Abundance and richness of pollinators in organic versus conventional apple orchards

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Abstract

*One of the main factors that determines the yield of apple orchards is the pollination. Apple fruit growers use pollinating varieties to ensure it but few attention is paid on insect pollinators. The aims of the present work are to describe the community of insect pollinators in organic versus conventional apple orchards located in Catalonia (NE of Spain) and to assess their contribution to apple pollination. The trial was conducted in 2015 in 28 apple orchards. Half of this orchards were organic and the rest were conventional. 17 orchards were placed in a landscape were more than the 65 % of the area was cultivated (province of Lleida), and the rest were located in a landscape were the cultivated area was about 30 % (province of Girona). In general, the richness of pollinators was very low since more than 90 % of flower visits were done by honey bee (*Apis mellifera *L.). The flower visits by honey bees were significantly higher in the province of Girona compared to the province of Lleida. However, the highest abundance of honey bees in the orchards placed in the province of Girona did not significantly increase the fruit set. The type of management (organic vs. conventional) did not affect the community of pollinators and the fruit set of apple orchards. The results of this work highlights the importance of the landscape in the abundance of insect pollinators.*

Keywords: fruit set, pollination services, wild bees, hoverflies

Introduction

One of the main factors that determines the yield of apple orchards is the pollination. Apple fruit growers use pollinating varieties to ensure it but few attention is paid on insect pollinators. In other crops like almonds, it was demonstrated that the presence of wild bees increased fruit set (Brittain *et al*., 2013), but there is no information about the role of these pollinators on apple orchards. The aims of the present work are to describe the community of insect pollinators in organic versus conventional apple orchards located in Catalonia (NE of Spain) and to assess their contribution to apple pollination.

Material and Methods

The trial was conducted in 2015 in 28 apple orchards. The size of these orchards ranged from 0.4 to 15 ha and the average was 2.8 ha. The abundance of flowering plants in those orchards was similar and very low. Half of this orchards were organic and the rest were conventional. 17 orchards were placed in a landscape were more than the 65 % of the area was cultivated (province of Lleida), and the rest were located in a landscape were the cultivated area was about 30 % (province of Girona). The percentage of organic farming respect to the whole cultivated area is about 4 % in both provinces.

Five trees per orchard with a similar number of bud flowers were selected. The assessments of pollinators and fruit set were carried out in three branches per tree. The number of bud flowers per branch were counted before blossom. The assessments of flower visits by pollinators were done one day at full bloom at 11:00, 13:00 and 16:00. Three weeks after full bloom the fruit set per branch was recorded and a 5-apple sample per tree was taken to count the number of seeds per fruit.

Three additional trees per orchard were selected to compare the rate of fruit set among hand pollination, open pollination and self-pollination. Six branches per tree were chosen and all the treatments were distributed in every tree (two branches per treatment and tree). The number of bud flowers per branch was counted before blossom, the number of newly opened flowers were

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recorded only in the treatments hand pollination and open pollination when hand pollination was performed. Hand pollination was done on newly opened flowers. Fruit set was assessed three weeks after full bloom, at that moment a 5-apple sample per branch was taken to count the number of seeds per fruit.

Results and Discussion

The number of open flower per branch in the day of the assessments were similar in all the orchards. In general, the richness of pollinators was very low since more than 90 % of flower visits were done by honey bee (*Apis mellifera* L.) and the rest by bumblebees (*Bombus terrestris* L.), *Osmia* sp., other wild bees and hoverflies.

There were no significant interaction between the type of management (organic vs. conventional) and the proportion of cultivated area in the number of flower visits by pollinators, fruit set and number of seeds per fruit. The flower visits by honey bees were significantly higher in the province of Girona compared to the province of Lleida, and no significant differences were found on the flower visits by the rest of pollinators. However, the highest abundance of honey bees in the orchards placed in the province of Girona did not significantly increase the fruit set and the number of seeds per fruit. The type of management (organic vs. conventional) did not affect the community of pollinators and the fruit set of apple orchards. The lack of influence of organic management in the abundance of insect pollinators may be due to the relative small size of the apple orchards compared to the surrounding conventional agriculture.

Fruit set and the number of seeds per fruit were significantly higher in open pollination than self-pollination regardless the intensification of the landscape and the type of management. However fruit set by open pollination can be improved since fruit set was significantly higher in hand pollination than open pollination.

The results of this work highlights that the abundance of insect pollinators in apple orchards is more influenced by the landscape context than the type of their production (organic or conventional): the lower proportion of conventional agriculture land the more abundance of insect pollinators. Therefore, the promotion and protection of insect pollinators should be addressed at landscape scale by the promotion of organic or sustainable agriculture both using ecological management practices.

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References

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