Soildiver Agro

REGIONAL COMMUNITIES & CASE STUDIES

www.soildiveragro.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 817819

DECEMBER 2023 - 3rd Edition
Edited and design by Fundación Empresa Universidad Gallega (FEUGA)

PREFACE

Innovative management practices and cropping systems with potential positive effects on European agriculture via farm productivity, soil biodiversity and environmental quality will be analyzed and/or tested in SoildiverAgro project. With this aim, 15 field case studies were established in real commercial farms and experimental plots provided by SoildiverAgro beneficiaries.

Field case studies are based mainly on wheat and potato, two crops widely cultivated in Europe across the different European pedoclimatic areas. They can be found in almost all European countries covering large areas of arable land. Wheat is the most important crop among cereals in terms of surface and production, whereas potato is the most important among root crops. Vegetables will be also considered in diversified-cropping systems. SoildiverAgro is testing innovative management practices and cropping systems based on mycorrhiza and plant growth promoting bacteria, appropriate management of soil organisms, suitable crop rotations and intercropping, pest alert systems, nutrient catch crops, trap crops for pest control, by-products as soil ameliorants and adequate tillage systems. All these management practices and cropping systems aim for: 1) enhancement of soil biodiversity; 2) reduction of pest/diseases incidence; 3) increases in plant growth and development; 4) increases in crop yields, quality and value; 5) the reduction of inputs (fertilizers, pesticides, water, fuel); 6) increases in soil fertility; 7) reductions of soil and water contamination; 8) reduction in GHG emissions; and 9) increase in soil C sequestration. Case studies were setup in farms from 6 pedoclimatic regions: Mediterranean South (MDS), Lusitanean (LUS), Atlantic Central (ATC), Atlantic North (ATN), Nemoral (NEM) and Boreal (BOR). These regions still cover all the main climatic regions in Europe (Mediterranean, Atlantic, Continental and Boreal), as well as a large edaphic variability.

David Fernández Calviño
Project Coordinator

Content

Multi-actor approach (MAA)

SoildiverAgro is a multi-actor project which follows a methodolody based on the relationships between 3 different groups, organized and composed by several actors to involve multipliers from all the whole value chain:

- **SoildiverAgro partners.**
  SoildiverAgro consortium involves 22 partners from 7 EU countries.
- **External Advisory Board.**
  The main function of the External Advisory Board (EAB) is the evaluation of project progress, and providing guidance regarding future work.
- **SoildiverAgro Community.**
  Farmers will be engaged by region (Mediterranean, Lusitanean, Atlantic, Continental, Nemoral, Boreal).

This strategy is addressed to ensure an effective involvement of Stakeholders throughout the SoildiverAgro life span and beyond.

Objectives:

- To improve knowledge exchange between scientists, and stakeholders.
- To co-create new knowledge.
- To put into practice research results.
- To boost interactive and demand-driven innovation.
- To focus on real problems or opportunities.
- To allow partners with complementary types of knowledge join forces in the project activities from the beginning to the end.

In order to reach these objectives, the project Work plan includes several activities directly involving a relevant number of stakeholders (surveys, discussion groups, consultation/demonstration workshops, field days, etc.) based on the involvement level needed.

→ *Involvement level*

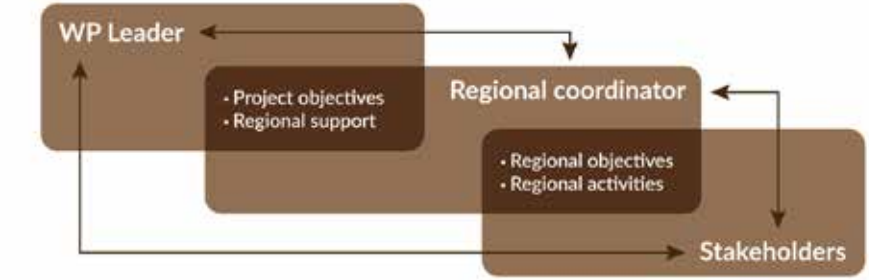
Methodology

This methodology is conceived as a matrix organizational structure with two main dimensions:

- **Geographical dimension.**
  This structure is conceived considering the "Regional Coordinator" (RC) as a facilitator (following the Innovation Brokering concept to contact the end-users and involve different stakeholders covering the whole value chain at local/regional level (policy makers, industry, consumers, etc.). Working with "umbrella" organizations such as cooperatives, associations, etc. will be key to reach a relevant number of stakeholders.
- **Technical dimension.**
  This structure is composed of "WP leaders (WPL)" that will need to interact with the stakeholders (through the regional communities) to collect information, validate information, disseminate results or simply communicate about the project activities. WP Leaders will have a scientific responsible role charge of preparing the technical contents to be exchanged with stakeholders.

"Stakeholder is any identifiable groups or individual who can affect or is affected by organisational performance in terms of its products, policies an work process"

