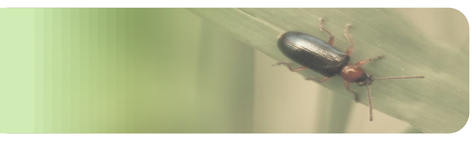
Effects of fertilization on biological-control of pest

O. Rennstam Rubbmark, D. Sint, M. Traugott

Mountain Agriculture Research Unit, Institute of Ecology, University of Innsbruck, Technikerstrasse 25, 6020 Innsbruck, Austria
oskar.rubbmark@uibk.ac.at

Austrian Science Fund

Background



Fertilization affect a range of ecosystem processes with implications for biological control., The internal relationship processes is complex, and so far understanding is limited to subsets of interactions with sometimes conflicting effects on biological control.

Here we choose to study how fertilization influences biological control of important cereal leaf beetle and aphid pest, through a wide range of interactions, spanning below ground to above ground systems under field conditions.

Study Design

- **Design**
  - 2 target pest; Cereal Aphids and Cereal Leaf Beetles
  - 3 cereal fields located in Tirol, Austria
  - 4 Fertilization treatments (Manure, Compost, Conventional and Unfertilized)
  - 5 replicates per treatment and field
  - Sampled at pest infestation and at peak pest density during 2014 (replicated 2015)
- **Measures**
  - Ground and vegetation dwelling predator composition
  - Pest development with and without predators
  - Predation intensity
  - Community composition of bellow and above ground alternative prey
  - Plant responses
  - Soil properties
  - Crop yield and quality

First results

A. Fertilization mediates pest control, but not only through predation

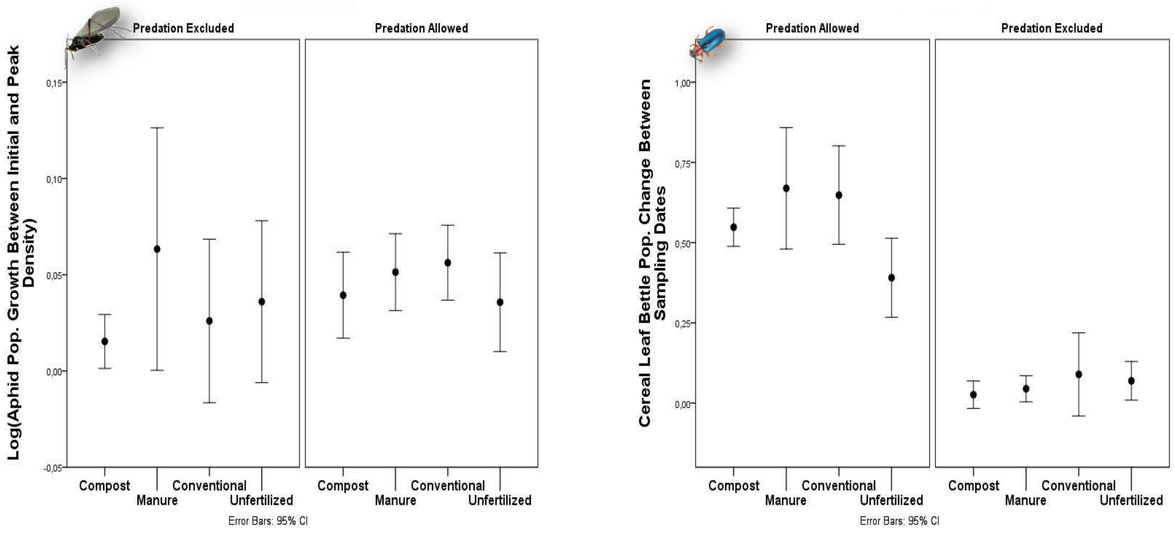


Figure A. When predators are excluded, growth rate of pest decreases in plots fertilized with compost, for aphids $F_{3.61,\ *}$ and Cereal Leaf Beetles that show a non-significant trend $_{p=0,052}$. In the presence of predators this effect is enhanced for Cereal Leaf Beetles $F_{11.33,}$ **, whereas, for aphids effects are no longer present.

