Researchers find 'sweet spot' for kiwifruit pollination

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Credit: Alternative Minerva/Unsplash

Plant & Food Research scientists and collaborators from the U.S. have compiled more than 30 years of field-based data from kiwifruit research to create "digital twins" of pollination processes in kiwifruit orchards, and have used these to predict how growers can optimize their fruit set.

Digital twins are virtual replicas of physical systems—in this case

mathematical models of the biology of the plants and the behavior of pollinating bees. These digital twins give researchers the ability to examine complex scenarios which examine multiple, intertwined factors at once. These types of trials are difficult or impossible to test in field—running a full combination of even six variables would require more kiwifruit orchards than exist in New Zealand.

Using this digital twin, the researchers predict that optimal fruit set is achieved with 60-75% female flowers in the orchard; something that growers can achieve by select pruning of male flowers. Most pollination benefit is gained from the first 6-8 honey bees/1000 flowers, with diminishing returns thereafter. The research suggests that fruiting success is more sensitive to variation in plant traits and the female-to-male flower ratio than bee density, provided this minimum density is achieved.

Dr. David Pattemore, pollination scientist at Plant & Food Research and leader of the research team, says, "This digital twin allows us to achieve something we couldn't have done before—simultaneous testing of the plant-based factors and the pollinator-based factors. It now provides us with a platform to test many more questions and develop recommendations for growers that can be confirmed in field trials."

The prediction should give kiwifruit growers confidence that what they have been practicing is more or less on the right track. The model provides strategies for improving crop management, such as selection of male and female cultivars which have their peak bloom at the same time, establishing the right balance of female to male flowers in the orchard and placing the sufficient numbers of hives to maintain more than six bees per 1000 flowers in the orchard to optimize yield."

The project is part of a wider program to develop digital twins for pollination, using a range of different modeling approaches to investigate

how different pollination factors interact and influence kiwifruit production. Although initially designed to investigate honey bees pollinating kiwifruit vines, the models can be adapted to suit a wide range of crop species and pollinators. The team is currently working to scale up the model to investigate more complex questions such as the influence of diverse pollinator species and the effect of the spatial layout of orchards. These digital twins could potentially be used as the foundation for the development of decision support tools for growers, to guide their orchard and pollination management to optimize yields.

The paper, titled "Orchard layout and plant traits influence fruit yield more strongly than pollinator behavior and density in a dioecious crop," has been published in *PLOS*.

More information: Angela Peace et al. Orchard layout and plant traits influence fruit yield more strongly than pollinator behavior and density in a dioecious crop, *PLOS ONE* (2020). DOI: 10.1371/journal.pone.0231120

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