↳ *R. E. Freeman, 1984*



→ *MAA methodology work flow*

Map of case studies

CS 15 *PETLA* — Nutrient catch crops

CS 14 A/B *MTJ/TT* — Till systems

CS 13 *PETLA* — By-products

CS 12 *EULS* — Till system; Pest alert systems; Suitable crop diversification

CS 11 *FAR* — Organisms interaction management

CS 10 *FAR* — Organisms interaction management

CS 9 *POMONA* — By-products

CS 8 *PSKW* — Till systems; By-products

CS 7 *INAGRO* — Suitable crop diversification

CS 6 *ILVO* — By-products; Suitable crop diversification

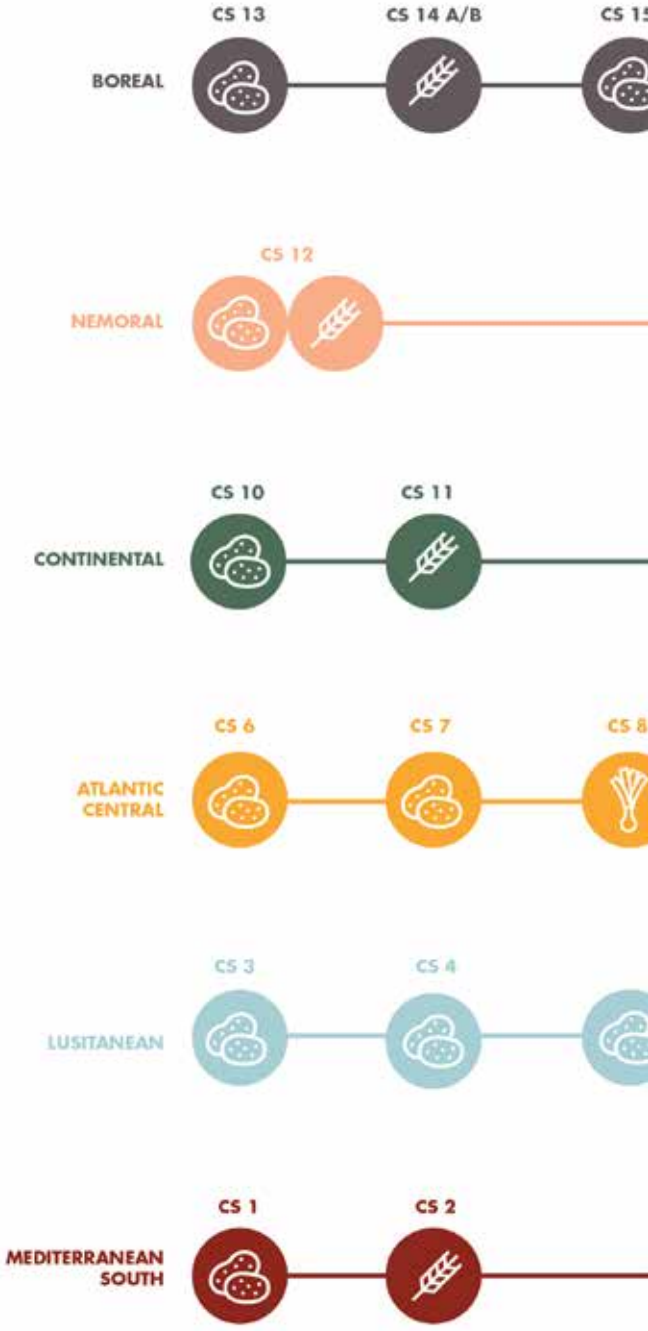
CS 5 *UVIGO* — Pest alert system

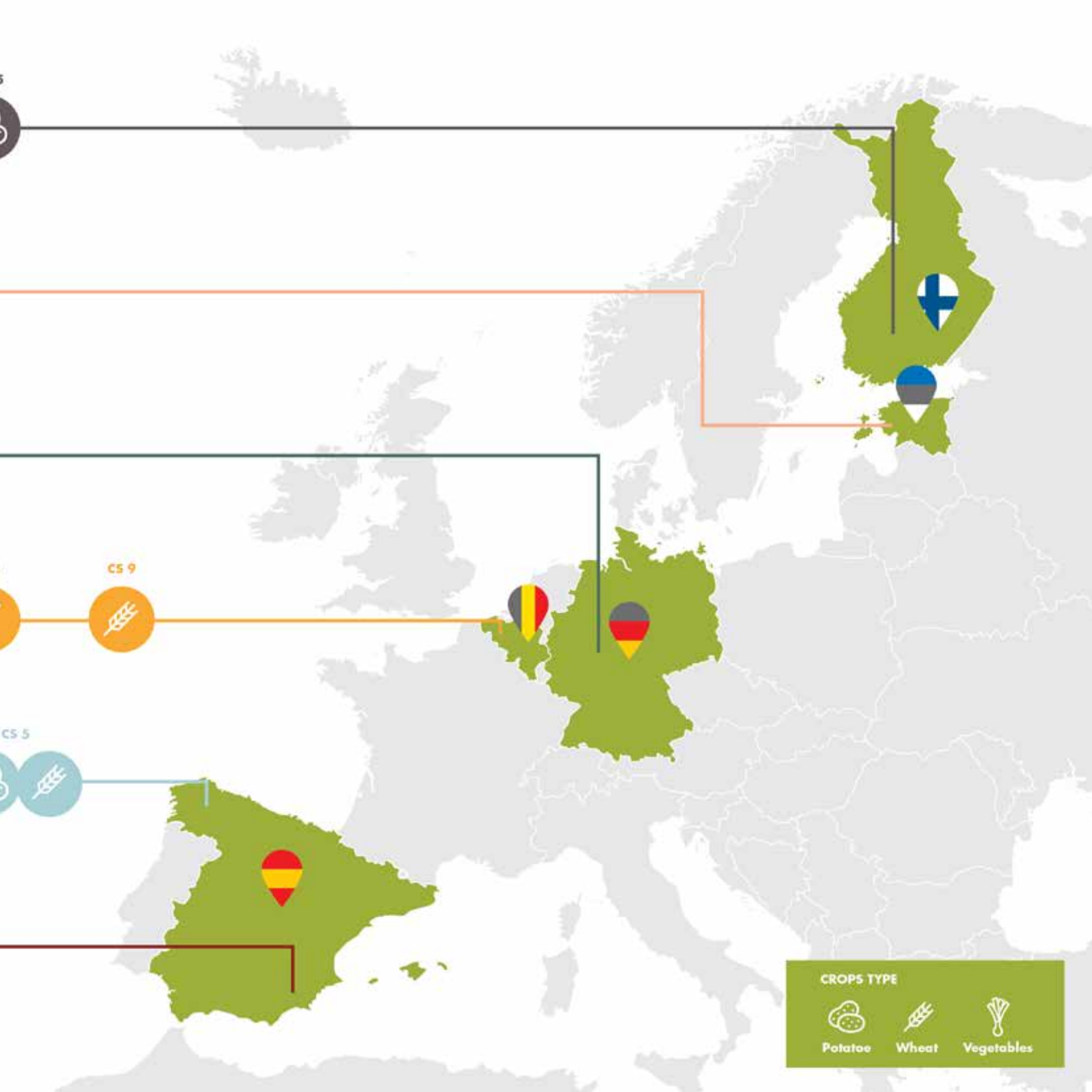
CS 4 *UVIGO* — Mycorrhiza

CS 3 *UVIGO* — Suitable crop diversification; Trap crops for pest control

CS 2 *UPCT* — By-products; Suitable crop diversification; Plant growth promoting microorganisms

CS 1 *UPCT* — Suitable crop diversification; Plant growth promoting microorganisms




CS 9
CS 5
CROPS TYPE
Potatoe
Wheat
Vegetables

MEDITERRANEAN SOUTH

RESPONSIBLE PARTNER

UPCT, (Spain)

COORDINATION

Raúl Zornoza

PhD in Environmental Sciences. Expert in soil quality and degradation, soil microbial diversity, organic matter dynamics and sustainable soil management practices.

+34 868 071 130 | raul.zornoza@upct.es

Objective

The vegetables and cereals cultivation in the Mediterranean region are mainly threatened by low availability of nutrients due to pH > 7.5, with the need to continuously add fertilizers. Most of the nutrients added precipitate in soil fast owing to the high pH, remaining unavailable for the crops. In addition, the high use of pesticides and monocultures are increasing pest/disease resistances, with more dependence to use more products, that may have negative effects on soil organisms. The climate conditions of the area favour soil organic matter degradation, which linked to monocultures and intensive tillage leads to soil degradation. In general, there is farmers are concerned about the difficulties in maintaining high crop yields due to soil nutrient depletion, pests and diseases. However, there is still lack of information about how the management of soil biodiversity can enhance the resilience of their farms and increase availability of nutrients and resistance to pests/diseases while decreasing the use of external inputs but maintaining the same yields.

There are two ways to tackle these problems: proper management of biodiversity by nature-based solutions and technology, which may evolve in parallel. With SoildiverAgro we aim to make a proper use of biodiversity by use biotechnological products based on microorganisms to increase soil nutrient availability, decrease the incidence of soil-borne diseases, increase soil organic matter and water retention, by decrease of chemical inputs. This will be associated with proper selection of crop diversification to enhance the functionality of soil macro and microorganisms, responsible for enhancing soil health, and so productivity. This is one of the challenges in the Mediterranean agriculture, and the results of this project, properly transferred to farmers, policy-makers and land managers may contribute to increase farm sustainability with the decrease of external inputs, by increasing soil biodiversity.

Stakeholders consultations

DISCUSSION GROUP

15.09.2020 | Cartagena, Spain (Online)

Share the main agronomic problems identified by surveys on potato production

8 PARTICIPANTS: Farmers, researchers, agribusiness

16.09.2020 | Cartagena, Spain (Online)

Share the main agronomic problems identified by surveys on wheat production

16 PARTICIPANTS: Farmers, researchers, agribusiness

REGIONAL MEETING

15.09.2020 | Cartagena, Spain (Online)

Solutions for wheat and vegetables cultivation by the management of soil biodiversity, searching to find the relationship between soil biological groups, crop production and quality

19 PARTICIPANTS: Farmers, researchers, agribusiness

TRAINING DAYS

To be confirmed

OTHERS

To be confirmed

FIELD DAYS

To be confirmed

NEXT STEPS

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

CASE STUDY 1

Use of soil biodiversity to reduce soil-borne diseases/pests incidence and increase nutrient availability in potatoes cropped in multiple cropping and rotations.

OBJECTIVE

The objective of this case study is to increase soil nutrient availability and soil water retention capacity and reduce soil-borne diseases/pests incidence to decrease productions costs.

PROPOSED PRACTICES

We will check better optimal multiple cropping and rotations to enhance soil fertility and biodiversity and reduce soil-borne diseases/pests incidence, integrated pest control and addition of nutrient solubilizing biological agents (plant growth promoting bacteria (PGPB) and fungi).

STATE OF THE ART

The potatoes and vegetables cultivation in the area is highly intense in external inputs to increase fertility (inorganic fertilizers and manure), reduce the incidence of diseases/pests (pesticides) and increase yields (irrigation water). Multiple cropping and rotations are common, but not optimized to maximize the development of soil organisms.

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

Finding adequate crop rotations/multiple cropping to manage soil biodiversity, not performed so far. Assessment of PGPB and fungi on soil biodiversity, since it has been proved their efficiency to enhance yields, but little is known about their effect on native microbial communities and time evolution. Maybe plant combination and organic matter addition could enhance native soil biodiversity with no need for bioaugmentation.

PROBLEM TO SOLVE

The vegetables cultivation in the area are mainly threatened by low availability of nutrients due to pH > 8, with the need to continuously add external inputs, the excessive use of water and the presence of cyst nematodes. This makes productions costs be high.

CROPS

LOCATION

Cartagena (Spain)

PARTNERS

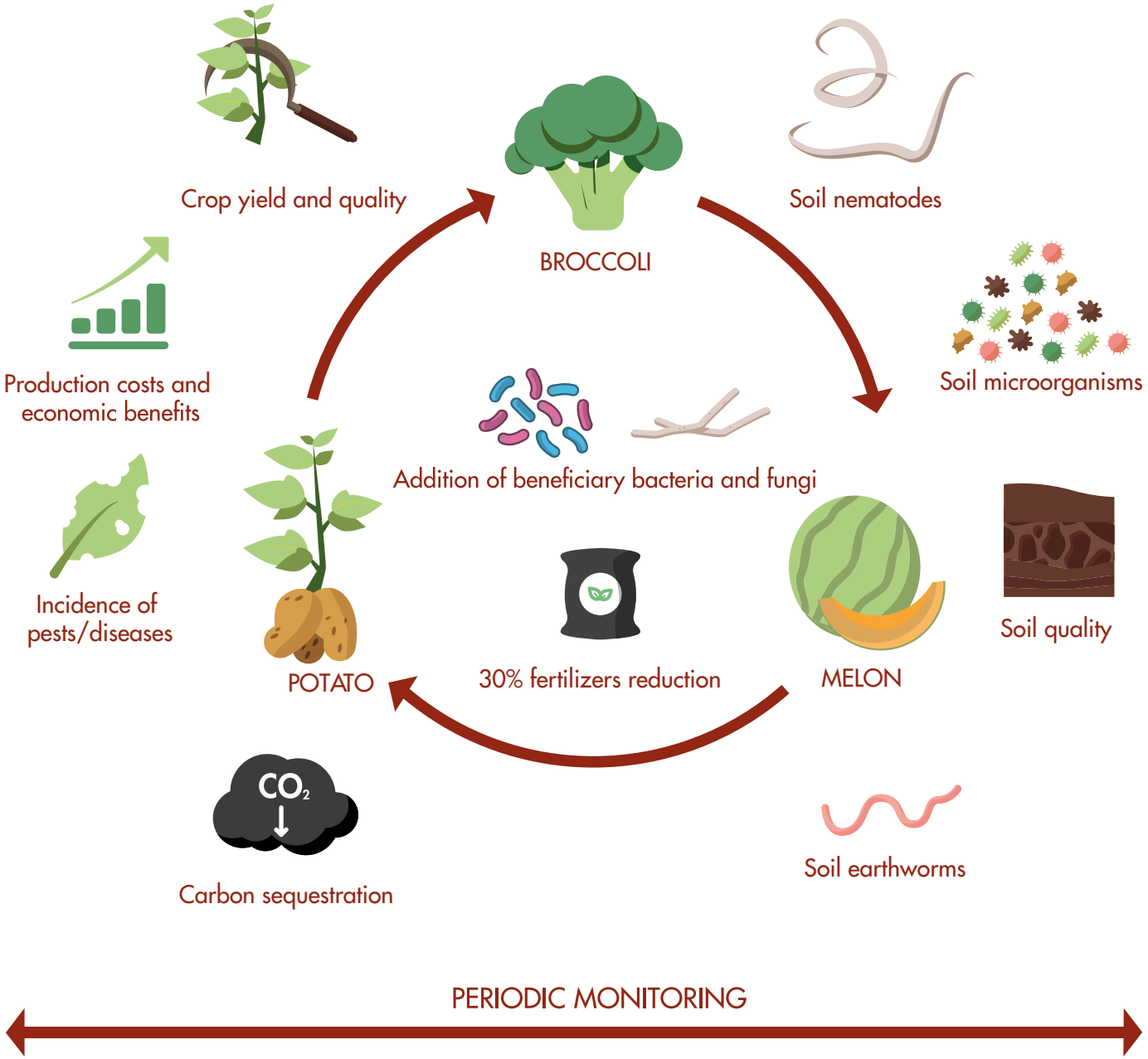
UPCT

ASAJA

FYNECO

CROPPING SYSTEMS

Crop rotation & Addition of nutrient solubilizing biological agents (plant growth promoting bacteria (PGPB) and fungi).


