

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/298791195>

Influence of agricultural management on canopy-dwelling predatory and herbivorous arthropod communities in Swedish apple orchards

Article · January 2016

CITATION

1

READS

164

5 authors, including:



Mario Porcel
Agrosavia

40 PUBLICATIONS 442 CITATIONS

[SEE PROFILE](#)



Joakim Pålsson
Swedish University of Agricultural Sciences

6 PUBLICATIONS 36 CITATIONS

[SEE PROFILE](#)



Georg K. S. Andersson
Lund University

50 PUBLICATIONS 2,175 CITATIONS

[SEE PROFILE](#)



Marco Tasin
University of Padova

84 PUBLICATIONS 1,417 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Entomología-química entomológica [View project](#)



Wild bee community composition and foraging behaviour in commercial strawberries - Effects of region, landscape, field-margins and cultivars [View project](#)

Influence of agricultural management on canopy-dwelling predatory and herbivorous arthropod communities in Swedish apple orchards

Mario Porcel¹, Joakim Pålsson¹, Georg Andersson^{2,1}, Marco Tasin¹ and Birgitta Rämert¹

¹Integrated Plant Protection, Department of Plant Protection Biology, Swedish University of Agricultural Sciences, Växtskyddsvägen 3, 230 53 Alnarp, Sweden; ²Centre for Environment and Climate Research, Lund University, Sölvegatan 37, 223 62 Lund, Sweden

E-mail: mario.porcel@slu.se

Abstract: Local agricultural management, and in particular pesticide usage, is a major driver of many arthropod communities in agroecosystems. For example, it is known to cause a significant impact on pest's natural enemies abundance and diversity. The aim of our study was to establish the effect of agricultural management on the community of predatory and phytophagous canopy-dwelling arthropods in Swedish apple orchards. Arthropods were sampled from the tree canopy in organic and conventional orchards using a field insect aspirator. We compared the composition at family level of the two functional groups considered (predators and herbivores) using multivariate analysis. Significant differences were obtained for the predatory community between organic and conventional orchards. Principal component analysis showed a clear clustering of conventional farms mainly associated to lower abundances of predatory mirids, anthocorids, ladybirds, dustywings and spiders. Furthermore, there was a higher variation in the predatory arthropod community in organic compared to conventional orchards. No differences were observed for the herbivore community collected in suction samples between management schemes suggesting a different response pattern to orchard management compared to the predatory community during the 2013 growing season.

Key words: apple, agricultural management, arthropods, organic, conventional orchards, natural enemies, phytophagous

Introduction

Local agricultural management, particularly pesticide use, is a major driver of many arthropod communities in agroecosystems (Bengtsson *et al.*, 2005; Rahmann, 2011). In fruit orchards, the effect of pest management has been studied for several taxonomic groups but seldom for whole arthropod communities (Simon *et al.*, 2010). The aim of our study was to establish the effect of agricultural management on the community of predatory and phytophagous canopy-dwelling arthropods in Swedish apple orchards.

Material and methods

Arthropods were sampled from the tree canopy of 10 apple orchards (6 organic and 4 conventional) using a field insect aspirator (InsectaZooka, Bioquip Products, USA). Samples were collected weekly from the 17th of June to the 26th of July 2013. In each orchard, 15 samples were taken, consisting of a 2 minute aspiration of up to four apple trees. The composition at family level (except for Araneae and Opiliones that were analysed on order level) of two functional groups (predators and herbivores) was compared between

management systems by a multivariate permutational analysis (PERMANOVA) (Anderson, 2001). A principal component analysis (PCA) was used to visualize multivariate patterns in the arthropods communities for different orchards and to identify possible grouping.

Results

A total of 25,351 arthropods were collected from 15 different orders; the most abundant were Hemiptera, Acari and Araneae. Significant differences were obtained for the predatory community between organic and conventional orchards (PERMANOVA, $F_{1,9} = 6.26$, $P = 0.004$). The PCA biplot showed a clear clustering of conventional farms associated with lower abundances of most of the natural enemies, mainly predatory mirids, anthocorids, ladybirds and dustywings, and with a higher abundance of spiders and anystid mites (Figure 1). Organic orchards recorded a higher variation in the predatory community composition between them than conventional orchards as shown in the distances in the PCA biplot. No difference was obtained between management systems for the herbivorous community that was collected in suction samples (PERMANOVA, $F_{1,9} = 0.82$, $P = 0.445$) (Figure 2).

