Climate change induced rainfall patterns affect wheat productivity and agroecosystem functioning dependent on soil types

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Introduction

Regional climate change scenarios for eastern Austria (Pannonian region) predict fewer but heavier rains during the vegetation period without substantial changes in the total annual amount of rainfall. While many studies investigated the effects of rainfall patterns on ecosystem properties, very little is known on how different soil types might alter ecosystem responses.

Materials and Methods

Study site

AGES lysimeter station consisting of 18 lysimeters (3 m^2) cultivated with winter wheat (*Triticum aestivum*) according to good farming practice (Fig. 1)

Fig. 1. Lysimeter site at AGES Vienna: Experimental plots (above) and basement of lysimeters (below)

Factors manipulated

1. **Rainfall:** Current (30 year mean amount) vs. prognosticated rainfall patterns based on regional climate scenarios (CNRM 2071-2100) as derived from the IPCC 4th Assessment Report (2007). Rainfall patterns were modelled using a stochastic weather generator (LARS-WG version 5.0).
2. **Three main soil types of the region:** Sandy calcaric phaeozem (S), gleyic phaeozem (F), calcic chernozem (T). Each factor was replicated three times

Parameters measured

- **Ground cover** – analysis of photos with image analysis
- **Leaf area index** – measured with ceptometer
- **Weed infestation** – measured on permanent areas
- **Root growth** – assessed with root ingrowth cores
- **Mycorrhization** – measured under the microscope after ink staining
- **Insect pests** – direct sampling
- **Primary production, yield** – destructive harvest

Statistics

ANOVAs using statistics package R

Results and Conclusions

Wheat yield (per plant) was significantly affected by soil type but unaffected by rainfall patterns (Fig. 2). Root mycorrhization was significantly lower under prognosticated rainfall and marginally affected by soil types (Fig. 3). Weed communities were significantly influenced by both soil types and rainfall patterns (Fig. 4).

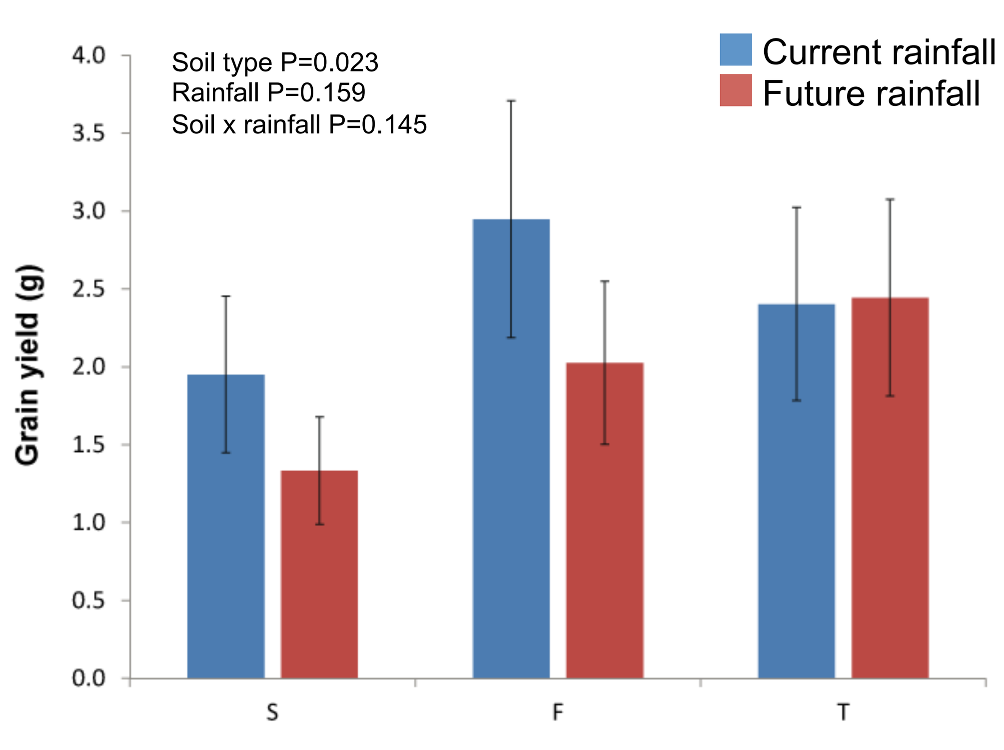

Fig. 2. Yield of winter wheat under current and future rainfall on three different soil types (S, F, T). Means ± SD, n = 15