Crop yield and quality
BROCCOLI
Soil nematodes
Production costs and economic benefits
Soil microorganisms
Addition of beneficiary bacteria and fungi
Incidence of pests/diseases
POTATO
30% fertilizers reduction
MELON
Soil quality
CO_2
Carbon sequestration
Soil earthworms
PERIODIC MONITORING

→ *Infographic for case study 1 made by UPCT*

CASE STUDY 2

Use of soil biodiversity to increase nutrient and water availability and reduce soil-borne diseases incidence to increase wheat yields.

OBJECTIVE

The objective of this case study is to increase nutrient and water availability and reduce soil-borne diseases incidence to increase wheat yields.

PROPOSED PRACTICES

We will introduce multiple cropping and rotations to enhance soil fertility and biodiversity and reduce soil-borne diseases/pests incidence, add green manure to improve soil structure and soil water holding capacity and addition of nutrient solubilizing biological agents (plant growth promoting bacteria (PGPB) and fungi).

STATE OF THE ART

The wheat cultivation in the area is highly intense in machinery and pesticides use, with low or nil fertilization and absence of rotations, with use of fallow periods to avoid soil exhaustion by cropping.

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

Finding adequate crop rotations/multiple cropping to manage soil biodiversity, not performed so far with this aim. Assessment of PGPB and fungi on soil biodiversity, since it has been proved their efficiency to enhance yields, but little is known about their effect on native microbial communities and time evolution. Maybe plant combination and organic matter addition could enhance native soil biodiversity with no need for bioaugmentation.

PROBLEM TO SOLVE

The wheat cultivation in the area are mainly threatened by low availability of nutrients due to pH > 8 and low water content owing to climatic constraints, with affection of fungi after rainfall events. This makes crop yields be low.

CROPS

LOCATION

Caravaca (Spain)

PARTNERS

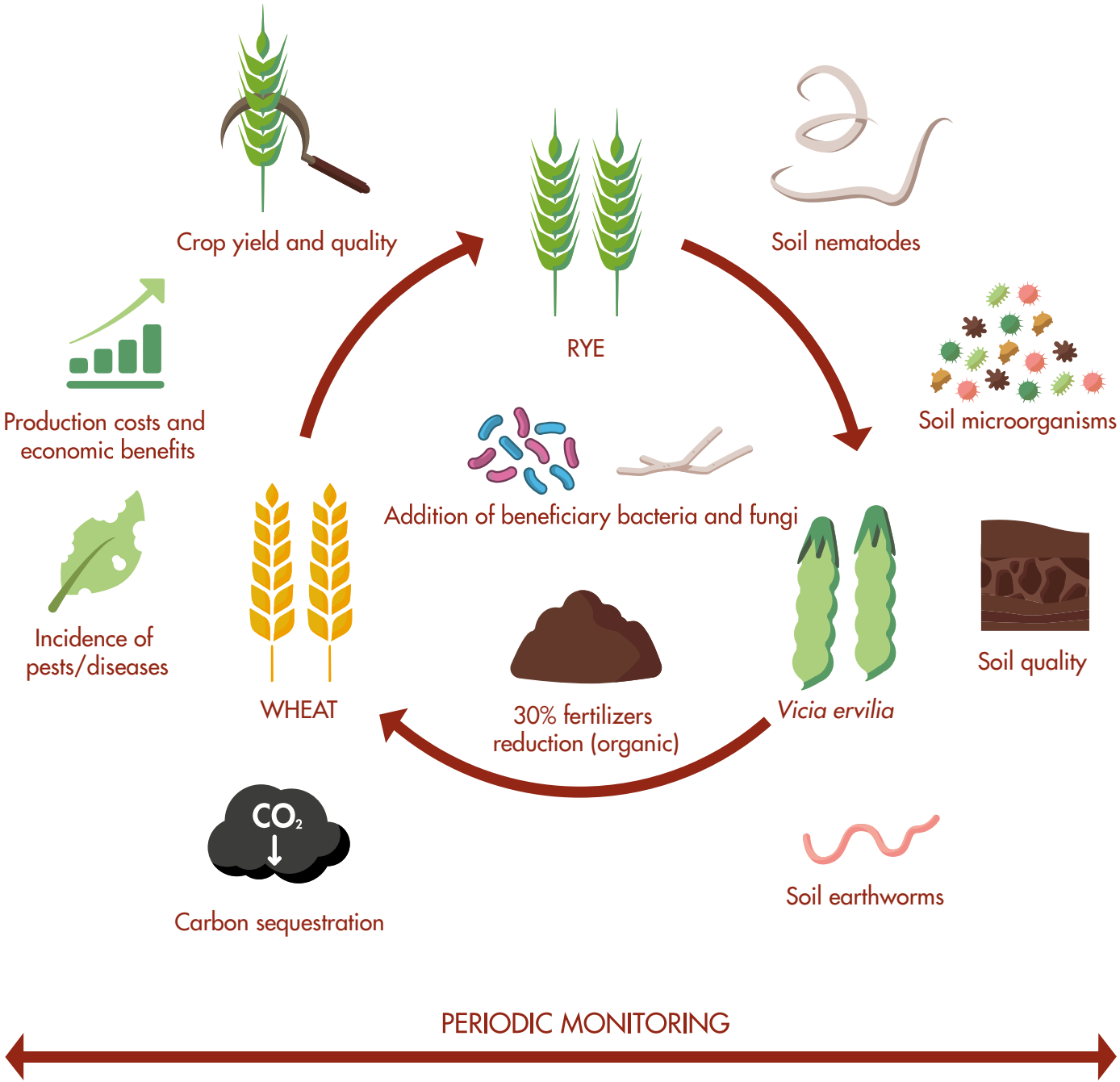
UPCT

ASAJA

FYNECO

CROPPING SYSTEMS

Addition of nutrient solubilizing biological agents (plant growth promoting bacteria (PGPB) and fungi) & crop rotation.


Crop yield and quality
RYE
Soil nematodes
Production costs and economic benefits
Soil microorganisms
Addition of beneficiary bacteria and fungi
Incidence of pests/diseases
WHEAT
30% fertilizers reduction (organic)
Vicia ervilia
Soil quality
Carbon sequestration
Soil earthworms
PERIODIC MONITORING

→ *Infographic for case study 2 made by UPCT*

LUSITANEAN

RESPONSIBLE PARTNER

UVIGO, (Spain)

COORDINATION

Paula Pérez Rodríguez

Agricultural engineer and PhD in Soil Science. Postdoctoral researcher in Plant and Soil Science Department at the University of Vigo. Research experience in soil heavy metals pollution, heavy metals immobilization by bio-adsorbents, nutrients and pollutants interaction in plant-rhizosphere-soil system, degradation mechanisms and nutrient sources by stable isotopes.

+34 988 387 059 | paulaperezr@uvigo.es

Objective

Potato and cereals are the most extensive crops cultivated at Lusitanean region. However, climatological and soil conditions disfavor their sustainable development. Potato crops are threatened by a high incidence of cyst nematode, the common scab and fungi attack, while cereal crops are also highly attacked by fungi. All these diseases make the need to apply great agrochemical amounts to control them. For instance, nematicides, fungicides and fertilizers are highly applied in the area. To control the common scab, potato cultivation is performed at pH < 5. That makes the P availability is very low despite high amount of P in soils. To solve this, P-fertilizers are added to the soil. In addition, the absence of proper rotations contributes to apply N-fertilizers in order to avoid nutrient deficiency in crops. All these issues make the area is highly polluted due to the application of great amount of inputs, both pesticides and fertilizers, contributing to water pollution and decrease soil biodiversity. Moreover, farmers are concern about profitability of crops, due to low potato values because of bad appearance, and expensive costs of inputs.

In SoildiverAgro, we aim to apply different management practices, pest alert systems and biotechnological products based on microorganisms to improve all those issues by reducing pest diseases, increasing nutrient availability to get a reduction of agricultural inputs, and to enhance soil biodiversity. All these challenges will be tested in SoildiverAgro in cooperation with local farmers and results could make the agriculture in Lusitanean region is more sustainable, profitable and environmental-friendly.

Stakeholders consultations

DISCUSSION GROUP

11.03.2020 | Xinzo de Limia, Spain

Implementation of possible more sustainable agricultural management practices

39 PARTICIPANTS: Farmers, researchers, agribusiness, policymakers, industry advisors

REGIONAL MEETING

18.11.2020 |Galiza, Spain (Online)

Presentation of SoildiverAgro project, current status of SoildiverAgro and presentation of Lusitanean case studies and discussion

22 PARTICIPANTS: Farmers, researchers, agribusiness, policymakers, industry advisors

FIELD DAYS

To be confirmed

TRAINING DAYS

To be confirmed

OTHERS

To be confirmed

NEXT STEPS

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

CASE STUDY 3

Use of crop diversification and trap crops in potato fields to reduce the incidence of cyst nematode, decrease the use of nematicides, increase the crop yields and increase the soil biodiversity

OBJECTIVE

The objective of this case study is to reduce the incidence of cyst nematodes in potatoes crops, the use of nematicides and increase the crops yields and soil biodiversity.

PROPOSED PRACTICES

We will introduce suitable crop rotations to increase the soil biodiversity and together with and adequate management of trap crops reduce the incidence of cyst nematodes for potatoes production.

STATE OF THE ART

The potatoes cultivation in the area is highly intense in nematicides use and absence of developed rotations. Also the use of trap crops (Solanum sisymbriifolium) for pest control is very low developed and many complications must be solved before trap crops use, specially the adequate conditions for the trap crops germination.

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

Finding adequate crop rotations and a suitable trap crop management, the soil biodiversity will be increased due to the existence of a higher plant diversity and reductions into pesticide use. The incidence of cyst nematode will be reduced without the employment of nematicides, decreasing the farm costs and increasing the crop yields. The potential damages of nematicides on soil biodiversity will disappear together with a reduction on soil and water pollution. Moreover, the introduction of legumes in the crop rotation contribute to decreases in the N fertilization and trap crops burial will contribute to increase the C storage in soils.

