CONTINENTAL

RESPONSIBLE PARTNER

Thünen-Institute (TI), (Germany)

COORDINATION

Stefan Schrader

Stefan Schrader is Deputy Head of the Thünen-Institute of Biodiversity in Braunschweig, Germany, and leader of the soil zoology working group. He is Professor for Soil Biology and Soil Ecology at the Technical University of Braunschweig. His research activity focuses on functional diversity of soil fauna and its provision of ecosystem services in agricultural systems.

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Objective

In the Continental region, increasing infestation pressure from soil-borne pathogens, especially from phytopathogenic fungi such as Fusarium or Alternaria, is increasingly posing challenges to agriculture. This affects both conventional and organic cultivation of cereals, but also of root crops such as potatoes. The main reasons for this development are rising temperatures as a result of global climate change, densely growing stands and tight crop rotations, especially in high-yield regions, and the reduction of soil tillage intensity to avoid soil erosion. Especially in combination with wet weather conditions, these factors favour the survival and spread of fungal diseases, leading to a reduction in yield levels and, through the formation of mycotoxins, also in yield quality. In the long term, negative effects on soil health, for example through leaching of mycotoxins, cannot be ruled out. In order to counteract this increasing infestation pressure and to avoid associated negative effects, high amounts of external inputs, especially fungicides and plant growth regulators, are currently being applied. However, these high application rates of plant protection products are not without risk, as they endanger soil biodiversity and, as a consequence, the resilience of agroecosystems.

Against this background, there is a great demand for alternative methods of controlling fungal pathogens. In this context, natural bottom-up bioregulation provides a promising approach, as fungivorous soil fauna communities represent effective antagonists against fungal pathogens, which can also accelerate the degradation of mycotoxins. With SoildiverAgro, we aim to identify management measures in wheat and potato cultivation that promote fungivorous soil fauna communities and ensure optimal use of the ecosystem service "bioregulation". The focus is on the use of undersowing and increasing seed row spacing while reducing pesticides. Thus, the case studies are conducted within commercial farms in close collaboration with farmers and other stakeholders. The results can help to increase the sustainability of agriculture by reducing external inputs (primarily fungicides) through the promotion of soil biodiversity. Therefore, proper knowledge transfer is aimed to farmers, consultants and decision makers.

Stakeholders consultations

DISCUSSION GROUP

03.11.2020 | Germany (Online)

Identification of farmers' demands for consideration in case studies 10 and 11

9 PARTICIPANTS: Farmers, researchers, agribusiness

REGIONAL MEETING

19.02.2020 | Germany

Summarizing feedback of German stakeholders at the WP2 questionnaire; planning the design of case studies 10 and 11

6 PARTICIPANTS: Farmers, researchers, agribusiness

13.11.2020 | Germany (Online)

Decisions on design of and management in case studies 10 and 11 based on the outcome of the discussion group

4 PARTICIPANTS: Farmers, agribusiness

19.01.2021 | Germany (Online)

Consultation and discussion of different possibilities to realize the undersowing treatment in case study 10

8 PARTICIPANTS: Farmers, agribusiness

19.03.2021 | Germany (Online)

Planning and decision on the technical process to establish the treatments in case study 10

7 PARTICIPANTS: Farmers, agribusiness

OTHERS

To be confirmed

FIELD DAYS

18.08.2021 | Nideggen (Rhineland), Germany

Oral presentations and an excursion to the experimental plots of Biocontrol of soil-borne phytopathogenic fungi by fungivorous soil fauna communities in potato cropping systems and Plant diversity is tested to promote soil intrinsic self-regulating processes and to enhance fungivorous soil fauna communities in wheat-cropping systems

38 PARTICIPANTS: Farmers, journalists and consultants

TRAINING DAYS

28.10.2021 | Braunschweig, Germany

Project introduction and presentation of aims and structure as well as first results.

16 PARTICIPANTS: Students

NEXT STEPS

A minimum of 2 field days per year will be organised to inform and consult stakeholders and everybody interested.

CASE STUDY 10

Biocontrol of soil-borne phytopathogenic fungi by fungivorous soil fauna communities in potato cropping systems.

OBJECTIVE

The objective of this case study is (i) to assess the biocontrol potential of fungivorous soil fauna communities and (ii) to promote fungivorous soil fauna communities in potato cropping systems.

PROPOSED PRACTICES

It is aimed to identify management practices which protect and promote fungivorous soil fauna communities in conventional and organic farming. The management practices to be tested will be decided together with the farmers including undersowing.