B. Fertilization affects predator community composition

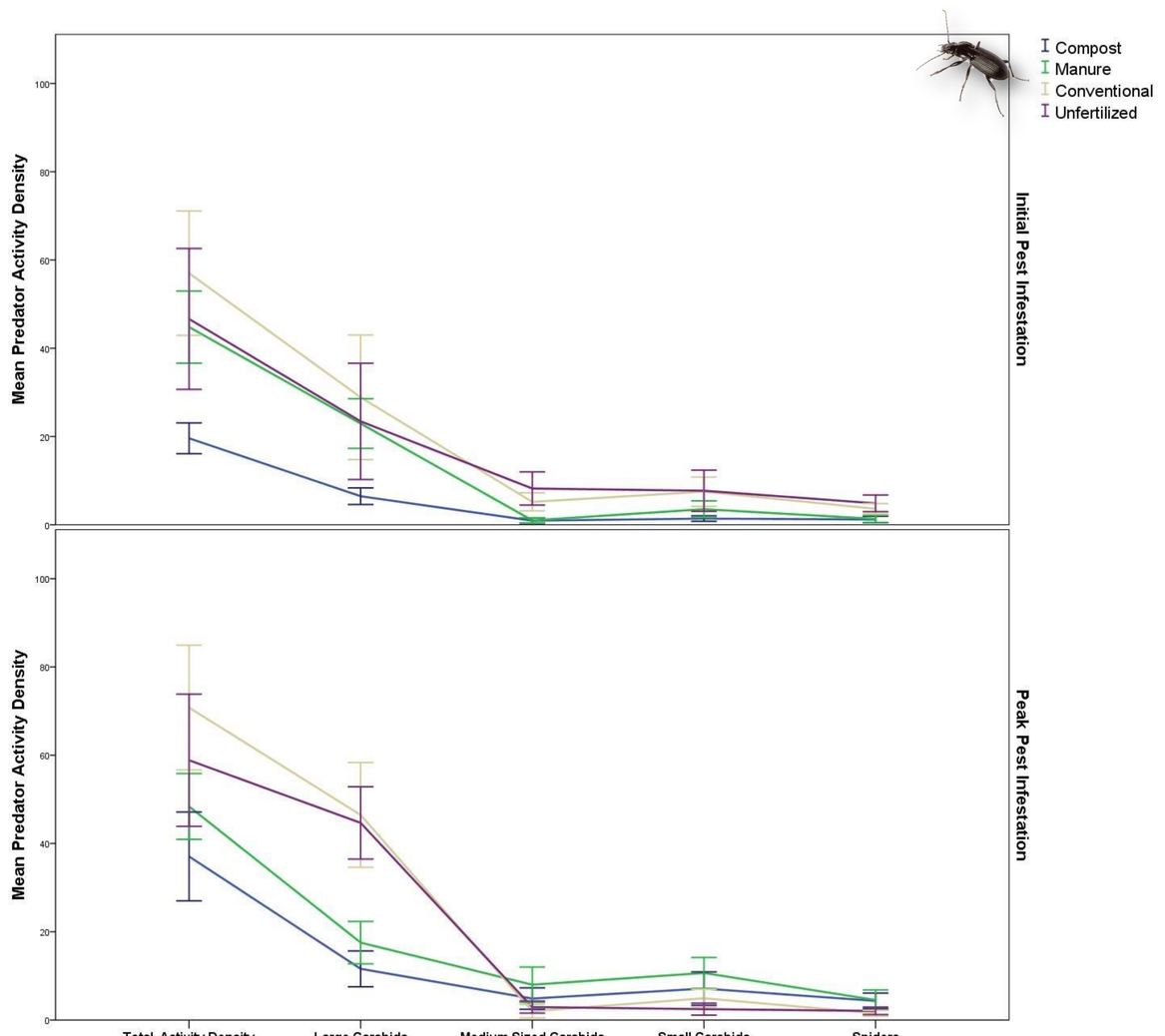


Figure B. Predator activity density increase between initial and peak pest infestation $F_{156.86,\ ***}$. At initial pest infestation, the proportional activity density of large carabids is lower in compost treatments $F_{17.29,\ ***}$, corresponding to effects on pest development (fig A). Later in the season, this effect becomes more pronounced $F_{57.23,***}$ and extend to manure treatments. In addition, there is an interaction between with treatment, season and predator group $F_{410.72,***}$ such that, at peak pest densities, the activity density of large carabids increase in conventional and unfertilized treatments, whereas medium-small carabids and spiders become less active. In compost and manure treatments this relationship is reversed such that the activity density of large carabids is reduced whereas the activity density of smaller predators increase.

Conclusions

I. Fertilization influence pest development, but not only through predation.
II. Activity density of predators is higher in conventional and unfertilized treatments. This relationship is not reflected by pest availability, however as pest increase it becomes more pronounced.
III. Large carabids account for the majority of overall activity density.
IV. In organic treatments, larger carabids become less active as pest infestation increase, whereas small and medium size carabids become more active. In conventional as well as unfertilized treatments this relationship is reversed, suggesting that fertilization could influence intra-guild interactions between predators.

In the near future, we will employ a suit of molecular techniques to produce extensive predator-prey interaction networks. These networks will, in combination with a range of plant and below ground variables, allow us to shed light on the interactions through which fertilization mediates ecosystem functions such as biological control.