PROBLEM TO SOLVE

The potatoes cultivation in the area is mainly threatened by the high incidence of cyst nematode which lead to important yield decreased, and hence, the high uses of nematicides to try to save crops. This high use of nematicides by farmers can be an important cost for potatoes production, contribute to soil and surrounding waters pollution and also to decrease soil biodiversity.

CROPS

LOCATION

Sandiás (Spain)

PARTNERS

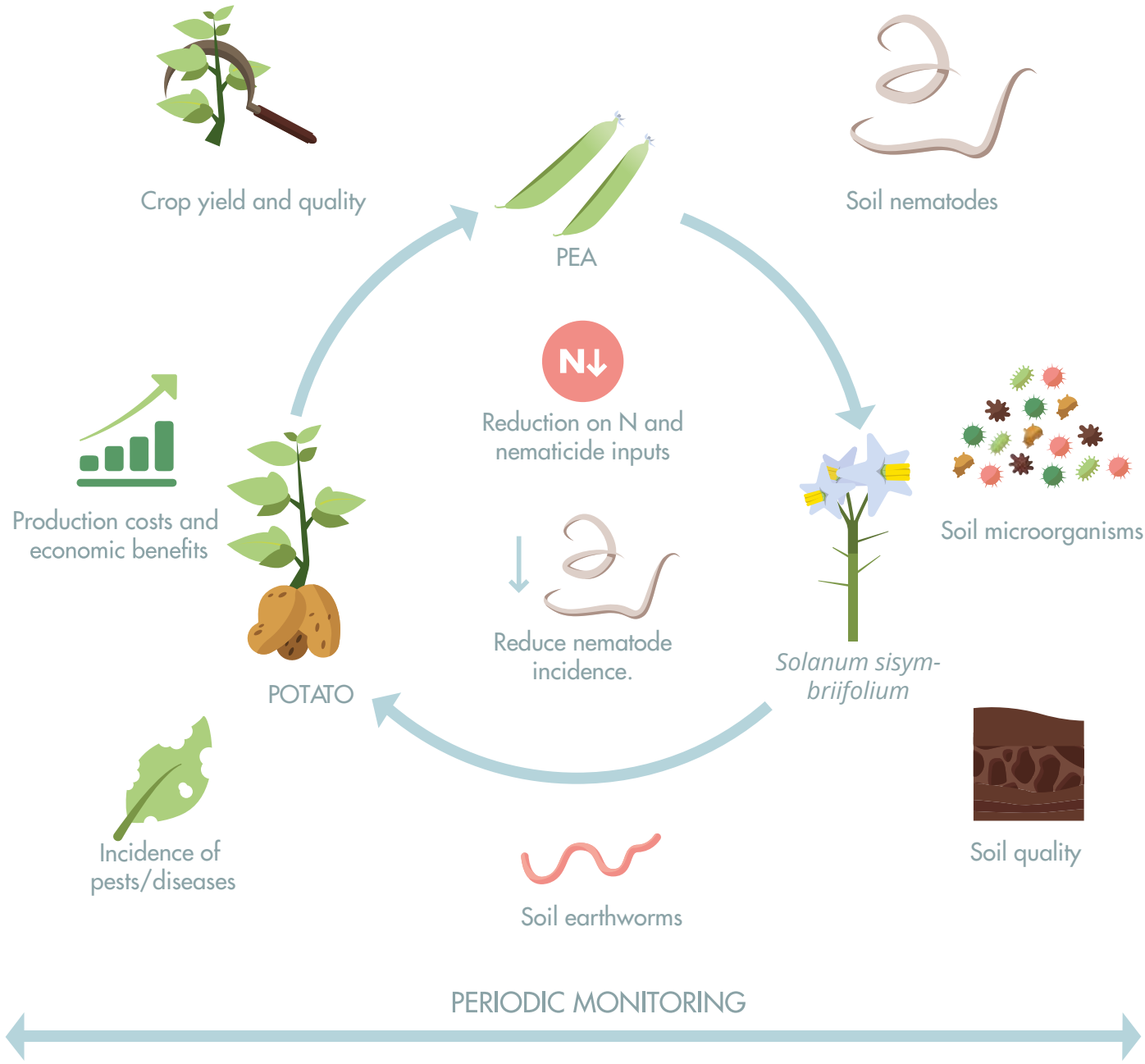
UVIGO

INORDE

RRG

CROPPING SYSTEMS

Crop diversification and trap crop.


Crop yield and quality
PEA
Soil nematodes
N↓
Reduction on N and nematicide inputs
Production costs and economic benefits
Soil microorganisms
Reduce nematode incidence.
POTATO
Solanum sisym-briifolium
Incidence of pests/diseases
Soil quality
Soil earthworms
PERIODIC MONITORING

→ *Infographic for case study 3 made by UVIGO*

CASE STUDY 4

Use of mycorrhiza in potato fields to reduce the incidence of common scab, decrease the use of phosphorus fertilizers, increase the crop yields and increase the soil biodiversity.

OBJECTIVE

The objective of this case study is to reduce the common scab incidence in potatoes crops, decrease P fertilization, allow potatoes cultivation at higher pH, and hence increase the crops yields and soil biodiversity.

PROPOSED PRACTICES

We will introduce mycorrhiza associated to potatoes crop to plant protection against common scab and increase P uptake by plants. Also we will perform soil sampling and establish the trap cultures to isolate the native AMF species from the target field sites.

STATE OF THE ART

The use of mycorrhiza associated to potatoes cultivation in the area was negligible and research on native mycorrhiza to be used for potatoes production increases and protection against diseases was not performed yet.

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

An adequate potatoes colonization by mycorrhiza will protect crops against common scab, provide a better P nutrition, and allow cultivation at higher soil pH. Therefore, production and value will increased, P inputs decreased and soil biodiversity increased.

PROBLEM TO SOLVE

The potatoes cultivation must be performed in very acid conditions (pH <5.0) to avoid the common scab disease due to the high organic matter contents in the soils. Under these conditions, P availability is very low and despite the presence of high amounts of phosphorus in the soils, the farmers in the area use big amounts of P fertilizers annually. Also in very acid soils the diversity of microorganisms and soil fauna is generally low. The common scab caused bad appearance in potatoes, and hence they can be only used for industrial uses, not for direct commercialization, decreasing the potatoes value.

CROPS

LOCATION

Xinzo da Limia (Spain)

PARTNERS

UVIGO

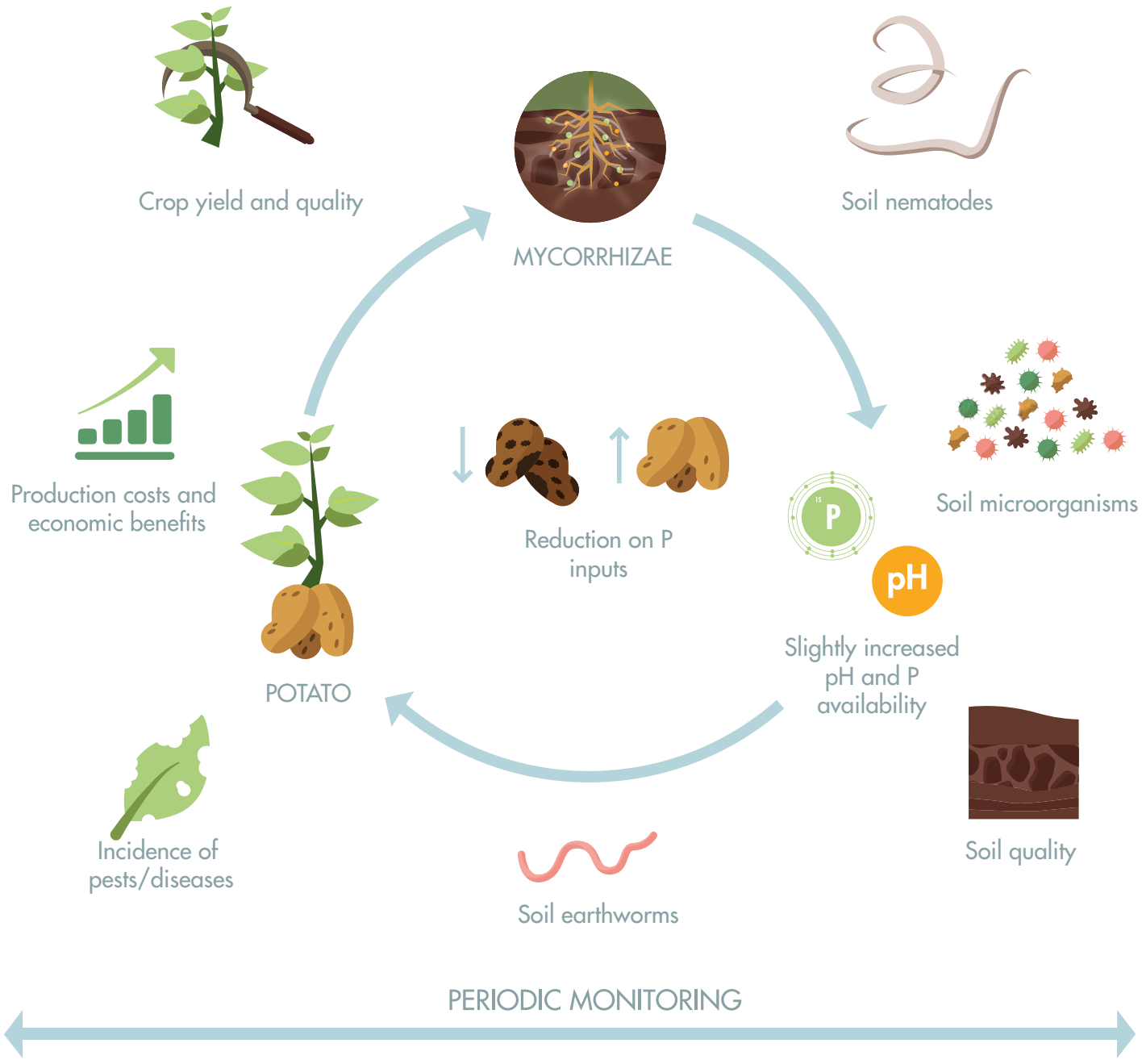
INORDE

RRG

SYMBIOM

CROPPING SYSTEMS

Use of mycorrhiza.


