The effect of wild flowers bloom in agricultural field margins on diversity patterns and activity of honey bees and wild bees

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Abstract

Biotic pollination is an important ecosystem service; it's a key step in the sexual reproduction of many flowering plants. Bees are the main and most important pollinators in almost every terrestrial ecosystem. In the last decades the populations and diversity of managed and wild pollinators have been declining, while the demand for pollination services of crops is growing. Shortage in pollination services to agriculture may cause lower crop quantity and quality and higher costs of pollination services and agricultural production. Therefore finding a solution for the "pollination crisis" is crucial. Wild bees can provide substantial pollination services to crops and wild plants. In general, the diversity and abundance of pollinators are higher in agricultural fields with higher proportion of natural and semi-natural habitats. Hence, the creation and enhancement of these habitats, and especially provision of wild bloom, can be a measure of increasing pollinator activity in agriculture fields. On the other hand, wildflowers in proximity to agricultural fields can compete with the crops for pollination services by managed and wild pollinators.

In this study I examined the effect of wildflower bloom in agriculture field margins on the diversity, abundance and activity of managed bees (honeybees) and wild pollinators. The goal of the research was to examine whether wildflowers' bloom

competes with the crop flowers for pollination or supports it. The research took place in Judean Foothills characterized by dry Mediterranean climate and a mosaic of agriculture, natural and semi-natural habitats. The area has high biodiversity, including many wild bee species. Two model crops were selected for the research, almond and sunflower, which highly differ by their biology and phenology, pollinators' attractiveness, pollination demands and pollination management. The study was conducted during two consecutive blooming seasons, in 2011-12. Five almond sites and five sunflower sites were sampled during 2011 and four almond sites and four sunflower sites during 2012. Each site had one plot close to wildflowers ("Close") and one plot far from it (>200m) ("Far"). In each almond plot we measured: a) visitation frequency to almond flowers and foraging behavior (pollen and/or nectar) of honeybees; wild visitors were too scarce to quantify, b) weight and type of pellets collected from adjacent honeybee hives using pollen-traps, and c) pollen amount and pollen type (almond or wild bloom) on different body parts of honeybees collected from adjacent hives. In each sunflower plot we measured: a) visitation frequency to sunflower heads and foraging behavior (pollen and/or nectar) of honeybees and wild pollinators, and b) during 2011 we captured wild bees in order to identify species' composition. Species richness of wild plants were recorded on both almond and sunflower sites.

In almond, honeybee visitation activity was higher and more stable along the day and along the blooming season in plots close to wild bloom compared to plots far from it. While in the plots close to wild bloom the proportion of almond pollen-collected remained stable along the season, in the plots far from wild bloom the proportion decreased by 50%. The proportion of pollen-collecting honeybees (out of overall honeybees' visits) and the proportion of almond pellets (out of overall pellets collected) were higher in the plots far from wild bloom compared to plots close to wild bloom. Nevertheless the total weight of pollen (almond and wildflowers) and the weight of almond pollen were higher in hives that were close to wildflowers. Hence I conclude that hives closer to wildflowers have higher growth rate and winter recovery compared to hives far from wildflowers.

In sunflowers no significant differences in honeybee visitation frequency was found between the two habitats (Close/Far). This may be explained by the relative ease of movement between the two habitats, due to the short distances and the low vegetation, unlike the almond orchards. In the plots far from wild bloom the proportion

of honeybees (out of all visitors (wild bees and other insects)) was higher, and the proportion of wild bees and other wild visitors (Lepidoptera, Diptera, Beetles, wasps etc.) was lower compared to plots close to wild bloom. But, while the number of honeybees' visits during the day and along the season was stable, the visits of wild bees and other visitors decreased at noon and increased in along the season, probably as a result of weather changes (warmer at noon) and the fact that more insects immerged along the blooming season. In the plots close to wild bloom higher diversity and richness of wild bees and other wild visitors were found. The species composition differed between habitats and along the day; probably reflecting differences in physiological adaptations of different species (to different temperatures ranges) and to ecological-behavioral characters (agriculture\natural landscape association). These results indicate the importance of wildflowers in bee (and other wild visitor groups) activity and diversity in sunflower fields. In both study crops honeybee visitation frequency decreased by 50% in 2012 compared to 2011. This may reflect the overall decline in honeybee numbers in Israel, among other sources of variation between years (climate conditions, wildflowers diversity and availability etc.)

In conclusion, in the studied system I found that wildflowers in agriculture field margins, do not compete for pollination with crop flowers. Rather, wild bloom positively affects crop visitation activity by wild and managed visitors, and the diversity and abundance of wild pollinators in agricultural areas, as well as increases honeybee colony growth rate. Hence, farmers should enhance wild bloom along their field margin as a measure of increasing wild and managed pollinator activity in their fields.