STATE OF THE ART

The external input by farmers to combat the problem of fungal pest incidence are high pesticide applications (conventional farming) and high tillage intensity (conventional and organic farming), which reduce functional soil biodiversity. E.g. during months May and June, fungicides are sprayed in potatos on average once a week, accounting for up to 90% of the total amount of pesticides in this crop. Farmers are advised to consider cultivation breaks of 5 years for potatoes in their crop rotation. For economic reasons, the rotation sequence can be tightened down to 3 years. In the short-term, farmers financially benefit more from comparatively high prizes for potatoes. In the long-term, soil conditions are threatened.

PROGRESS WITH THE CASE STUDY IN RELATION WITH THE STATE OF THE ART

Reduced external input and modified management will strengthen soil intrinsic self-regulating processes. A synergistic interaction between farmers' management (top-down control) and soil fauna services (bottom-up control) for fungal plant pest control (i) protects the soil; (ii) increases system resilience in arable land; (iii) reduces management costs and (iv) makes root crop products economically more competitive by improving product quality and avoiding yield depression.

PROBLEM TO SOLVE

In moist soil, risks for incidence with e.g. Fusarium spec. and Rhizoctonia spec. increase which threaten quality and quantity of e.g. root crops (here: potato). This situation leads to higher input intensities by farmers which make the agroecosystem less resilient including loss of soil biodiversity.

CROPS

LOCATION

Nideggen (Germany)

Trippigleben - Klötze (Germany)

