**The effect of distance from honey bees hives on wild pollinator activity, crop quality and quantity in apple orchards**

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**Abstract**

A key challenge in crop pollination today is how to integrate commercial and wild pollinators in a way that will maximize yield quantity and quality. Apple (*Malus domestica*) is a good model crop for studying this issue, since most apple varieties require insect pollination to produce economically viable yields, and in Israel, as in large parts of the world, apple pollination is intensively managed (high stocking density of commercial honey bees). Furthermore, a number of studies from different regions have shown a direct link between the presence of wild pollinators in apple orchards and their yield’ quality and quantity. However, the interactions between honey bees and wild pollinators, and the effects of these interactions on the overall level and spatial spread of pollination activity in apple orchard is little known. The goal of this study was to investigate the effect of distance from honey bee hives on the pollination activity of both honey bees and wild pollinators, and ultimately, on crop quantity and quality in apple orchards.

The study was conducted in 2017-18 in 17 apple orchards of Cripps Pink (marketed in the under the name Pink Lady) in northern Israel. In each orchard, pollinator activity and the quantity and quality of fruit on trees were measured at two locations - close to honey bee hives (about 15 meters), and far from hives (about 115 meters). The distance of both locations to the nearest patch of natural habitat was kept constant. The number and type of visits (providing/not-providing pollination – legitimate/non-legitimate visits, respectively) of wild pollinators and honey bees was concurrently examined in the close and far localities in each orchard. I additionally measured the percent fruit-set and fruit quality (using the number of seeds as a proxy) in each locality in each orchard.

The total number of flower visits was significantly higher (about 34%) in the trees close to the hives compared to those far from the hives. Honeybees and wild pollinators showed an opposite spatial pattern; honeybee visits decreased and wild pollinator visits increased with the distance from the hives. Furthermore, honeybees and wild pollinators differed in their visitation behavior; while about 36% of honeybee visits were non-legitimate (side approach to the flower), the vast majority of wild pollinator visits were legitimate. There was no effect of the time from the hive introduction to the orchard and visitation activity of honeybees or wild pollinators. The dominant wild pollinator found in visiting apple flowers was a drone fly (*Eristalis tenax*), followed by wild bees from different groups. Despite these significant differences in pollinator activity across the orchard, there were no differences in fruit quantity and quality close and far from honeybee hives.

In conclusion, I found that the pollination requirements of Cripps Pink orchards in the north of Israel are fully met; there is uniformity in the quantity and quality of fruit across the orchard despite differences in the extent and quality of visitor activity. These results further indicate that the apple orchards tested are saturated in terms of the amount of pollination applied. The study also shows the potential contribution of wild pollinators to apple pollination, and their ability to provide a safety net in situations in which honeybee activity decreases, especially in the areas far from honeybee hives.