Soildiver Agro

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CASE STUDY 10a

Soil biodiversity enhancement in European agroecosystems to promote their stability and resilience by external inputs reduction and crop performance increase

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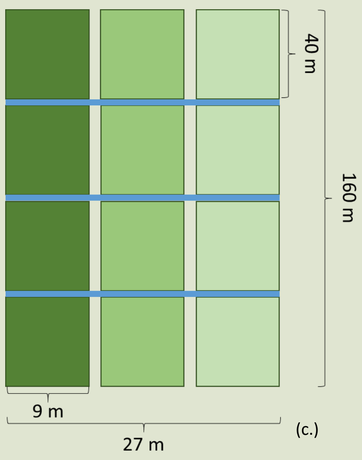
Initial experimental approach

Initially, the same experimental approach was to be followed in **the continental region** in CS10a (conventional potato cultivation) as in CS10b (organic potato cultivation): (i) evaluation of the biocontrol potential of fungivorous soil animals with respect to *Fusarium* and *Alternaria* and their mycotoxins, and (ii) promotion of fungivorous soil fauna communities in potato crops. For this purpose, the corresponding treatments (see poster for CS10b) were established in the experimental field and sampled in 2021.

- Cropping system: conventional
- Location: Nideggen (North Rhine-Westphalia)
- Mean annual temperature: 8.8 ºC
- Mean annual precipitation: 600 mm



- Control (chemical seed treatment)
- Inorganic seed treatment + seed furrow treatment (ITN)
- Biological and inorganic seed treatment + seed furrow treatment (BITN)
- Herbicide application between replications

Crop 2020: winter wheat
Crop 2021: potato
Crop 2022: winter wheat

Fig. 1 Location of the experimental field (a.), arrangement of plots on the field (b.) and experimental design (c.).

Fig. 2 New wheat trial in April 2022.

Problems

In the summer of 2021, a flood disaster occurred in North Rhine-Westphalia, the location of case study 10a. The trial treatments in the potato field were completely destroyed by heavy rain. More than 50% of the potatoes were infected with late blight (*Phytophthora infestans*) and could not be sold. The **potato experiment had to be cancelled**.

The undersowing was washed away by masses of water

All treatments were destroyed

Late blight (*Phytophtora infestans*) in all plots due to extreme humidity

Over 50% of potatoes were infested and could not be sold

Sowing of wheat: October 2021
First sampling: June 2022

Solution

Since the cultivation of potatoes in two consecutive years is to be avoided for phytosanitary reasons and an alternative field was not available, a **new wheat trial** was planned for 2022 on the same field as a new case study 10a. This case study is therefore continued with a new thematic focus: Biocontrol of soilborne phytopathogenic fungi by fungivorous soil fauna communities in **conventional wheat cropping systems**.

Background

In the continental region, increasing infestation pressure from soilborne plant pathogenic fungi such as Fusarium is posing increasing challenges to agriculture. In particular, factors such as rising temperatures due to global climate change, densely growing stands, tight crop rotations, and reduced tillage intensity favor the survival and spread of fungal diseases, leading to a reduction in yield levels and, through mycotoxin formation, also in yield quality. In the long term, negative effects on soil health, e.g. through leaching of mycotoxins, are to be expected.

State of the art

To reduce the incidence of fungal diseases, many external inputs (mainly fungicides) are currently used. For example, it is common practice to chemically treat cereal seed (e.g. wheat) with plant protection products to protect the seed or planting material from fungal attack and also from pests (e.g. insects) to which seedlings are particularly susceptible. To prevent emergence diseases, cereal seed is treated with fungicides. In addition, large quantities of plant protection products and fertilizers are used during the crop growing season to ensure optimum crop protection and nutrient supply.

Objective

In this case study, alternative seed treatments and seed furrow treatments are applied in conventional wheat production to increase root growth and fine root formation, improve plant water and nutrient uptake, and promote soil productivity and soil biodiversity. The objective of this case study is to assess the potential of these practices to improve soil self-regulatory processes and reduce fungal diseases (Fusarium) by promoting antagonistic fungivorous soil fauna.
In this context, the following treatments (Fig. 1) are investigated:
(1) Conventional chemical seed treatment (Control)
(2) Inorganic (phosphorus-potassium-based) seed treatment + seed furrow treatment with liquid micro- and macro-nutrients (injection) (ITN)
(3) Biological (bacteria-based) and inorganic (phosphorus-potassium-based) seed treatment + seed furrow treatment with liquid micro- and macro-nutrients (injection) (BITN)
In treatments (2) and (3), fertilization during the vegetation period is carried out demand-oriented. For technical reasons, the seed row spacing in all treatments (1-3) is 22.5 cm (Fig. 2).

Progress with the case study in relation with the state of the art

The use of biologically and inorganically treated seed reduces chemical inputs, accelerates root growth, and increases biological activity around the seeds. This way, fungivorous soil fauna communities (antagonists of fungal pathogens) are also promoted and soil intrinsic self-regulation processes are strengthened. Such promotion of soil self-regulation in wheat cultivation helps to (i) reduce the amounts of external inputs, mainly fungicides, (ii) enhance the fertility of soil, (iii) improve product quality and (iv) reduce farmers costs and make cereals economically more competitive. Seed furrow treatments with micro- and macronutrients can help to reduce fertilizer inputs during the growing season.

Sampling and experimental parameters

General sampling - Climatic factors, soil conditions, crop parameters, biodiversity: annually at BBCH stages 39 and 90 +

Experimental sampling - Treatment effects on soil intrinsic bioregulation: annually at BBCH stages 39 and 90:

Samples:	Parameters:
• **Soil samples (0-25 cm) for extraction of microarthropods (collembolans, mites) (n=3) (BBCH 39)**	• Abundance • Diversity • Share of fungivorous species
• **Litter from the soil surface** (50 x 50 cm) (n=3) (BBCH 39) • **Plant material** (wheat) (BBCH 39 and 90)	• Litter amount • DNA amount of *Fusarium* species • Mycotoxin contamination

First sampling: June 2022