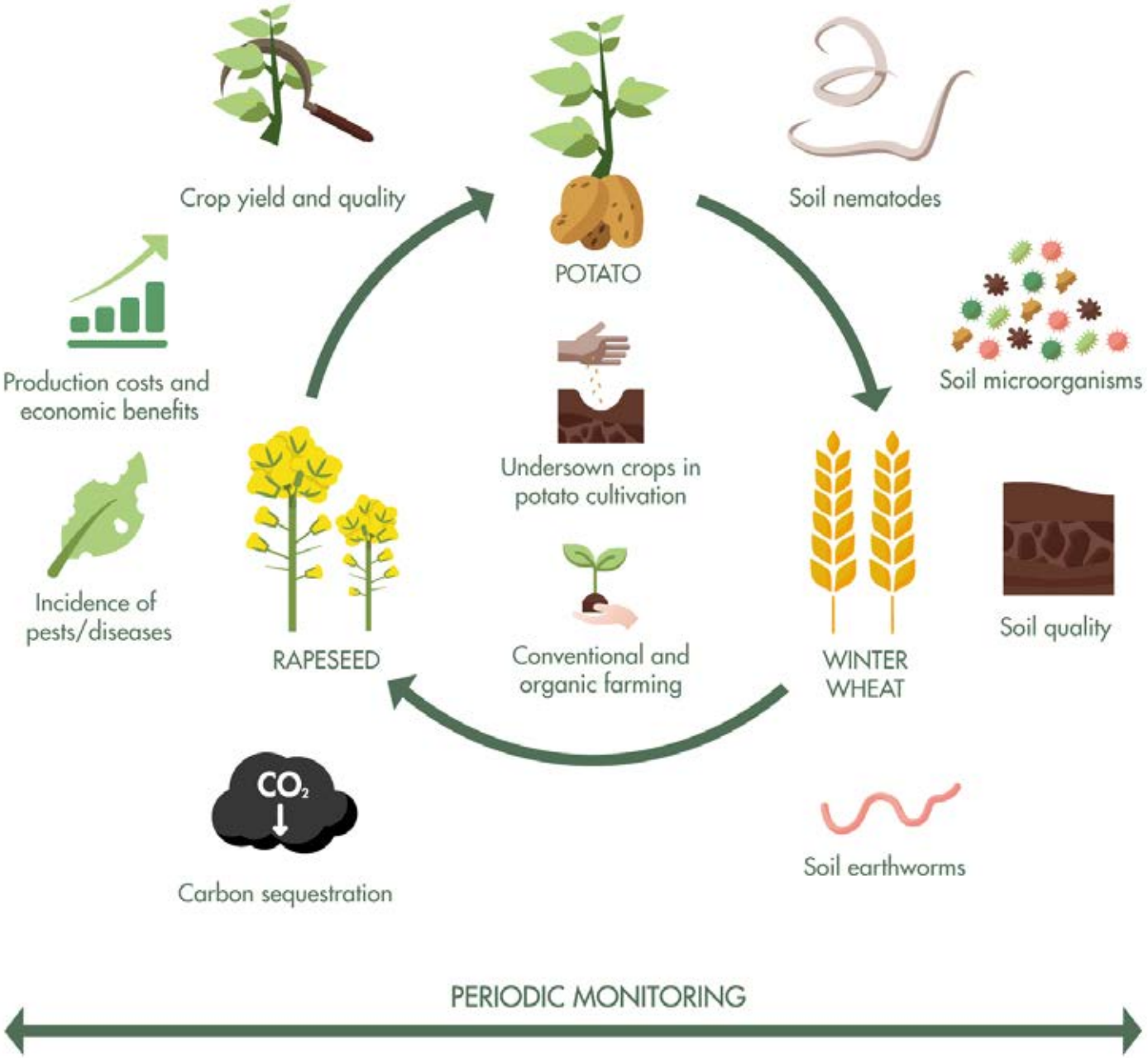
PARTNERS

TI

FAR

CROPPING SYSTEMS

Crop rotation, use of undersown crops, and different undersowing techniques.


Crop yield and quality
POTATO
Soil nematodes
Production costs and economic benefits
Soil microorganisms
Undersown crops in potato cultivation
Incidence of pests/diseases
RAPESEED
Conventional and organic farming
WINTER WHEAT
Soil quality
CO_2
Carbon sequestration
Soil earthworms
PERIODIC MONITORING

→ *Infographic for case study 10 made by FAR*

CASE STUDY 11

Plant diversity is tested to promote soil intrinsic self-regulating processes and to enhance fungivorous soil fauna communities in wheat-cropping systems.

OBJECTIVE

The objective of this case study is to assess the potential of plant diversity in wheat cultivation to reduce fungal diseases and strengthen soil intrinsic self-regulating processes. In this context we will investigate (i) wheat grown in extensive farming (reduced seeding rate, no pesticides) as well as (ii) the diversification of the extensive farming of wheat by adding undersown crops (including legumes). Both (i) and (ii) are supposed to increase associated plant diversity within the crop, with (ii) also enhancing sown plant diversity. Both (i) and (ii) are compared to conventionally cropped wheat at the same site.

STATE OF THE ART

Usually a very high level of external inputs (mainly fungicides but also stalk-reducing substances) is used to reduce the incidence of fungal diseases. Increasing amounts of cereals within the crop rotation favour the spread of soil-borne phytopathogenic fungi also in the following vegetation period, leading to even higher fungicide application rates. The reduction of tillage in terms of preventing soil erosion and lowering farmers costs additionally promotes soil-borne phytopathogenic fungi.

PROPOSED PRACTICES

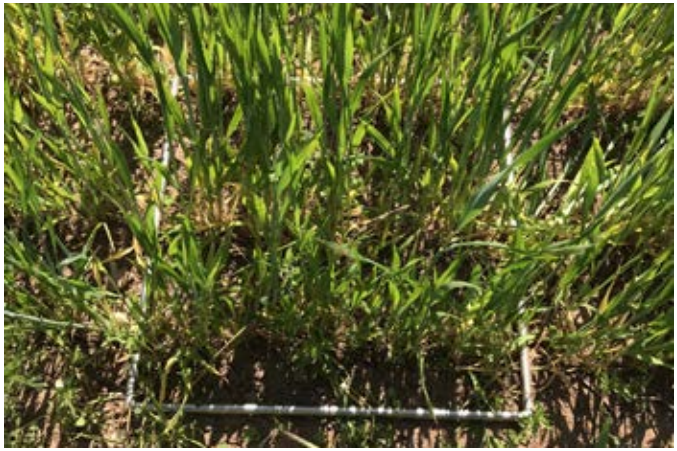
We will identify suitable adjustments of wheat crop rotations that will help farmers to reduce fungal diseases without a further increase of external inputs. The proposed adjustments will be fitted in dialogue with the farmers.

PROGRESS WITH THE CASE STUDY IN RELATION WITH THE STATE OF THE ART

The promotion of soil intrinsic self-regulating processes and the enhancement of fungivorous soil fauna communities in wheat-cropping systems will help 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 the grown cereals economically more competitive.

PROBLEM TO SOLVE

The cropping of wheat is very susceptible to soil-borne phytopathogenic fungi. Especially in regions of generally high yields due to very fertile soils (e.g. aeolian silt) with tight seed rows, fungal diseases can spread easily, leading to a significant reduction of yield and nutritional quality.



