IOBC
Working Groups
"Integrated fruit protection in fruit crops"

Proceedings of the 7th International Conference on Integrated Fruit Production

At

Avignon (France)

October 27-30, 2008

Edited by

J Cross, M Brown, J Fitzgerald, M Fountain, D Yohalem

Impact of flower strip establishment in apple orchards on natural enemy populations

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Abstract. Composite flower strips were established in 2006 in three commercial apple orchards in Quebec. Strips were composed of the Canadian goldenrod (*Solidago canadensis*) and the common yarrow (*Achillea millefolium*), two native plants known to attract beneficial organisms. The aim of the project was to reduce pesticide application treatments directed against orchard pests, more specifically the European red mite (*Panonychus ulmi*), the two-spotted spider mite (*Tetranychus urticae*), the green apple aphid (*Aphis pomi*), the European ***apple*** sawfly *(Hoplocampa testudinea*), the tarnished plant bug (*Lygus lineolaris*) and the white apple leafhopper (*Typhlocyba pomaria*). In the present trial, populations of potential natural enemies of these pests were monitored in 2008, using sticky white traps, in both control and managed areas. The most common predator species were Coccinellidae, Syrphidae, Neuroptera (Chrysopidae and Hemerobiidae) and Aranea. Results varied according to the species of natural enemy, the treatment (control versus floral strip) and the distance to the flower strip.

Key words: habitat management, *Achillea millefolium, Solidago canadensis,* Aranea, Chrysopidae, Coccinellidae, Hemerobiidae, Syrphidae, predator.

Introduction

Habitat management in agriculture can provide alternative food (preys, hosts, pollen, nectar), refuges, oviposition and breeding sites to natural enemies (Altieri, 1994; Andow, 1991). Such management practices aim to increase the diversity and abundance of natural enemies in order to control pests and consequently reduce insecticide applications. Several studies deal with pest management in apple orchard but no one treatment was sufficient to efficiently control pest populations (Brown & Glenn, 1999; Wyss, 1996). In this study, we chose to establish in apple orchards a flower strip composed of two native plants which have been reported to attract beneficial organisms. The goal is to increase significantly the abundance of natural enemy populations and to establish permanently a biodiversity able to reduce apple's damages.

We hypothesize that the management of a flower strip will increase the abundance of natural enemies in apple orchard.

Material and methods

Flower strips

Strips of composite flower were established perpendicularly to apple trees rows in 2006 in three commercial apple orchards in Quebec (Canada) (45N; 71O). Flower strips (2m x 20m) were composed of Canada goldenrod (*Solidago canadensis*) and common yarrow (*Achillea millefolium*). Each orchard contained two or four flower strips. Each managed area (with flower strip) was paired to an unmanaged area (control) for comparison, and had similar apple

tree age, size, rootstock and variety. Buffer zones of 10 to 15m were established on each side of the treatment areas to minimize edge effect.

Sampling of natural enemies

Natural enemy populations were monitored weekly from May to September in 2008 in the two central apple tree rows, with a sticky white trap hung (150cm from ground level) on each of the two apple trees located at 0, 10 and 30m from the treatment areas. Two traps were also placed 50cm above the ground within each flower strip and control treatments. Sticky white traps were kept in an icebox until the identification of insects in the laboratory. The main groups monitored were composed of Syrphidae, Coccinellidae, Chrysopidae and Hemerobiidae adults, and Aranea immature and adults. A paired t-test was used to compare managed and unmanaged areas at each distance from the treatment.

Results

Natural enemies assemblage

In 2008, 1868 individuals of natural enemy were collected on sticky white traps. The mean number per trap and per week was significantly higher at 0m in managed areas (0.772 adults) than in control areas (0.544) (df = 7; T = -1.960; *P* = 0.0454).

Syrphidae

Syrphidae constituted the most important family of natural enemies with 1224 captured adults. They were more abundant within the control (1.508 adults/trap/week) than within the flower strips (0.844 adults) (df = 6; T = 2.483; *P* = 0.0238) (Fig. 1).

