

Impact of supplementary pollination on the yields of strawberry

Christopher Menzel, Principal Horticulturist, Department of Agriculture and Fisheries

- The importance of insect pollination on the performance of strawberry was reviewed.
- Studies showed a 20% increase in yield for plants with supplementary pollination compared with natural pollination which reinforced past studies that have found pollination is better with insects than with wind and gravity.
- This suggests that the introduction of managed hives or additional wild bees can improve productivity.
- Management of pollination will become more important in the future with the loss of pollinating insects under global warming.

Studies around the world have highlighted the positive impact that supplementary pollination has on plant fertility and yields. Burd (1994) used published data on 258 species in which fertility was reported for natural pollination and hand pollination.

He found significant improvements in fertility with hand pollination at some time, or at some sites, in 62% of the species. Bennett et al. (2020) reviewed seed and fruit set across 1,247 species around the globe and found a 63% increase in reproduction following supplementary pollination compared with open pollination.



Strawberry flowers. Photo credit: Christopher Menzel



Bee on strawberry flower. Photo credit: Jane Richter

Sáez et al. (2022) assessed data from 52 studies encompassing 18 different self-compatible crops and reported that supplementary pollination increased yield by 22%.

In this article, data from published studies investigating pollination in strawberry crops was used to investigate the impact of supplementary pollination on the productivity of strawberries.

Assessing the impact of supplementary pollination

The impact of supplementary pollination can be estimated by comparing the fertility of plants with and without supplementary insects, or by comparing the fertility of hand- and open-pollinated flowers.

There are issues with both methods that should be remembered when interpreting the results of the studies:

- The response to supplementary pollination depends on the abundance of native pollinators at the site. If there are sufficient pollinators already present, the response to supplementary pollination will be reduced.
- Research suggests that the benefits of supplementary pollination with insects is underestimated.
- Hand-pollination can damage the flowers or apply excessive pollen to the stigmas; this will reduce the efficacy of supplementary pollination.

How the impact of supplementary pollination was calculated:

Impact of supplementary pollination

$$= (P_s - P_o) / P_{Max}$$

P_s is the yield or fruit weight from the supplementary pollination treatment

P_o is the yield or fruit from the control treatment (open pollination)

P_{Max} is the larger of the two values

Open versus supplementary insect pollination

25 studies were reviewed to compare the fertility of flowers under natural open pollination with those that were exposed to supplementary insects (Figure 1).

20 of these studies used yield response to estimate the impact of supplementary pollination. In these studies, there was a moderate, but variable impact across the experiments. The average benefit to yield was 0.20 (20%) \pm 0.17 ($P < 0.001$).

There was a different result when estimates were based on fruit weight, where the average increase in fruit weight was 0.06 (6%) and highly variable (\pm 0.18, $P = 0.106$) across the twenty-five studies.

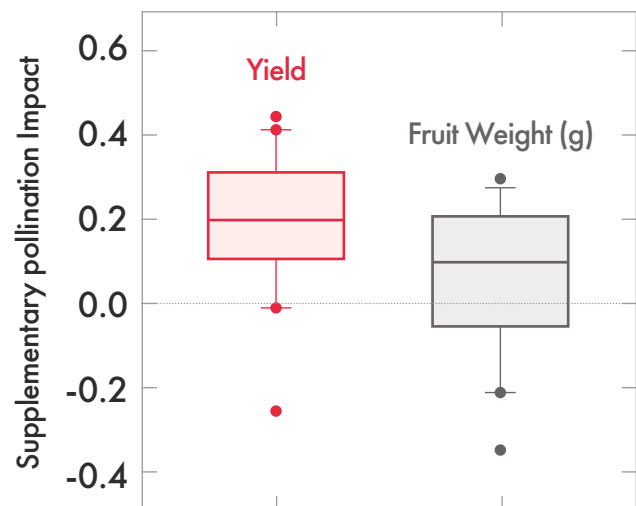


Figure 1. Impact of supplementary pollination on the yields of strawberry across 20 studies and fruit weight across 25 studies.

Open versus hand pollination

A second analysis was conducted to estimate the impact of supplementary pollination based on a comparison of hand- and natural open-pollination.

Different measures were used, including fruit weight, fruit width and the number of achenes or seeds per fruit.

The average benefit was 0.03 (3%) \pm 0.11 ($P = 0.307$) across eleven studies, suggesting a small and variable benefit from hand pollination.

Implications for commercial strawberry production

- The average benefit of supplementary insect pollination on yield in strawberry was 0.20, indicating that additional pollination provided 20% higher productivity.
- These results suggest the introduction of managed hives or additional wild bees can improve yields.
- Earlier work indicated that strawberry plants are dependent on insects for pollination (Menzel, 2022).
- Fruit set was better with insects than with self-pollination with wind and gravity.
- Strawberry plants have a moderate dependence on pollinators and a moderate yield improvement with supplementary pollination.
- Management of pollination will become more important in the future with the loss of pollinating insects under global warming.

References

Bennett, J.M., Steets, J.A., Burns, J.H. et al., 2020. Land use and pollinator dependency drives global patterns of pollen limitation in the Anthropocene. *Nature Communications* 11, 3999.

Burd, M., 1994. Bateman's principle and plant reproduction – the role of pollen limitation in fruit and seed set. *The Botanical Review* 60, 83–139.

Menzel, C., 2022. Yields in commercial strawberry fields are limited by the availability of pollen and insect pollinators. *Australian Berry Journal* 12, 89–93.

Sáez, A., Aguilar, R., Ashworth, L., Gleiser, G., Morales, C.L., Traveset, A., Aizen, M.A., 2022. Managed honeybees decrease pollination limitation in self-compatible but not in self-incompatible crops. *Proceedings of the Royal Society B* 289, 20220086.

Acknowledgements

The Queensland Government is funding the research through the Department of Agriculture and Fisheries. Many thanks to the Florida Strawberry Growers' Association (FSGA) for financial support and to Gary Hopewell for reading an earlier draft of the article.



Queensland
Government



FOR THE
BEST
BERRIES



- Effective control of grey mould in berries
- Flexible use pattern
- Strong protectant action

Flute 50 EW
FUNGICIDE

- Highly effective on powdery mildew in strawberries
- Nil withholding period
- Translaminar & vapour action

Innovation. Quality. Solutions.