Crop yield and quality
MYCORRHIZAE
Soil nematodes
Production costs and economic benefits
Reduction on P inputs
Soil microorganisms
POTATO
P
pH
Slightly increased pH and P availability
Incidence of pests/diseases
Soil earthworms
Soil quality
PERIODIC MONITORING

→ *Infographic for case study 4 made by UVIGO*

CASE STUDY 5

Implementation of the Decision Support Systems (pest alert system) to reduces the use of fungicides in potato and wheat crops and their impact in biodiversity.

OBJECTIVE

The objective of this case study is the reduction of the use of these fungicide treatments, improving the forecast of the risk of the disease.

PROPOSED PRACTICES

The proposal will consider phenology, aerobiological data and meteorology to obtain the best decision support systems to the management of some potato and cereal fungal diseases.

STATE OF THE ART

The use of fungicides is often with a schedule calendar, which marks the onset of the first application and the frequency of the consecutive ones, applied independently of the risk of infection. This system allows farmers an inadequate control of the disease with great weaknesses. Mainly the economic cost of acquiring and applying these treatments and the negative and costly environmental footprint in water, soil, and air and as a consequence in biodiversity.

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

An efficient forecast of the risk of infection by a pathogen in a crop is indispensable for a sustainable use of the agricultural systems. This help farms to save production costs, decrease fungicides and fuel consumption, reduce soil and surrounding water pollution and increase soil biodiversity.

PROBLEM TO SOLVE

The environmental conditions of this region favors the attack of fungi to potatoes and cereal crops. The control of these plant diseases is based mainly on the application of high amounts preventive fungicide treatments. The high amounts of fungicide treatments require an important number of machinery passes on field contributing to soil compaction and together with fungicides to decreases in soil biodiversity.

CROPS

LOCATION

Sandiás (Spain)

PARTNERS

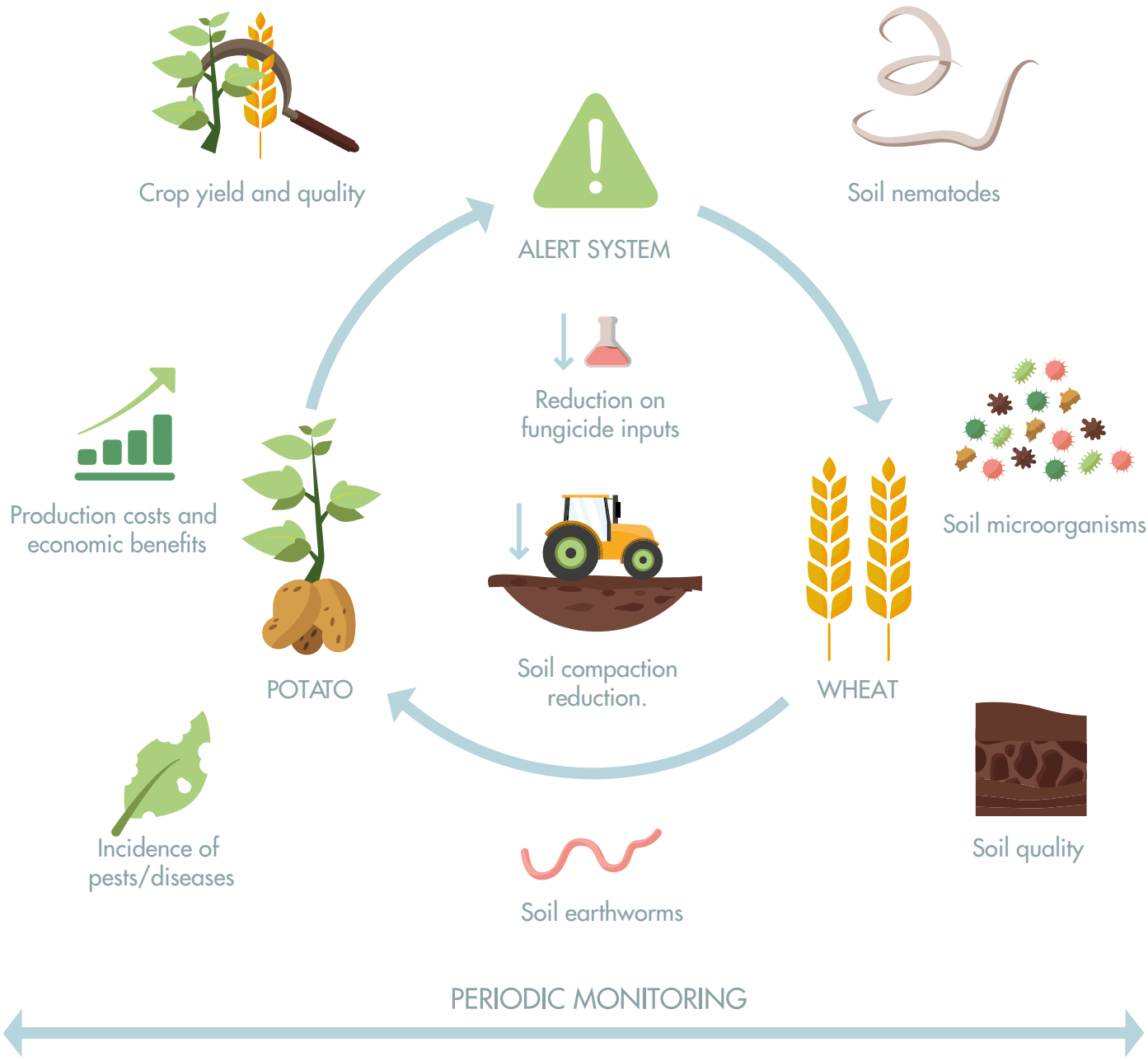
UVIGO

INORDE

RRG

CROPPING SYSTEMS

Pest Alert System


Crop yield and quality
ALERT SYSTEM
Soil nematodes
Reduction on fungicide inputs
Production costs and economic benefits
Soil microorganisms
POTATO
Soil compaction reduction.
WHEAT
Incidence of pests/diseases
Soil quality
Soil earthworms
PERIODIC MONITORING

→ *Infographic for case study 5 made by UVIGO*

ATLANTIC CENTRAL

RESPONSIBLE PARTNER

EV-ILVO, (Belgium)

COORDINATION

Lieven Waeyenberge

Senior researcher at ILVO, with expertise in molecular diagnostics of plant-parasitic and entomopathogenic nematodes. In this regard, he cooperated with several international research groups to aid in resolving diagnostic problems. Since a couple of years, his focus shifted towards amplicon-sequencing (a Next Generation Sequencing technique) to characterize soil nematode communities. Nematode communities are considered as capable bio-indicators of ecosystem health.

Lieven.waeyenberge@ilvo.vlaanderen.be

Objective

A questionnaire and regional discussion group meetings with stakeholders and end-users revealed and prioritised the main threats affecting the agro-ecosystems of the Atlantic Central region and the qualitative assessment of their severity. Use of chemical fertilizers and liquid manure or slurry still cause a too large leakage of nitrate and phosphate in surface water and groundwater, intensive management regimes cause a deficit of soil organic matter, and a general drop of 'soil health', recognized by degraded biological and structural conditions, causes additional problems like soil erosion and water shortage.

Field experiments have been established to test different management practices for wheat, potatoes and vegetables in order to address the above mentioned agricultural threats. Especially attention is paid to soil fertility, organic matter content and biodiversity in each case-study in a different way: case-study 6 will investigate the combined effect of with and without 'brown' material co-composted farm yard manure and a differential management of the cover crops (incorporation or mowing), case-study 7 will focus on the effect of cover crop mixtures which will diversify further the cropping system (from simple till 12 species mixtures), case-study 8 will compare different agricultural systems (intensive versus extensive, conventional versus organic), and case-study 9 will investigate the use of different organic fertilization sources like farm yard manure, compost and silage (fermented) grass-clover.

The obtained data of the case-studies will contribute to the analysis of the environmental and economic impact on a farm and regional level. This will finally result in the proper selection of the most promising crop diversification methods (including cover crops), organic fertilizers, and farming systems to enhance the functionality of soil macro- and microorganisms, responsible for enhancing soil health, crop productivity and other ecosystem services.

Stakeholders consultations

DISCUSSION GROUP

19.05.2020 | Merelbeke, Belgium (Online)

Conclusions of the extensification of vegetable production survey presentation: What are the main problems and best fitting solutions for vegetable cropping in Flanders?

14 PARTICIPANTS: Farmers, researchers, agribusiness, policymakers, industry advisors.

30.06.2020 | Merelbeke, Belgium (Online)

General conclusions of the potato production survey were presented: What are the main problems and best fitting solutions in Flanders?

15 PARTICIPANTS: Farmers, researchers, agribusiness, policymakers, industry advisors.

REGIONAL MEETING

08-09 of 2020 & 02 of 2021 | ILVO, PSKW, Inagro, Pomona, Belgium. (Online and 'in person')

Finalising the details concerning the organisation, maintenance and study-objects of the case-studies in Flanders.

15 PARTICIPANTS: Belgian regional partners, researchers and experts in mechanisation, fertilization, plant quality assessment, lab technicians, field workers, advisors .

FIELD DAYS

12.08.2020 | Antwerpen, Belgium

Trial visit on their organic leek trial field.

7 PARTICIPANTS: Farmers and distribution sector.

29.09.2021 | Rumbeke-Beitem, Belgium

'Bioveldag' including visit of the SdA field trial.

71 PARTICIPANTS: Researchers, agro-technicians, advisors, farmers (conventional and organic), teachers, organic sector, policy makers and the industry.

19.02.2022 | POMONA, Meerdonk, Melsele & Verrebroek, Belgium

'Grote info- en Rondneustoer', including visiting the SdA field trial.

MORE THAN 100 PARTICIPANTS: Families, farmers, scientist-agronomists.

