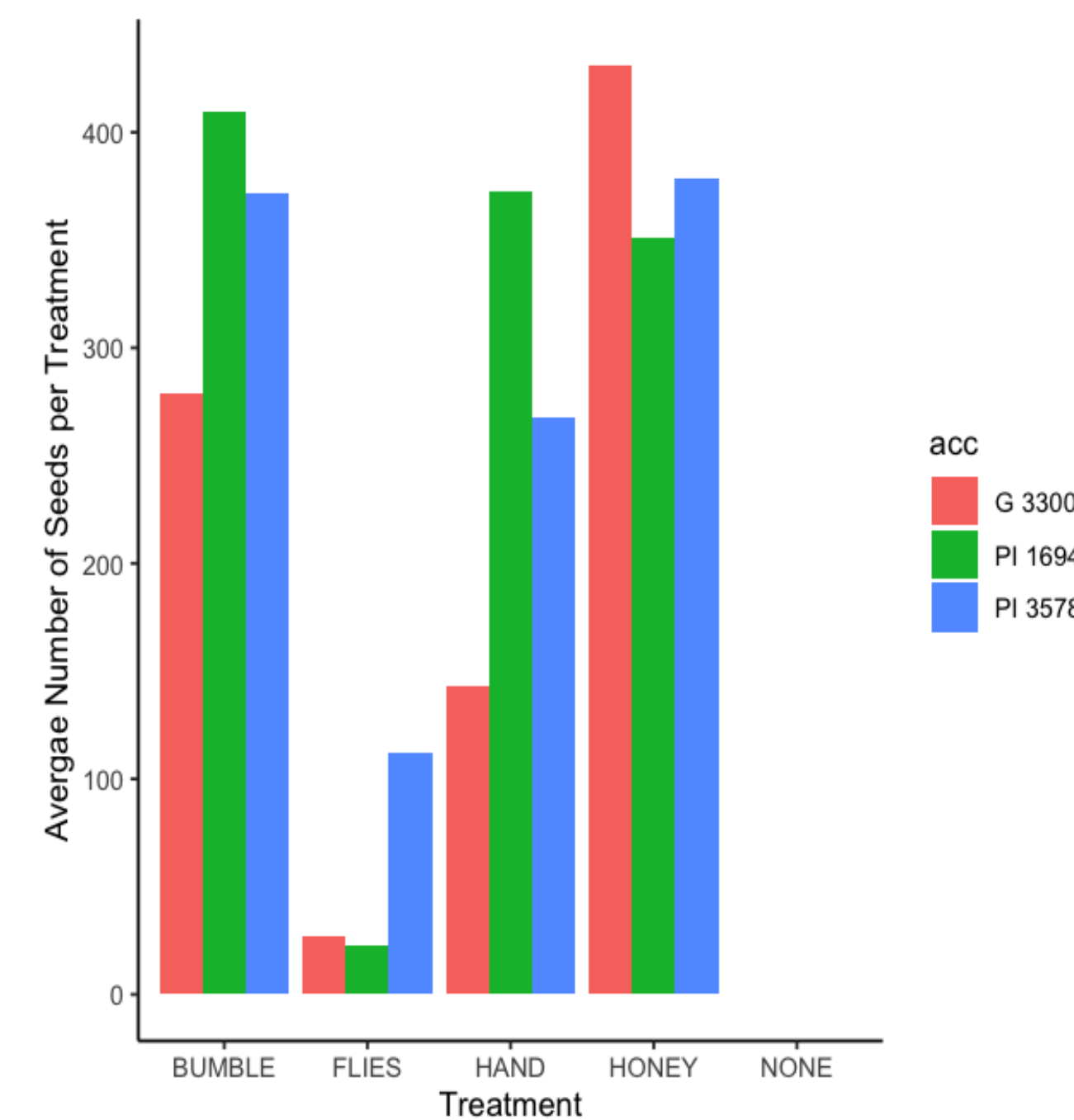


Figure 6. The average number of seeds in each fruit. The seeds in each fruit were counted separately by treatment and accession.

