A tale of two cover types and the pollination of blueberry flowers by honey bees

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Here we report on a case study of pollination in highbush blueberry (cultivar 11-11) grown as an evergreen crop underneath bird net and under high tunnels covered with plastic film. Data collected on honey bee visits to flowers, floral nectar and berry quality, were used to evaluate pollination success in this crop under the two cover types with some unexpected results.

Previous research has shown that crop covers can be a barrier to honey bees, limiting their access to the crop and its floral resources. Whilst bird net generally has holes large enough for honey bees to pass through, in contrast, a plastic film-covered tunnel is less accessible with entry possible only via the tunnel ends.

In our research we wanted to answer the question 'Do tunnels present a barrier to pollination success in blueberry?' and we conducted our study on a commercial farm in northern NSW in three 100-metre-long tunnels and under bird net (Figure 1). The honey bees were placed in two groups of 16 hives outside and the honey bees had to enter through bird net covering the sides of the adjacent blocks in order to access the plants in the tunnels and under bird net (Figure 2).

Methods

In July 2021 over two days, we counted bee visits to flowers and collected floral nectar and tagged individual flowers for later assessment of berry weight and berry sugars indicated by total soluble solids (Degrees Brix), under both covers. For the control treatment, mesh bags were placed over some flowers to prevent honey bees entering and taking the sweet nectar and also to prevent the entry of pollen via bee activity which would otherwise facilitate pollination (Figure 3). Sensors were also placed within the crop to record temperature, relative humidity and wind characteristics.

Honey bee counts

The number of honey bees landing on flowers were counted for 5 minutes at the 36 experimental plants on four occasions across the day and these counts appeared to be little influenced by the type of crop cover, except perhaps in the tunnels where the presence of bees was sometimes greater towards both ends of the tunnels. In contrast, the day of recording appeared more influential with the second day having 25% fewer bees than the first, probably related to cloudier and cooler conditions. The maximum temperature was 25°C on the first day compared with 21°C on the second day and the researchers counting on this day noticed a complete absence of bees when there was cloud cover.

Sugars in floral nectar

The floral nectar was extracted by shaking flowers in a small vial of water. The total sugars analysed in these suggest that the honey bees were actively harvesting sugars from the flowers under both cover types to a similar degree. The total weight of nectar sugars in the open flowers in the early morning, before the honey bees were flying, was about 1 milligram (mg) per flower but this declined to below 1 mg per flower in the afternoon compared with those flowers where bees were excluded. With bees absent, the sugars in the bagged flowers accumulated during the day to about 2-3 mg per flower.

Figure 1. The study site showing the intersection between the crops under the tunnels and bird net. Photo credit: Sophie Parks, NSW DPI

Figure 2. The honey bee hives placed outside the blueberry crop next to the tunnels. Other hives were placed outside near the intersection between the tunnels and bird netted crops. Photo credit: Sophie Parks, NSW DPI

Figure 3. One of the mesh bags placed over a blueberry flower used to exclude pollinators from entering the flower. This was the 'no pollination' control. Three to five of these were placed on each experimental plant.
Photo credit: Sophie Parks, NSW DPI

Fruit quality

This study shines a light on the importance of pollinator presence for fruit development in the 11-11 blueberry variety since fruits from the pollinated flowers were almost 2.5 times the weight of fruits from the unpollinated flowers. In contrast, the effect of the cover types on fruit weight appeared negligible as berry weights from pollinated flowers were similar under both (2.8 grams per berry). However, the sugar levels in the berries from the tunnels at 16.6 Degrees Brix appeared to be higher than those under bird net at 13.1 Degrees Brix (although we have yet to confirm the statistical significance of these results).

Given the similar presence of honey bees and characteristics of floral nectar between the two covers, factors other than pollination appear to be contributing to the higher fruit sugars from the tunnels.

The tunnel plants were not rain fed and were receiving more fertiliser via fertigation compared with the bird netted crop and may have had superior nutrition and therefore a greater capacity to support the developing fruits such as having a larger canopy. We are currently collecting canopy size, and flower and fruit load data from photos taken of each experimental plant to explore this hypothesis further.

Conclusion

Although a plastic-covered tunnel can present some challenges for honey bees accessing crops, in this case study we do not believe the tunnels have inhibited pollination success in this blueberry variety. Honey bee abundance was similar, and the floral nectar appeared to be as well utilised, under both crop covers. Here, we have not only highlighted the value of the presence of honey bees and the role of floral nectar to pollination and berry development in variety 11-11, but also the importance of non-pollination factors to fruit quality.

Acknowledgements

This project is being delivered by Hort Innovation with support from the Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program – and NSW Department of Primary Industries, Plant and Food Research Australia, The University of New England,The University of Tasmania, University of Adelaide, and multiple industry partners.

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