TRAINING DAYS

To be confirmed

OTHERS

23.06.2021 | Online

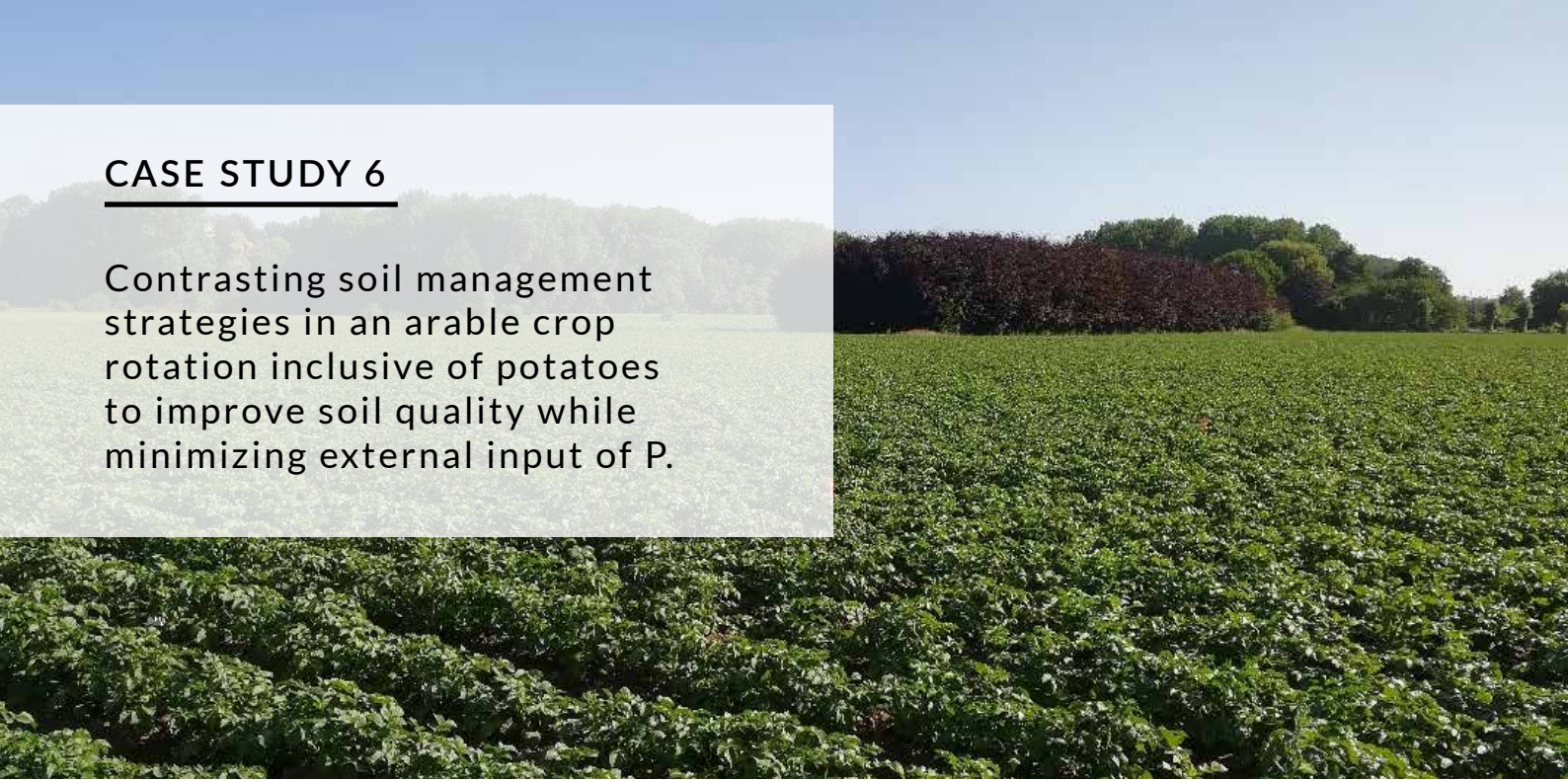
Mini-symposium 'organic research' about results of projects (including SdA) dealing with organic farming.

70 PARTICIPANTS: Researchers, advisors, farmers, farmer organisations and policy makers.

NEXT STEPS

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

FestILVO: ILVO exists 90 years and organises a festival (15-19 September 2022). During this festival a regional meeting about SdA and other projects dealing with "soil" will be organised for stakeholders.



CASE STUDY 6

Contrasting soil management strategies in an arable crop rotation inclusive of potatoes to improve soil quality while minimizing external input of P.

OBJECTIVE

The objective is to explore to what extent innovative strategies, contributing to soil quality and N supplying capacity, might reduce P surpluses compared to the usual soil management.

PROPOSED PRACTICES

N:P and C:P ratios of farm yard manure (FYM) will be modified by co-composting FYM with 'brown' material (e.g., grass clippings from nature reserves). The effect of co-composted FYM, compared to stockpiled FYM, on crop performance and soil quality will be assessed in a multiyear field trial with repetitive application of both fertilization products. A blank treatment with no base fertilization is included as well. In the same trial, two different management variants will be applied for cover crop mixtures grown in between the main crops in the rotation. The cover crop mixtures will be either used as green manure or harvested as a fodder crop. Differences in treatments regarding both factors will result in differences with regard to C and N input, and therefore possibly in differences with regard to main crop performance and soil quality.

STATE OF THE ART

An increasing amount of easily available P, as a result of a high soil P status (most of the Flemish agricultural and horticultural land) seems to counteract microbial activity in the rhizosphere. In particular, organic growers rely on this microbial activity in the rhizosphere as a plant feeding mechanism. Therefore, soil management strategies should aim at preventing P surpluses by reducing external input of organic matter.

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

This case study will illustrate best practices for soil fertility building while minimizing P input or balancing P input by fertilization products with P export by harvested plant parts.

PROBLEM TO SOLVE

Soil management strategies for organic cropping systems will be developed aiming at the sustainment of soil quality on one hand and at a balanced P supply on the other hand.

CROPS

LOCATION

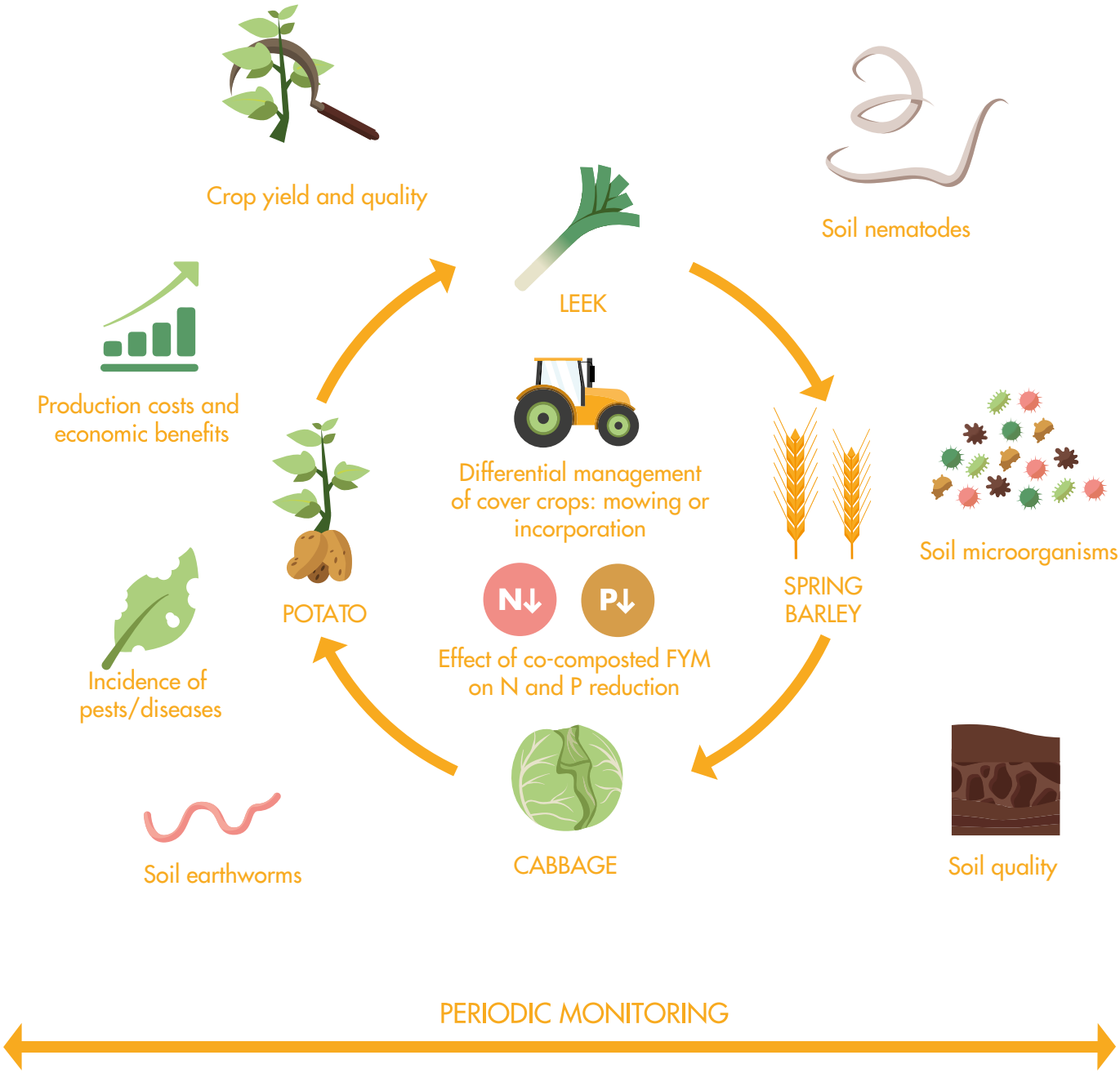
Melle, East-Flanders (Belgium)

PARTNERS

ILVO

CROPPING SYSTEMS

Application of co-composted farm yard manure and use of cover crops.


Crop yield and quality
Soil nematodes
LEEK
Production costs and economic benefits
Differential management of cover crops: mowing or incorporation
Soil microorganisms
POTATO
SPRING BARLEY
N↓
P↓
Effect of co-composted FYM on N and P reduction
Incidence of pests/diseases
CABBAGE
Soil earthworms
Soil quality
PERIODIC MONITORING

→ *Infographic for case study 6 made by ILVO*

CASE STUDY 7

Cover crop mixtures: a promotor of soil biodiversity in potato crops?