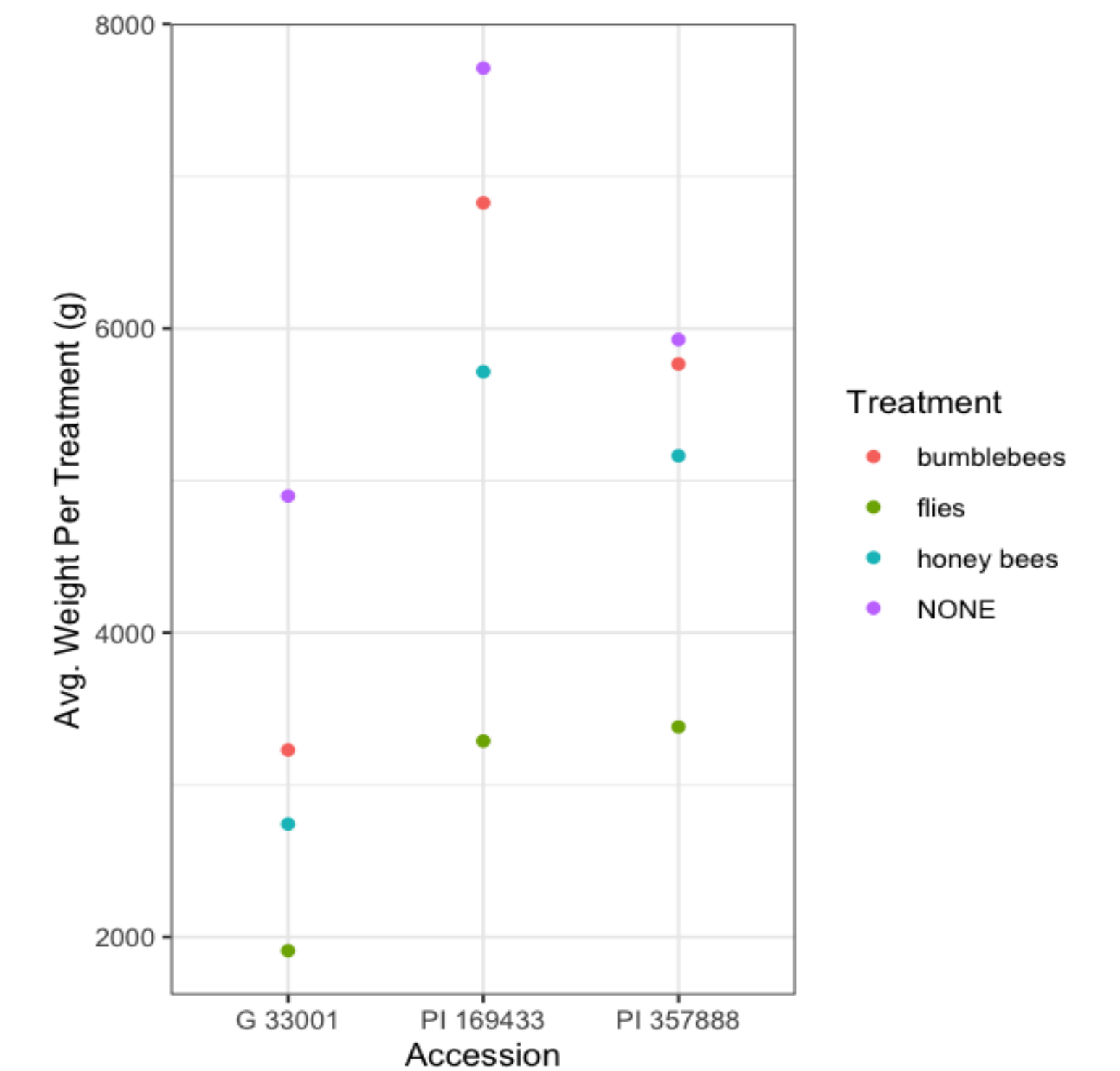


Figure 5. The average weight of fruits from the three different accessions across different pollinator treatments. Weight is in grams. "NONE" refers to fruits that were hand pollinated.

