

Popular scientific result summary for project funded by Ekhagastiftelsen

Popular scientific result summary is to be submitted by e-mail within 3 months of project end.

Application number:	2015-11
Project title:	Ground cover management in organic apple orchards in South Africa: Trade-offs between above- and belowground ecosystem services
Receiver of grant (name, address):	Lunds universite Department of Biology Sölvegatan 37 223 62 Lund
Contact / project manager:	Klaus Birkhofer
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By Ekhagastiftelsen granted sum:	SEK 1 480 000

Result summary: (max 900 words)

- Background and aims of the project

Organic growers have to rely on multiple beneficial functions that are provided by the ecosystem ("ecosystem services"). The provision of individual ecosystem services in organic fruit production systems can be supported by management decisions, but it remains unknown to what extent individual management practices affect the relationships between multiple ecosystem services. South Africa is among Africa's largest organic producers, but organic pome fruit production suffers from major constraints, namely the limited availability of alternative strategies for pest control and nutrient management in soils. Ground cover management in organic orchards generally aims to reduce competition for soil nutrients and water between weeds and fruit trees. Here, we studied the impact of ground cover management on weeds under the canopy of trees in organically managed fruit orchards with the aim to understand how weeds affect below- and aboveground microbial and faunal communities and the provision of ecosystem services and disservices. We aim to understand how weeds can be managed to beneficially affect orchard diversity and the provision of important ecosystem functions.

- Theory and method

We hypothesized that: (1) certain levels of weed coverage are beneficial for the simultaneous provision of multiple below- and aboveground services and (2) effects of weeds on microbial and animal communities and trade-offs between services differ between ground cover management options and (3) it is possible to establish ground cover management strategies that are characterized by a certain tolerance towards weeds. We further hypothesize that (4) an improved understanding of the motivation of growers to apply certain ground cover management strategies will

improve communication between growers and researchers and can lead to a win-win situation for growers and the environment.

To test these hypotheses, we selected eight organic orchard plots in four cultivated pome fruits that were available at a certified organic farm (two sites of each: apricot, peach, plum and quince) and two conventionally managed apricot plots at an adjacent farm. In these plots, the ground cover treatments that were established in October 2016 were a) business as usual = 4-5 cuts under the canopy with removal of material and 1-2 cuts in the working row versus b) mow & blow: 4-5 cuts under the canopy and 1-2 cuts in the working row with addition of the cut material ("living mulch") under tree canopies. In plots of both treatments, as well as in the conventionally managed plots, soil properties, microbial, weed and animal communities as well as important functions such as predation or decomposition were quantified in November/December 2016 and June/July 2017.

- Results from the project

The „mow and blow“ mulch treatment did reduce the weed cover under fruit tree canopies by about 10% relative to the untreated control trees by December 2016. It also reduced the amount of bare ground by 40% compared to the controls, but had no effect on the availability of soil nutrients, other major soil properties or microbial communities. Along with the differences in weed and bare ground cover came differences in faunal composition. The mulched plots had higher abundances of springtails (Collembola) which can act as important decomposers of organic matter, probably an effect of the higher litter availability and more favourable microclimatic conditions in our treatment plots. Treatment plots also had a higher activity of ants (Formicidae), but lower activity of spiders as beneficial predators of potential pest organisms. The average amount of beetle prey in spider webs was more than 35% higher in mulched plots compared to the control, even though more herbivorous beetles were active in control plots. This may be particularly relevant as the major insect induced damage on apricot fruits in our study plots was caused by beetles. Aphid and thrips prey, as additional potential pests, was more commonly observed under control conditions, but the number of plant parasitic nematodes and herbivorous beetles was also higher in those plots. Fruit growers participating in this study were a diverse group who faced a variety of challenges that influenced management decisions. Decisions are made with consideration to financial capacity and long-term goals and ideologies are among the dominant drivers behind choices of farming practices.

- Conclusion

In summary, the tested mow and blow treatment has the potential to reduce weeds and promote selected beneficial animal groups or predation-related ecosystem services. To understand these effects in greater detail and to elaborate effects on soil properties and microbial communities, longer-term studies with repeated mulch treatment establishment would be needed. A second obvious pattern also would warrant further confirmation, the two included conventionally managed orchard plots provided only a fraction of the potentially positive properties in organically managed plots, but also had much lower values for the potentially negative properties. In

essence, these plots were pretty bare of life compared to the organically managed plots. The tested mow & blow treatment therefore seems to be a valid compromise between no control by ground management (business as usual) and conventional control with chemicals.

Our study was too short to affect soil properties significantly and repeated mow and blow applications over several seasons would be needed to indicate potential mid- and long-term effects of the treatment on soil properties. Our study also fell in a period of historic drought conditions in the Western Cape, with abnormally low rainfall.

- List of publications (if applicable)

Due to the fact that this was an 18-months project, no papers are yet published.