OBJECTIVE

The objective is to test the potential beneficial impact of different cover crop mixtures in organic agriculture on soil biological diversity in function of the cultivation of potatoes. Whether more species-diverse mixtures can combine more soil benefiting functions like catching nutrients (nitrogen) is also investigated. By including leguminous species, the function of delivering nitrogen to the following main crops is tested. From these trails, farmers will be able to improve the design of their cover crop mixtures.

PROPOSED PRACTICES

Four different cover crop mixtures will be compared for their impact on soil biodiversity, N mineralization and main crop yield. The same mixtures will be sown in the same place for three years. BAU, the business as usual, is a mixture of phacelia and black oat. Secondly, a mixture of phacelia and Egyptian clover is tested. The two other mixtures are species-diverse: a five species mixture containing phacelia, black oat, Egyptian clover, fodder radish and vetch and a 12-species mixture that combines all the previously mentioned species with the addition of species such as pea, lupine and flax.

STATE OF THE ART

Advisors often recommend organic farmers to use species diverse cover crop mixtures to stimulate the soil diversity. However, little is known about the actual impact of the use of such cover crop mixtures on the soil diversity, nor in the short or longer term.

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

Increased understanding of the impact of different cover crop mixtures on soil biology and related ecosystem services together with increased knowledge to improve the design of cover crop mixtures.

PROBLEM TO SOLVE

Organic farmers heavily rely on an active and diverse soil biology to make their system work. The soil biology needs to be able to digest diverse types of organic material to provide sufficient and timely nutrients for the crops. Moreover, soil microorganisms also need to control soilborne diseases ('suppressiveness of the soil'). The use of species diverse cover crop mixtures could contribute to improve the soil biology.

CROPS

LOCATION

Rumbeke-Beitem (Belgium)

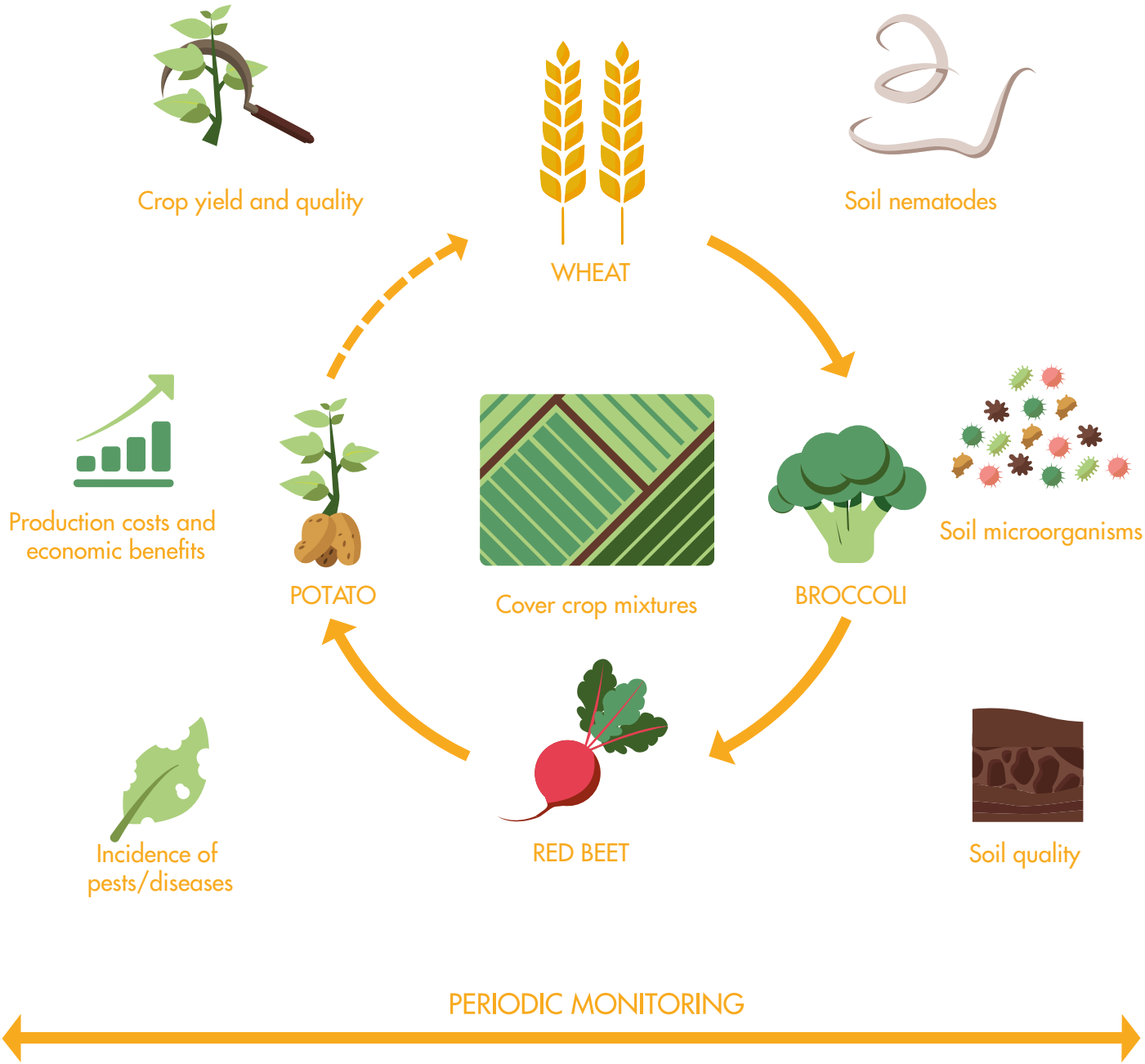
PARTNERS

INAGRO

ILVO

CROPPING SYSTEMS

Use of cover crop mixtures.


Crop yield and quality
WHEAT
Soil nematodes
Production costs and economic benefits
POTATO
Cover crop mixtures
BROCCOLI
Soil microorganisms
Incidence of pests/diseases
RED BEET
Soil quality
PERIODIC MONITORING

→ *Infographic for case study 7 made by INAGRO*

CASE STUDY 8

Extensification of conventional and organic vegetable farming.

OBJECTIVE

The objective is to test the positive effect of extensive farming on the soil compared to intensive farming, in conventional and organic vegetable cropping. What is the effect on the fertility of the soil and on soil pathogens when reversing to another farming system.

PROPOSED PRACTICES

We will work on a conventional field and an organic field. Each field will be divided in two halves. On one half, we will continue with an intensive cultivation as a reference. On the other half, we will switch to a more extensive system to study the benefits of it. Reduced tillage, use of compost and green manure will be studied in a system approach.

STATE OF THE ART

In Belgium around 45% of the area of vegetable production outdoors are used for intensive farming. The rest is cultivated in crop rotation with arable crops (extensive farming). The growers are mainly focused on the yield of their crops, sometimes at the expense of the soil quality.

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

With these studies we hope to demonstrate the long-term positive effects of extensive and organic farming compared to intensive farming. Growers need to be convinced of the positive effects this type of farming can have on their soil and their crops, even when they don't see immediate results in for example the yield. The goal is to persuade them that investing in a healthy soil will eventually result in a better crop.

PROBLEM TO SOLVE

The intensive vegetable production in Belgium with intensive tillage, limited crop rotation and unilateral fertilization has a negative effect on soil quality. This could also lead to a favourable environment for pests and diseases and result in a lower yield and quality of the crop.

CROPS

LOCATION

Sint-Katelijne-Waver (Belgium)

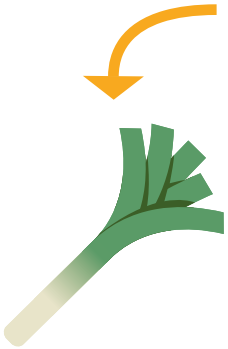
PARTNERS

PSKW

ILVO

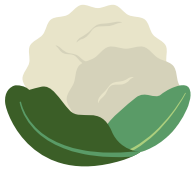
CROPPING SYSTEMS

Crop rotation, different cultivation techniques, reduced tillage, and use of compost and green manure.

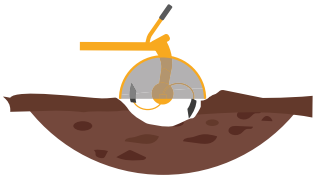


LEEK

CELERY



CAULIFLOWER



Inverting tillage

INTENSIVE REFERENCE

Low imput of organic matter

COMPARE WITH

ADAPTED SYSTEM FOR SOIL BIODIVERSITY

Non-inverting tillage

Higher input of organic matter

Green manure
(Spring: Phacelia and crimson clover) (Autumn: ryegrass)

INCREASE

Soil microorganisms

Soil quality and organic carbon content

Crop yield and quality

→ *Infographic for case study 8 made by PSKW*

CASE STUDY 9

Testing different sources of green manure in agro-ecological wheat and potato production.

OBJECTIVE

Agro-ecological farming relies on ecological processes to support the production system. It is a holistic way of thinking on agronomy, ecology and biology. In this respect, the objective is to test different sources of locally produced organic fertilizer to increase the SOM content, ameliorate the soil's structure and improve plant health and development. Especially farmyard manure, compost and fermented organic waste will be tested.

PROPOSED PRACTICES

We will divide a field with an organic farming system, in combination with agro-forestry, into different parts. Each part will receive another source of green manure. Especially farmyard manure, compost and fermented organic waste (bokashi) which was produced 'on farm' or locally will be tested.

STATE OF THE ART

Organic farming mostly applies composted or non-composted green manure to increase C-content, and improve the soil's structure. However, fermented organic waste has some additional advantages: improved microbial diversity and activity to produce natural antibiotics, essential vitamins and plant growth hormones; the soil's quality improves further and it gets more resilient against pests and diseases.

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

With this experiment we hope to demonstrate that different sources of green manure exist as excellent alternatives the conventional way of external inputs of nutrients. Also we want to demonstrate the potential of fermented organic waste on soil structure, SOM content and improved plant health.

