

Floral margins to increase auxiliary fauna in Mediterranean apple orchards

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Abstract

*Ecological infrastructures can be used to promote ecosystem services such as biological control and pollination. The aim of this study was to evaluate the contribution of an introduced floral margin on the community of pollinators and natural enemies in organic apple orchards. The trial was conducted from April to September of 2015 in four organic apple orchards located in Catalonia (NE-Spain). The floral margin was formed by four insectary plants (*Achillea millefolium* L., *Lobularia maritima* L., *Moricandia arvensis* L. and *Sinapis alba* L.) and it was compared to a spontaneous margin. Visual observations and beating tray samplings were performed to evaluate the presence of pollinators, natural enemies and alternative food. The floral margin significantly attracted more small wild bees, hoverflies, parasitoids, predatory trips and Pentatomidae Leach than the spontaneous margin. As a first approach, the introduced margin increased the abundance and richness of beneficials and therefore they can become a potential tool to promote pollination and biological control in apple orchards.*

Keywords: biological control, ecosystem services, ecological infrastructures, predators, parasitoids

Introduction

Ecological infrastructures can be used to promote ecosystem services such as biological control and pollination. Several studies demonstrated that habitat management has positive effects on the enhancement of the auxiliary fauna and pest control (Landis *et al.*, 2000; Boller *et al.*, 2004; Fiedler *et al.*, 2008; Simon *et al.*, 2009). However, few of them have been carried out in fruit orchards (Wyss, 1996; Simon *et al.*, 2009; Kienzle *et al.*, 2014) and as far as we know, there is no information about the effect of introduced floral margins on natural enemies and pollinators in apple orchards. In order to provide a practical advance in the promotion of auxiliary fauna, the aim of our work is to assess the contribution of an introduced floral margin on the community of pollinators and natural enemies in organic apple orchards.

Material and Methods

The trial was conducted from April to September of 2015 in four organic apple orchards located in Catalonia (NE-Spain). In each orchard, a floral margin formed by 4 insectary plants *Achillea millefolium* L., *Lobularia maritima* L., *Moricandia arvensis* L. and *Sinapis alba* L., was established 5 meters from the edge of the orchard. It was compared to a spontaneous margin mainly composed by grass and other non-honey plants.

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In the margins, three-minute visual observations were used to evaluate the presence of adult hoverflies and bees, and beating tray samplings were performed to evaluate other natural enemies and alternative preys. The falling insects were counted and identified to family level when possible. Afterwards, they were subdivided into three groups: predators, parasitoids and alternative prey for predators. The assessments were carried out every two weeks.

Data from the whole period were used to compare the insect means' abundance between treatments. Data were log-transformed to reduce heterocedasticity if necessary. Data were analysed by ANOVA, Welch's test or Kruskal-Wallis' test ($\alpha=0.05$) according to the normality and homocedasticity of the data. Data were analysed using the JMP statistical software package (Version 8; SAS Institute Inc., Cary, North Carolina).

Results and Discussion

In general, the most abundant auxiliary fauna found in the margins was small wild bees (Hymenoptera), adult hoverflies (Diptera: Syrphidae), parasitoids (Hymenoptera) and spiders (Arachnida). Floral margins significantly attracted more pollinators and natural enemies than spontaneous margins. Hoverflies and wild small bees both visited about ten times more the introduced margins than the spontaneous margins.

The abundance of parasitoids, predatory trips (Thysanoptera: Aeolothripidae), and *Eurydema* Laporte de Castelnau (Hemiptera: Pentatomidae) was significantly higher in the introduced margins than in the control ones. In contrast, the abundance of spiders, ladybirds (Coleoptera: coccinellidae), Miridae Hahn (Hemiptera), *Lygaeidae* Schilling (Hemiptera), phytophagous trips (Thysanoptera) and aphids (Hemiptera: Aphididae) did not statistically differ between both kinds of margins.

This study shows that the introduced floral margins were more attractive to the auxiliary fauna than the spontaneous ones by providing them with a favourable environment. The mixture had an extended flowering period, from April to September, which could contribute to feed pollinators and natural enemies for a longer period of time (Landis *et al.*, 2000; Fiedler *et al.*, 2008). Furthermore, the location of the margin, at the edges of the orchard, has contributed to provide shelter and undisturbed habitat (Landis *et al.*, 2000; Boller *et al.*, 2004).

In this study we demonstrated that the introduction of floral margins increased the abundance and richness of pollinators and natural enemies in the edges of the apple orchards and therefore it highlights their importance to become a potential tool to promote biological control and to increase pollination services in these orchards. Further research is needed to assess their contribution on ecosystem services.

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