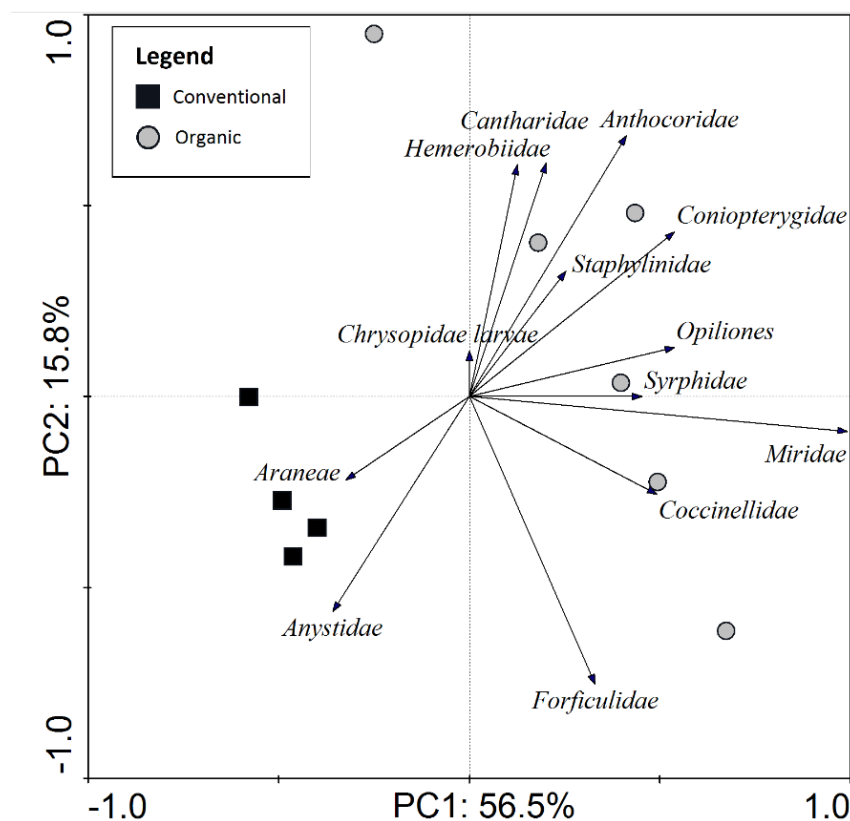


Figure 1. PCA biplot of predators collected through suction sampling from 10 different orchards. A total of 3,900 individuals were collected.

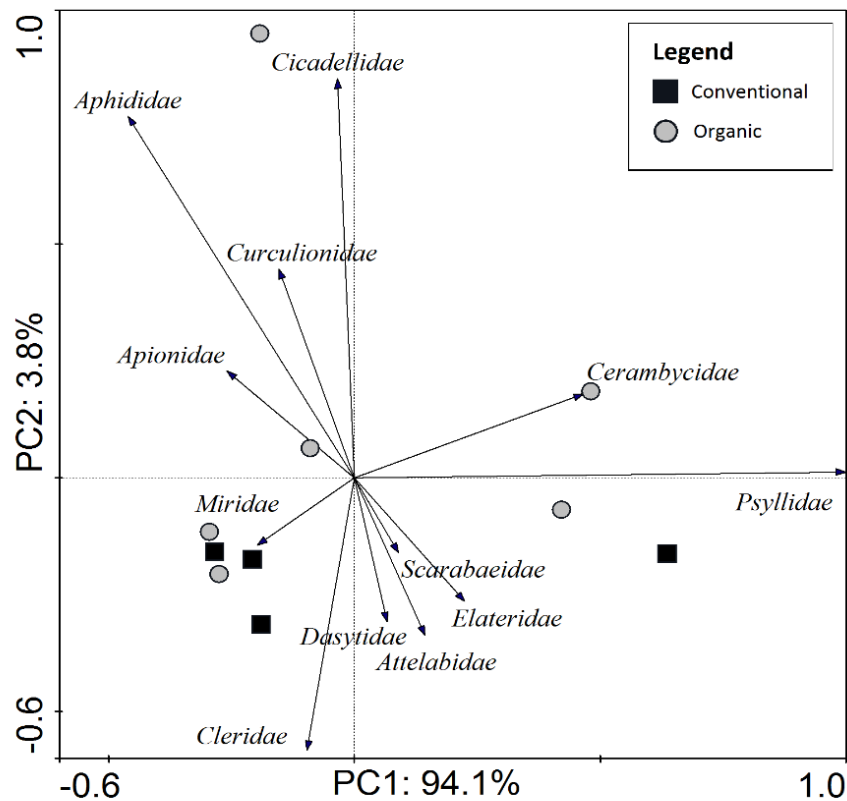


Figure 2. PCA biplot of herbivorous arthropods at family level collected through suction sampling from 10 different orchards. A total of 21,451 individuals were collected.

Discussion

The difference observed in this study between the predatory communities in organic and conventional orchards was related to a decrease in abundance of certain taxonomic groups associated with pesticide use. Our results are consistent with similar studies for natural enemy communities. However, these other studies found a correspondence between a decrease in natural enemies and a decrease in herbivore abundance in sites under conventional management (Simon *et al.*, 2007; Suckling *et al.*, 1999). We observed no, or very small, differences in abundance of the most commonly collected herbivore groups (psyllids, aphids and leafhoppers) between management systems. The Swedish situation suggests a different response pattern to orchard management of the predatory arthropod community, including predatory hemipterans (mirids and anthocorids), as compared to hemipteran herbivores, during the 2013 growing season.

References

- Anderson, M. J. 2001: A new method for non-parametric multivariate analysis of variance. *Austral Ecology* 26: 32-46.
- Bengtsson, J., Ahnström, J., Weibull, A.-C. 2005: The effects of organic agriculture on biodiversity and abundance: a meta-analysis. *Journal of Applied Ecology* 42: 261-269.
- Rahmann, G. 2011: Biodiversity and organic farming: What do we know? *vTI Agriculture and Forestry Research* 61: 189-208.
- Simon, S., Bouvier, J.-C., Debras, J.-F., Sauphanor, B. 2010: Biodiversity and pest management in orchard systems. A review. *Agronomy for Sustainable Development* 30: 139-152.
- Simon, S., Defrance, H., Sauphanor, B. 2007: Effect of codling moth management on orchard arthropods. *Agriculture Ecosystems & Environment* 122: 340-348.
- Suckling, D. M., Walker, J. T. S., Wearing, C. H. 1999: Ecological impact of three pest management systems in New Zealand apple orchards. *Agriculture, Ecosystems & Environment* 73: 129-140.