CROPS

LOCATION

Nideggen (Germany)

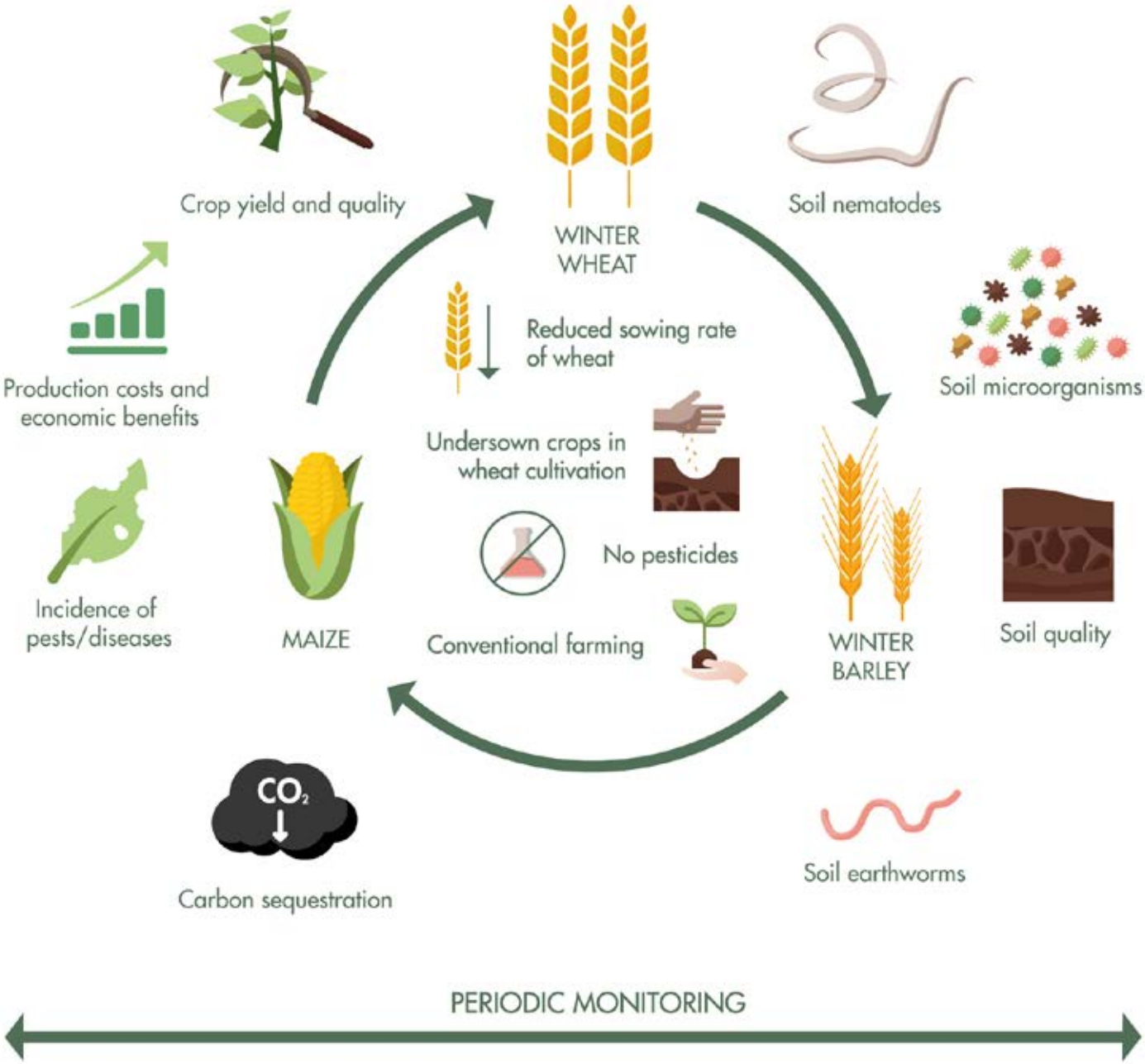
PARTNERS

TI

FAR

CROPPING SYSTEMS

Crop rotation, reduced sowing rate, no pesticide application, and use of undersown crops.


Crop yield and quality
WINTER WHEAT
Soil nematodes
Production costs and economic benefits
Reduced sowing rate of wheat
Soil microorganisms
Undersown crops in wheat cultivation
Incidence of pests/diseases
MAIZE
No pesticides
WINTER BARLEY
Soil quality
Conventional farming
Soil earthworms
CO_2
Carbon sequestration
PERIODIC MONITORING

→ *Infographic for case study 11 made by FAR*