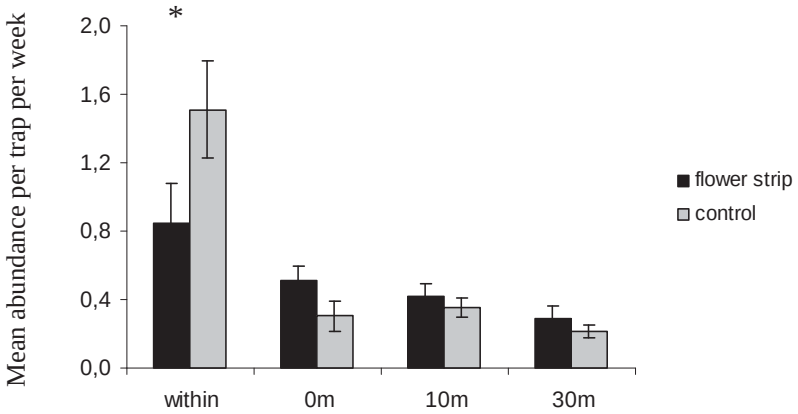

Figure 1. Mean abundance per trap and per week of Syrphidae adults captured on sticky white traps in three commercial apple orchards. * indicates statistically different values by Paired T-test ($P \leq 0{,}05$).

Coccinellidae

Coccinellidae was the second most important family of recovered natural enemies with 389 individuals belonging to more than 10 species. Four species represented 83% of all Coccinellidae captured. They were more abundant within the flower strips (mean of 0.554 adults/trap/week) than within the control (mean of 0.336 adults) (df = 6; T = -2.604; *P* = 0.020) (Fig. 2).

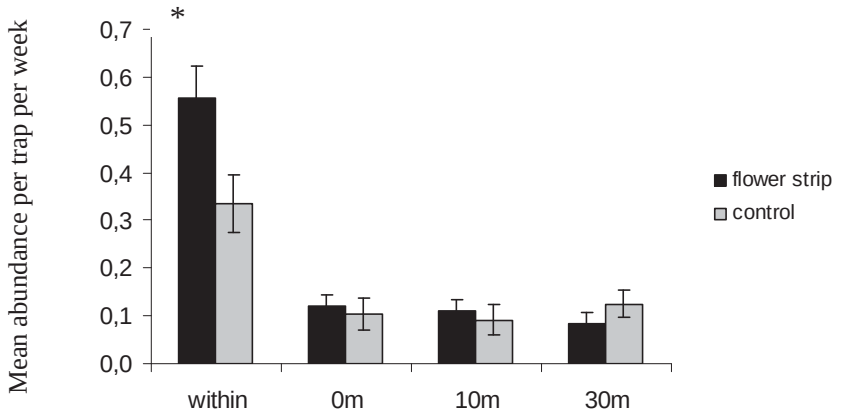

Figure 2. Mean abundance per trap and per week of Coccinellidae adults captured on sticky white traps in three commercial apple orchards.

Aranea and Neuroptera

No differences were observed between managed and unmanaged areas concerning the abundance for both Aranea and Neuroptera captured on sticky white traps.

Discussion

Our study shows that management of a flower strip has a significant positive impact on natural enemies. They were more abundant in managed orchards, near the flower strip, than in unmanaged area. However, this impact was restricted to the edge (<10m) of the orchard. Results about impact of such management techniques differ according to the studies, revealing either floral diversity increases natural enemy's abundance (Kinkorova & Kocourek, 2000), or has no significant effect on natural enemies (Prokopy, 2003; Steffan-Dewenter & Leschke, 2003).

Syrphidae were significantly more abundant on the control groundcover than in the flower strip. Nevertheless, no difference was observed at any distance in the orchard between treatments. Our results contradict previous studies which noted that abundance of Syrphidae increased with flower density and proximity (Kohler *et al.*, 2008; Pontin *et al.*, 2006).

Coccinellidae were more abundant in the flower strip than in the control, confirming that *A. millefolium* and *S. canadensis* efficiently attract theses predators. They may be attracted by pollen and nectar from these plants (Spellman *et al.*, 2006; Price *et al.*, 1980). In spite of this attractiveness, no effect was observed within the orchard.

Concluding, samplings have to be continued during the next years in order to establish 1) if the impact would be confirmed and increased, 2) if the impact would spread in the entire orchard or be restricted to the vicinity of the strips.

Acknowledgement

This work was funded by Conseil pour le Développement de l'Agriculture du Québec and supported by Club Agroenvironnemental de l'Estrie and Horticulture Indigo. Special thanks to Spencer Mason, Mr and Mme Mason and Martin Hutchison.

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