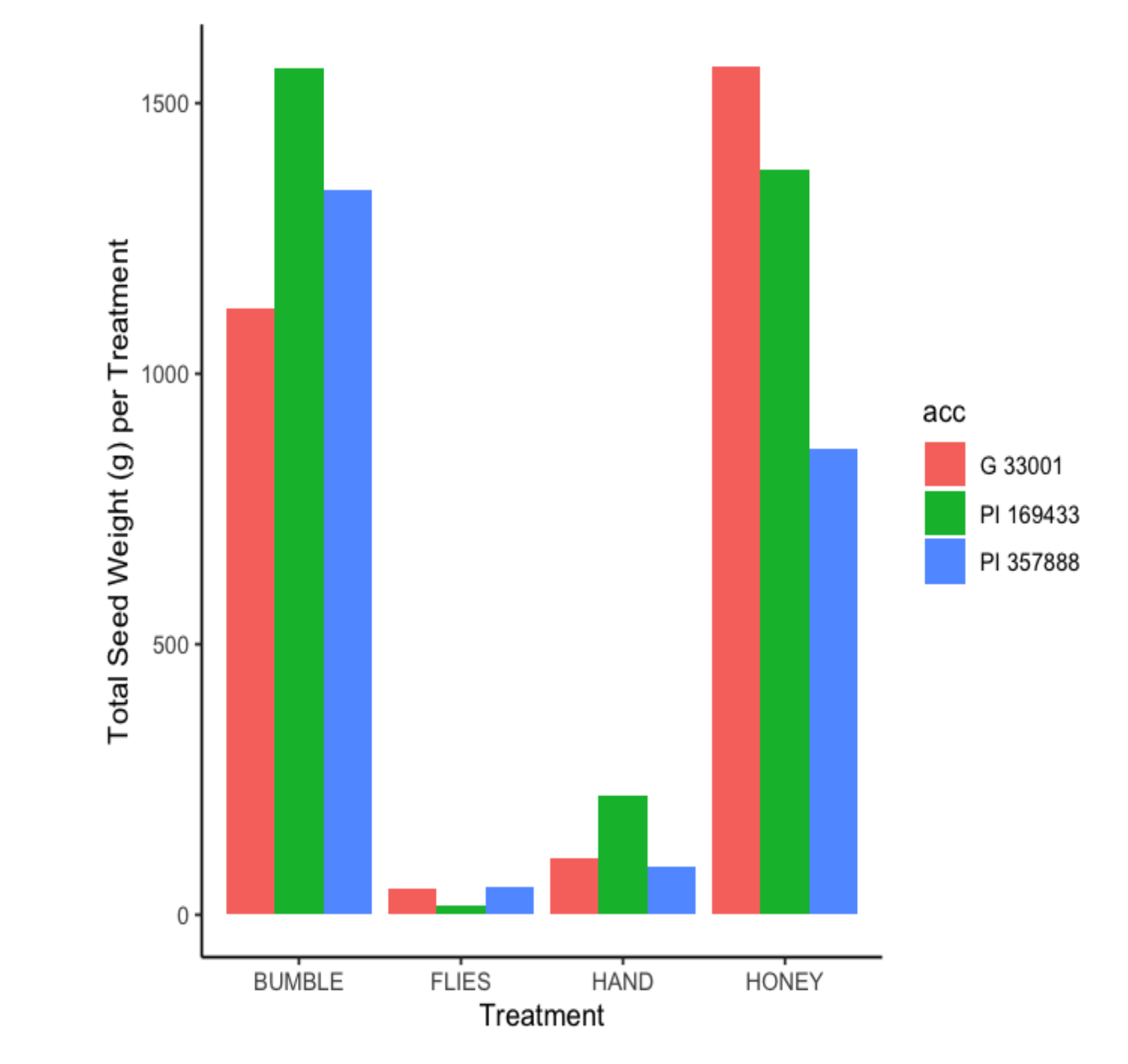


Figure 7. The weight of the seeds found in the fruits for each accession and treatment. Hand pollinated plants had a controlled number of fruits.

## Approaching Food Insecurity in Geneva, NY

- Based on these results, we know that bumblebees are an effective pollinator for squash, as well as honey bees. Bumble bees require less management time, so they can save producers resources.
- Geneva, New York has systems in place for fighting food insecurity, but they could be strengthened. One example is the pop-up food pantry at the Boys and Girls Club, which is sponsored by Food Linked. The pop-up pantry offers no-cost groceries to anyone who needs them. There is no sign up to participate. People simply get in line and drive through the pickup zone. Over 700 people can be served on any given pickup day.
- The groceries are provided by Food Linked. Some of the foods given out are fresh produce (grapefruits, lettuce, and grapes), bread, muffins, canned items, and coffee creamer (figure 8). All the produce was imported from other countries. By using locally grown crops, more people can be served fresh produce, and it would have a lower impact on the environment, which helps prevent further food insecurity due to climate change.
  - Now that we know which pollinators are easiest and effective, this experiment can be implemented into the community by raising efforts to voluntarily grow food. Then, it can be included in the food pickup. Additionally, programs can be more flexible for people who don't have cars or whose schedules prevent them from participating in pop-up pantries.