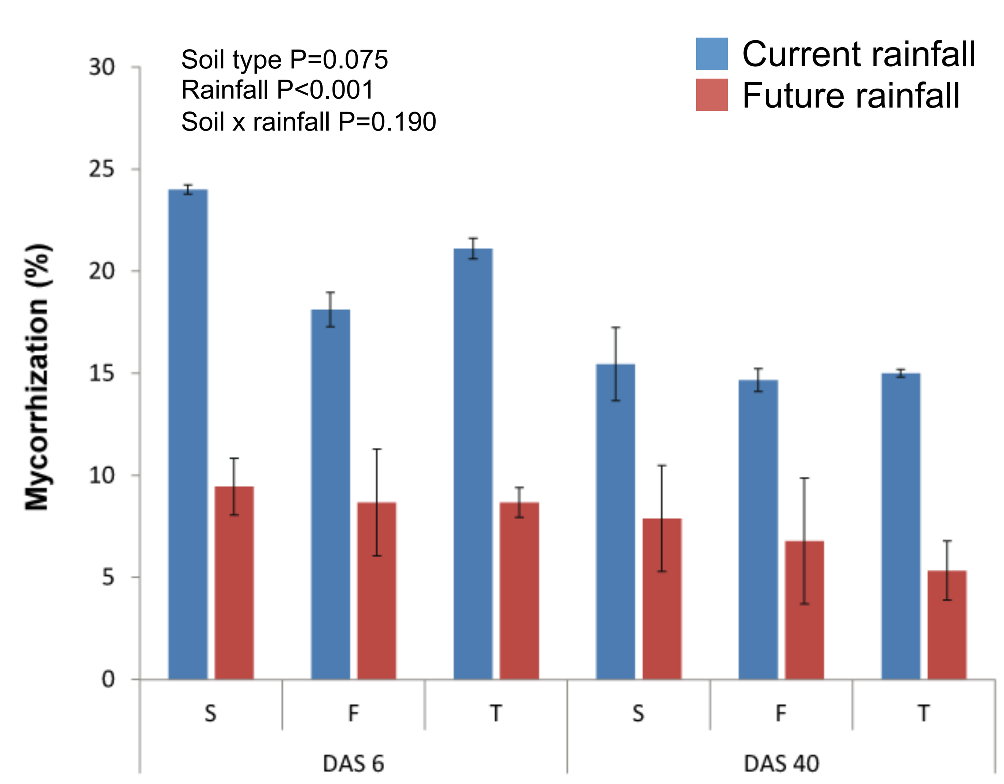

Fig. 3. Percentage of AMF at the early growth stages (DAS 6) and during booting (DAS 40) under current and future rainfall on three different soil types (S, F, T). Means ± SD, n = 3

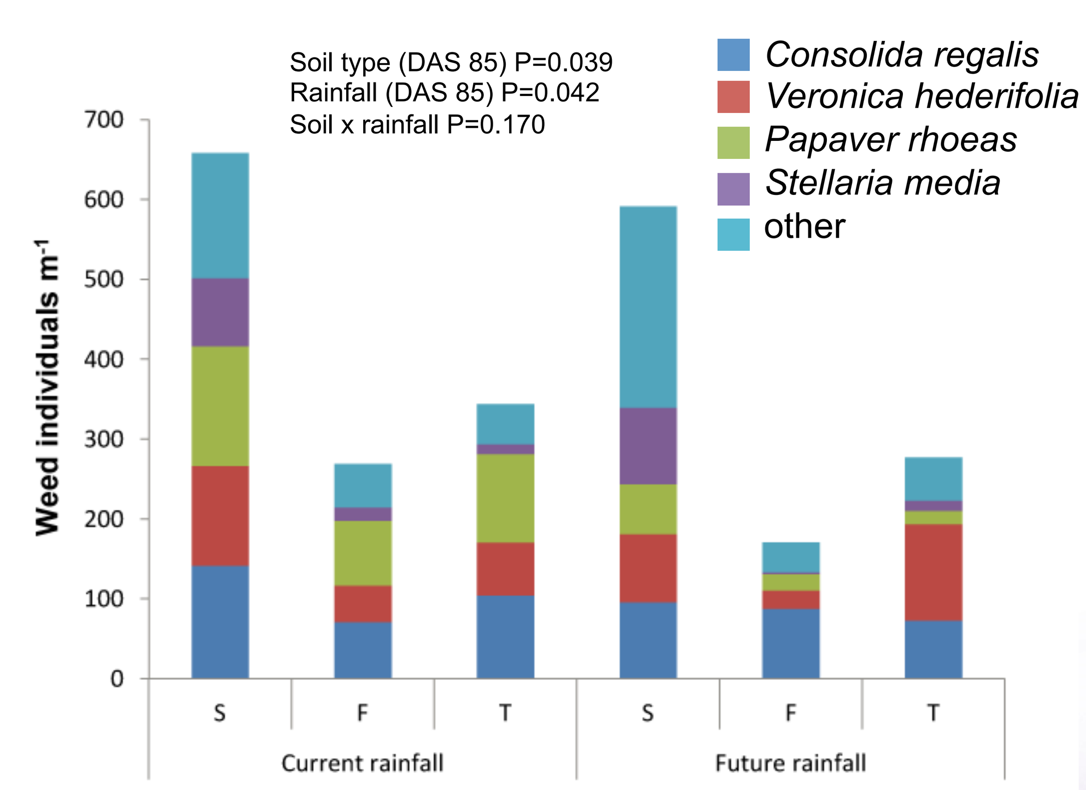

Fig. 4. Composition of weed communities under current and future rainfall on three different soil types (S, F, T).

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Our results show that various properties of agroecosystems will be affected either by future rainfall patterns or by soil types. The lack of significant interactions between rainfall patterns and soil types indicates that the role of different soil types in triggering responses to climate change seem to be minor, at least under the circumstances studied here.

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