Requirements for Terrestrial Model Ecosystems (TME) in Environmental Risk Assessment – influence of coring sites and management on microarthropod communities

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Introduction

Terrestrial Model Ecosystems (TME) can serve as an intermediate tool between laboratory and field tests in the Environmental Risk Assessment (ERA) of plant protection products and have been proven to be a suitable test system for a refined risk assessment. These outdoor test systems realistically represent the field situation and allow the examination of effects on complex soil communities at different trophic levels (Scholz–Starke et al. 2011, Schäffer et al. 2008). At RWTH Aachen University in cooperation with Bayer CropScience a structural higher-tier TME-test system in soil ecotoxicology has been developed which is now considered to be ready for routine operations.

The initial situation of a TME study as well as the test conditions in the course of a one-year study can be quite variable depending on the selected habitat for coring of the test units and the management of the TME. Habitat selection and maintenance of the soil community are crucial issues, determining the representativeness, reproducibility and thus the validity of a test.

In advance we consider it necessary to answer three main questions:

1. Are there minimum requirements concerning the diversity and community structure of a TME site?
2. Which management strategies are suitable to sustain a stable test community over a one year period?
3. Do meadow sites contain a community which is protective for in-crop and off-crop sites?

Coring site and management scenarios

To answer these questions we tested the influence of different habitat management strategies on the soil microarthropod community (Collembola, Acari, Gamasina) in TME from two different coring sites. Additionally we tried to examine whether the management of the vegetation (mowing, fallow, mulching) within the test units (TME) has an influence on the population dynamics of the soil microarthropod community. To involve the structure and diversity of agricultural land as protection target in risk Assessment the study was carried out with an oatgrass meadow community system (off-crop).

Influence of the Coring Site

Methods

• Coring site: two meadows in the Eifel region (western Germany, near Monschau)
  A. Extensive meadow, no fertilization for more than 10 years (7 TME)
  B. Intensive meadow, conventionally fertilized with nitrogen, phosphate, potassium (6 TME)
• The sites were situated side by side, with the same geological soil properties
• Endpoints: species abundance and diversity

Results

Fig. 1: Picture of the coring sites; in front: intensive meadow, behind the fence: extensive meadow

Fig. 2: Abundance and species richness of soil arthropods from two meadow sites (whiskers indicate standard error)

Influence of the TME Management

Methods

Coring Site:
  oatgrass meadow near the river rhine (Monheim)

Treatments:
  Fallow: no usage
  Mowing: mowing of the grass every month, including the grass layer in the sampling soil arthropods in TME
  Mulching: establishing of the grass every month, according to standard literature

Replicates:
  8 TME for each treatment

Samples:
  a. description of 8 cm core taken for each TME and coring date

Duration:
  T1: April 15
  T2: May 15
  T3: June 30
  T4: November 4

Fig. 3: Population dynamics of soil arthropods Gamasina, Oribatida, Collembola, in Terrestrial Model Ecosystems; demonstrated are mean numbers of individuals /m² (whiskers indicate standard error), T1–T4 are four sampling dates

Conclusion

• Soil arthropods could be quite variable in numbers of individuals and in diversity depending on the meadow site
• It is essential to screen the coring site on its species structure to fulfill statistical evaluation requirements
• The Influence of the TME management within one year has minor effect on soil community
  - Most of typical in-crop systems are having reduced diversity concerning their soil community (Theißen 2010) and according to that, TME cored in–crop would not generate data being sufficiently protective for diversity of soil fauna
  - The study focus regarding important soil taxa should be addressed carefully before setting the coring site

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