## Work Cited

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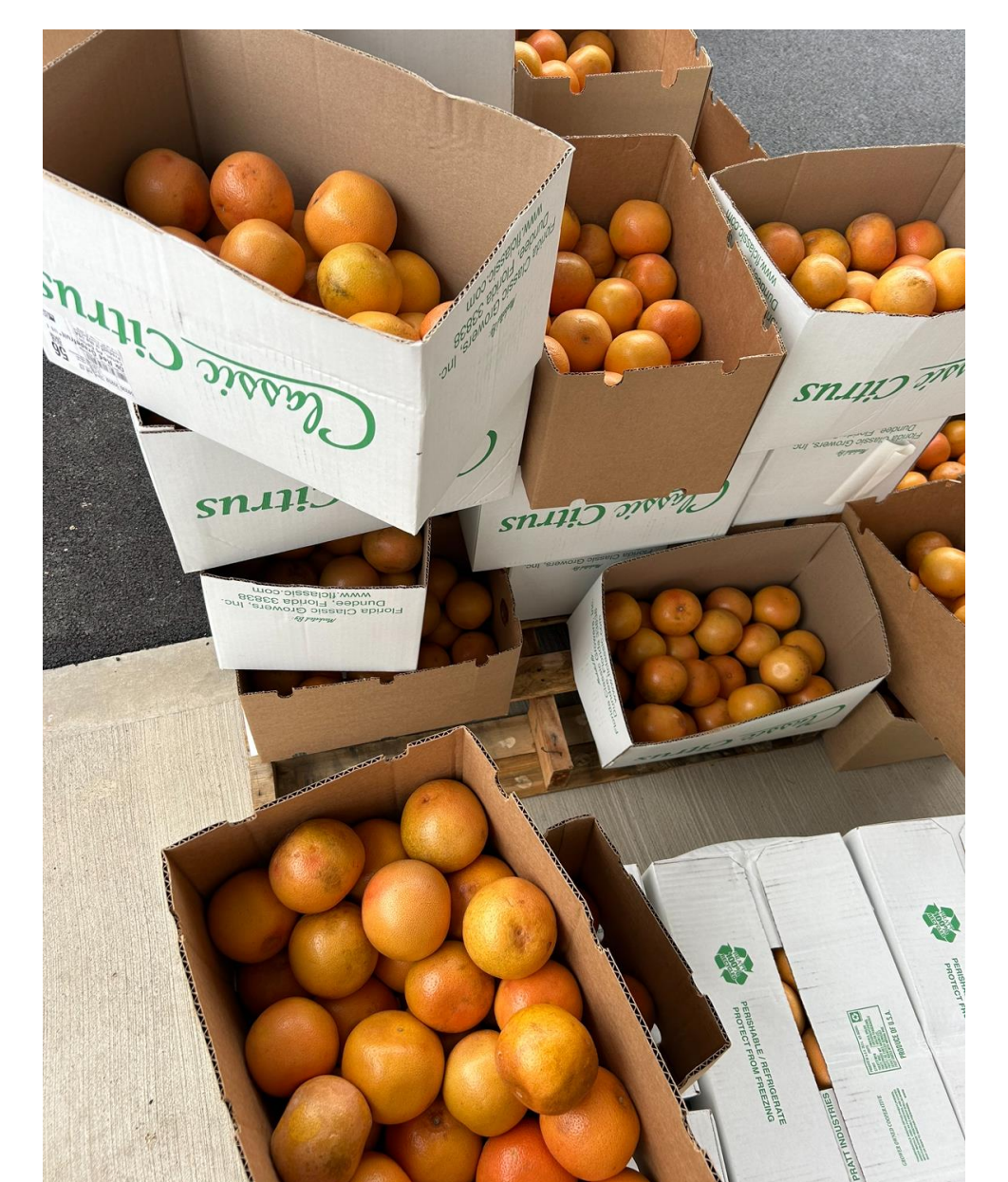


Figure 8. Some grapefruits served at the Geneva pop-up pantry.