European Mesofauna Under Drought Stress

- Evidence from Wheat Fields

Svenja Meyer
THE SOILCLIM PROJECT

• BiodivERsA-project

• **Soil** system under **climate** change

• Different levels of **soil carbon** content

• Study system: agricultural fields (winter wheat)
THE SOILCLIM PROJECT

Two experiments

2017: Switzerland
- Drought effects in conventional and biodynamic farming
- Evaluation of drought simulation

2018: Sweden, Germany, Spain
- Drought effect on soils with different organic carbon content
Climate change models for Europe

• Temperature: increase!

• Precipitation: patterns change

➢ Combination of T and precipitation models: *Soil moisture*
CLIMATE CHANGE – SOIL MOISTURE

- Decline, especially during the growing season
- Decline, especially from mid summer to autumn
- Clear decline all year round

THE RAINOUT-SHELTERS

Design and Manual to Construct Rainout-Shelters for Climate Change Experiments in Agroecosystems

Dominika Kundel1,2*, Svenja Meyer1, Herbert Birkhofer1, Andreas Fillesbach1, Paul Mäder1, Stefan Schau1, Mark van Kleunen1,2 and Klaus Birkhofer4

1 Soil Sciences Department, Research Institute of Organic Agriculture (FIO), Frick, Switzerland. 2 Department of Biology, University of Konstanz, Konstanz, Germany. 3 Animal Ecology, J.R. Bunkenbus Institute for Zoology and Anthropology, University of Gottingen, Gottingen, Germany. 4 Product Development and Machine Elements, Faculty of Mechanical and Process Engineering, Darmstadt University of Technology, Darmstadt, Germany. * Cheley Provost, May Laboratory of Hert, evolutionary biology and conservation, Tsinghua University, Beijing, China. 5 Department of Ecology, Brandenburg University of Technology, Cottbus, Germany
The Rainout-Shelters

Characteristics

- 2.5 × 2.5 × 1.2–1.7 m (6.25 m²)
- V-shaped acrylic glass bands
- Exclusion of 65% of ambient precipitation
- Edge-effect on soil moisture of max. 0.75 m: 1 m x 1 m sampling area

... Reality
THE RAINOUT-SHELTERS

... Reality

Three experimental treatments

• **Roof** (“R”): Rain exclusion
• **Roof Control** (“RC”): Roof construction without exclusion
• **Control** (“C”): ambient control
Two

Three experimental treatments

- **Roof** ("R"): Rain exclusion
- **Roof Control** ("RC"): Roof construction without exclusion
- **Control** ("C"): ambient control
The DOK trial – a long term experiment

• Close to Basel

• Since 1978

• Comparison of biodynamic, organic and conventional farming

• We used
  ➢ conventional farming with mineral fertilizer (low carbon content)
  ➢ biodynamic with organic fertilizer (high carbon content)
**Sampling**

**MacFadyen**
- 5 cm Ø
- 10 cm depth

- **Mesofauna**

**Kempson**
- 20 cm Ø
- 10 cm depth

- **Macrofauna, Mesofauna**
Rainout-Shelter Performance

- March: comparable soil moisture
- April: trend
- May: roof treatment with significantly lower soil moisture
- June: differences decrease
• March: comparable soil moisture

• April: trend

• May: roof treatment with significantly lower soil moisture

• June: differences decrease
RESULTS - Oribatida

9 species

- *Scheloribates laevigatus*
- *Tectocepheus velatus sarakensis*
- *Oppiella subpectinata*
- *Oppiella nova*
- *Suctobelbella sp.*
- *Zygoribatula excavata*
- *Phthiracarus compressus*
- *Ceratozetes mediocoris*
- *Ceratozetes gracilis*
RESULTS - Oribatida

- Rain exclusion decreases Oribatida abundance
- Little decreased abundances in conventional compared to biodynamic system

GLMM: Oribatida ~ Rain Exclusion Treatment * Carbon Content + (1|Block/Carbon Content); Rain Exclusion Treatment: p < 0.001
RESULTS - Oribatida

Drought treatment

Farming system
RESULTS - Collembola

33 species

- Brachystomella parvula
- Neotullbergia crassicuspis
- Neotullbergia tricuspis
- Stenophorurella quadrispina
- Stenophorurella parisi
- Ceratophysella denticulata
- Ceratophysella gibbosa
- Paratullbergia macdougalli
- Mesaphorura pongei
- Mesaphorura kraubaueri
- Mesaphorura macrochaeta
- Parisotoma notabilis
- Cryptopygus thermophilus
- Isotomurus fucicolus
- Isotomurus maculatus
- Isotomurus graminis
- Isotoma viridis
- Isotoma caerulea
- Folsomia candida
- Orchesella villosa
- Heteromurus major
- Heteromurus nitidus
- Sminthurinus elegans
- Sminthurinus aureus
- Sminthurinus niger
- Stenacidia violacea
- Sphaeridia pumilis
- Deuteromimus pallipes
- Lepidocyrtus cyaneus
- Pseudosinella alba
- Pseudosinella petterseni
- Sinella tenebricosa
- Entomobrya lanuginosa
• Drought decreased Collembola in conventional farming

• Drought increased Collembola in biodynamic farming

**RESULTS - Collembola**

GLMM: Collembola ~ Rain Exclusion Treatment * Carbon Content + (1|Block/Carbon Content); Interaction: p < 0.001
RESULTS - Collembola

**Drought treatment**

**Farming system**

Reduction to 3 dimensions, stress = 0.071
• Drought decreased Collembola in biodynamic farming

• In conventional farming nearly no effect of roof treatment

RESULTS - Epigeic Collembola

GLMM: Epigaec Collembola ~ Rain Exclusion Treatment * Carbon Content + (1|Block/Carbon Content); Interaction: p < 0.05
RESULTS - Epigeic Collembola

Drought treatment

Farming system

reduction to 2 dimensions, stress = 0.095
RESULTS

- Only Collembola escape to deeper soil under drought
SUMMARY

• Oribatida:
  ➢ decreased under drought simulation
  ➢ Different communities in the two farming systems

• Collembola
  ➢ Different communities in the two farming systems
  ➢ decreased under drought simulation in conventional system
  ➢ increased under drought simulation in biodynamic system

• Epigeic Collembola
  ➢ Different communities in the two farming systems
  ➢ decreased under drought simulation in biodynamic system

Drought vulnerability
SUMMARY

- **Oribatida:**
  - Decreased under drought simulation
  - Different communities in the two farming systems

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  - Decreased under drought simulation in conventional system
  - Increased under drought simulation in biodynamic system

- **Epigeic Collembola**
  - Different communities in the two farming systems
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SUMMARY

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Drought vulnerability (at low $C_{org}$)

Drought vulnerability (at high $C_{org}$)
Thank you for your attention!