Effects of forage plant diversity on the activity, diversity and function of the soil micro-food web in the Mediterranean area

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Introduction

The sustainable use of resources (e.g. forage quality, livestock) is just as important as maintaining or even increasing the productivity of agricultural systems. The use of a variety of seeds in forage production minimizes the risk of failures associated with yield losses due to unsuitable cultivation systems (e.g. monocultures) and climate change. In many Mediterranean countries, grass monocultures are favored under grazed conditions, despite their known disadvantages. Sown forage mixtures have shown a higher productivity and quality forage, enhanced yield stability, lower susceptibility to pests and diseases, reduced nitrogen need and decreased greenhouse gas emissions (GHG) compared to monocultures. Furthermore, mixtures show a better increased water and nutrient use efficiency as well as positive effects on soil biodiversity. All these abilities become more and more important, especially with less regular rainfall and stricter fertilization regulations.

Field Experiments in the Mediterranean Area

Experimental plots are established in representative study regions of different countries, following the climate gradient of the Mediterranean area.

Map of the Mediterranean area ©Wikimedia

Experimental design

Various mixtures of locally adapted plants (grasses, legumes and forbs) are planted.

- monocultures with only one plant
- 3 species mix (dominance of one species and balanced)
- 4 species mix (dominance of one or two species and balanced)
- 6 species mix (balanced)
- 9 species mix (balanced)

Of these mixtures, ungrazed and grazed versions are compared

From left to right: two grasses (*Lolium perenne* and *L. rigidum*,) a legume (*Medicago sativa*) and a forb (*Cichorium intybus*) ©Wikimedia

Indicators

Nematodes

Their high abundance and diversity as well as their influence on soil processes make nematodes good indicators. With the help of various ecological indices (Channel Index, Structure and Enrichment Index, Maturity Index, Plant Prasite Index and metabolic footprint) information about soil fertility and health as well as the carbon dynamics can be obtained.

Phospholipid fatty acids (PLFA)

PLFAs will be employed as tools to assess microbial biomass and community structure in the soil. The PLFAs are extracted, determined and assigned to the biomarkers representing the biomass of broad microbial groups (Gram-positive bacteria, Gram-negative bacteria, actinobacteria, arbuscular mycorrhiza and saprotrophic fungi). Multivariate analyses of PLFA pattern will provide information on community changes.

Root-knots

In order to determine the role of sown diversity on soil pest regulation, infection with plant parasitic nematodes will be determined in root samples collected at selected subplots. Here the root knots indicate the extent of the infection and the damage. While high infection rates have negative effects on plants, low-level root herbivory may even be beneficial for plant growth.