PROBLEM TO SOLVE

Conventional farming depends on high amounts of external inputs of fertilizer because it negatively disturbs the soil's capacity to produce crops: nutrients get depleted, the SOM (soil organic matter) content decreases and the structure of the soil deteriorates. The proposed field trial wants to demonstrate that a sustainable way of farming is possible in combination with a reduced dependence of external fertilizers.

CROPS

LOCATION

Verrebroek, East-Flanders (Belgium)

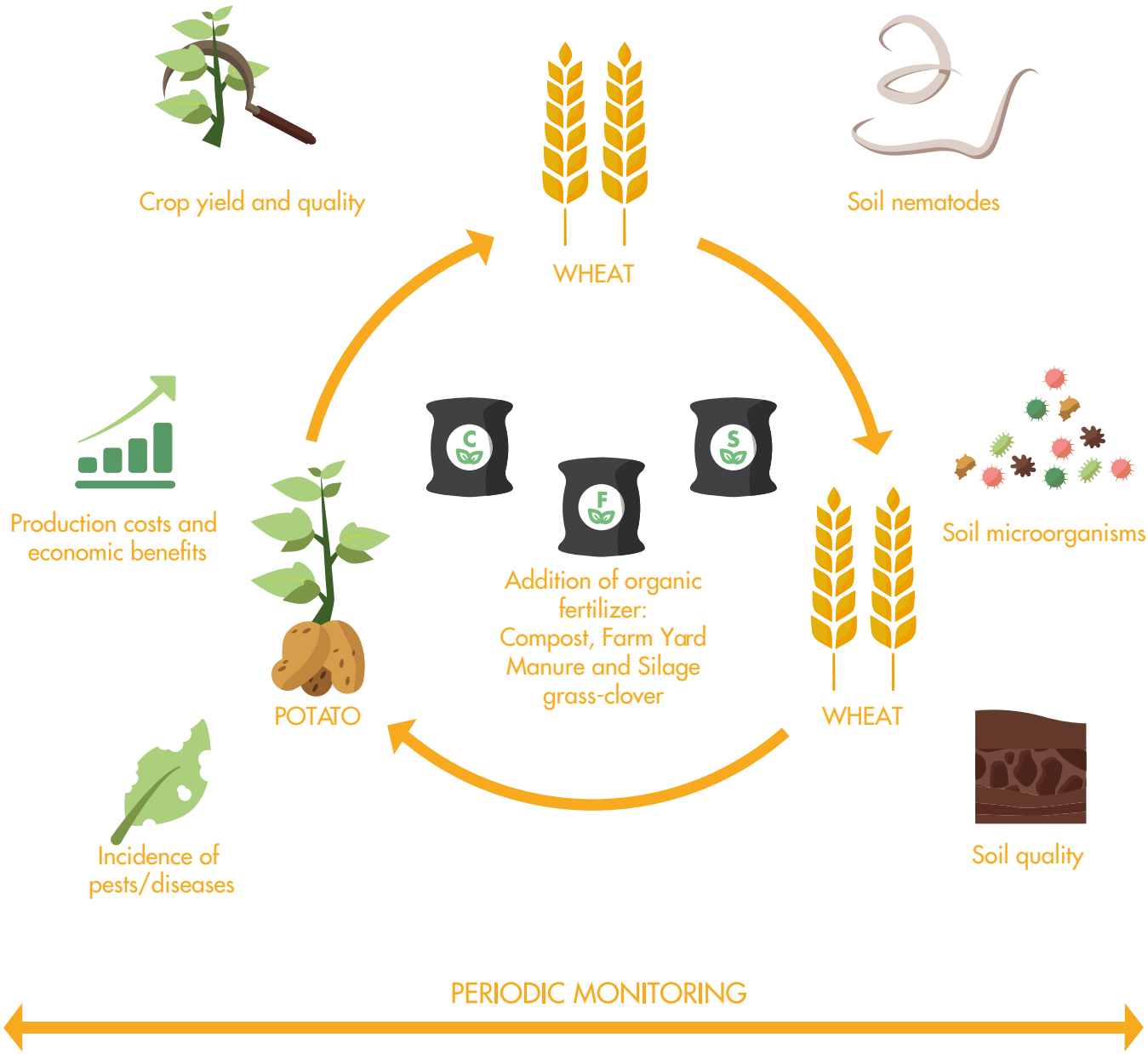
PARTNERS

POMONA

ILVO

CROPPING SYSTEMS

Application of different types of green manures, cover crops incorporated after destruction, reduced tillage.


Crop yield and quality
WHEAT
Soil nematodes
Production costs and economic benefits
C
F
S
Soil microorganisms
Addition of organic fertilizer: Compost, Farm Yard Manure and Silage grass-clover
POTATO
WHEAT
Incidence of pests/diseases
Soil quality
PERIODIC MONITORING

→ *Infographic for case study 10 made by POMONA*

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.

stefan.schrader@thuenen.de

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

10.01.2022 | Germany (Online)

FAR informed the Stiftung Rheinische Kulturlandschaft via an online presentation about the SoildiverAgro project and the scientific field experiments in Germany.

23 PARTICIPANTS: Biologists, agronomists and geographers

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

OTHERS

To be confirmed

NEXT STEPS

More information will be shared with local project partners and the project community.

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)

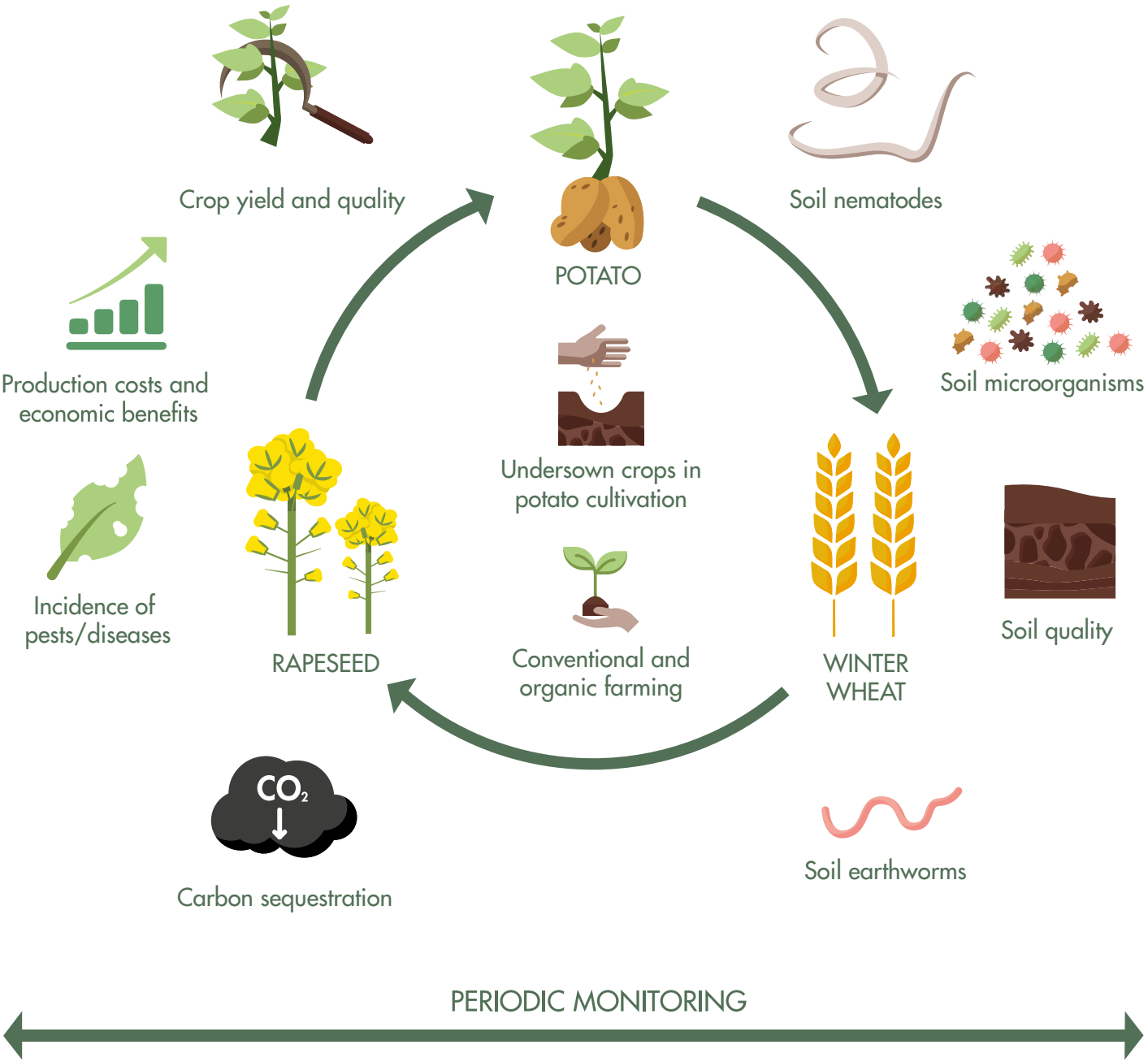
PARTNERS

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

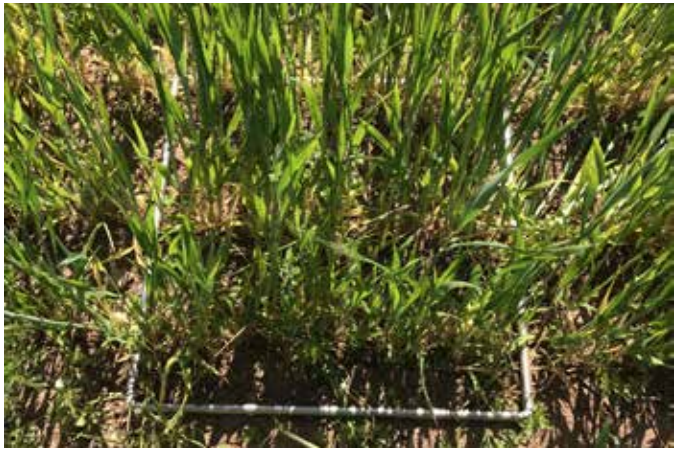
We will identify suitable adjustments of wheat crop rotations that will help farmers to reduce fungal diseases without a further increase of external inputs. The proposed adjustments will be fitted in dialogue with the farmers.

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)

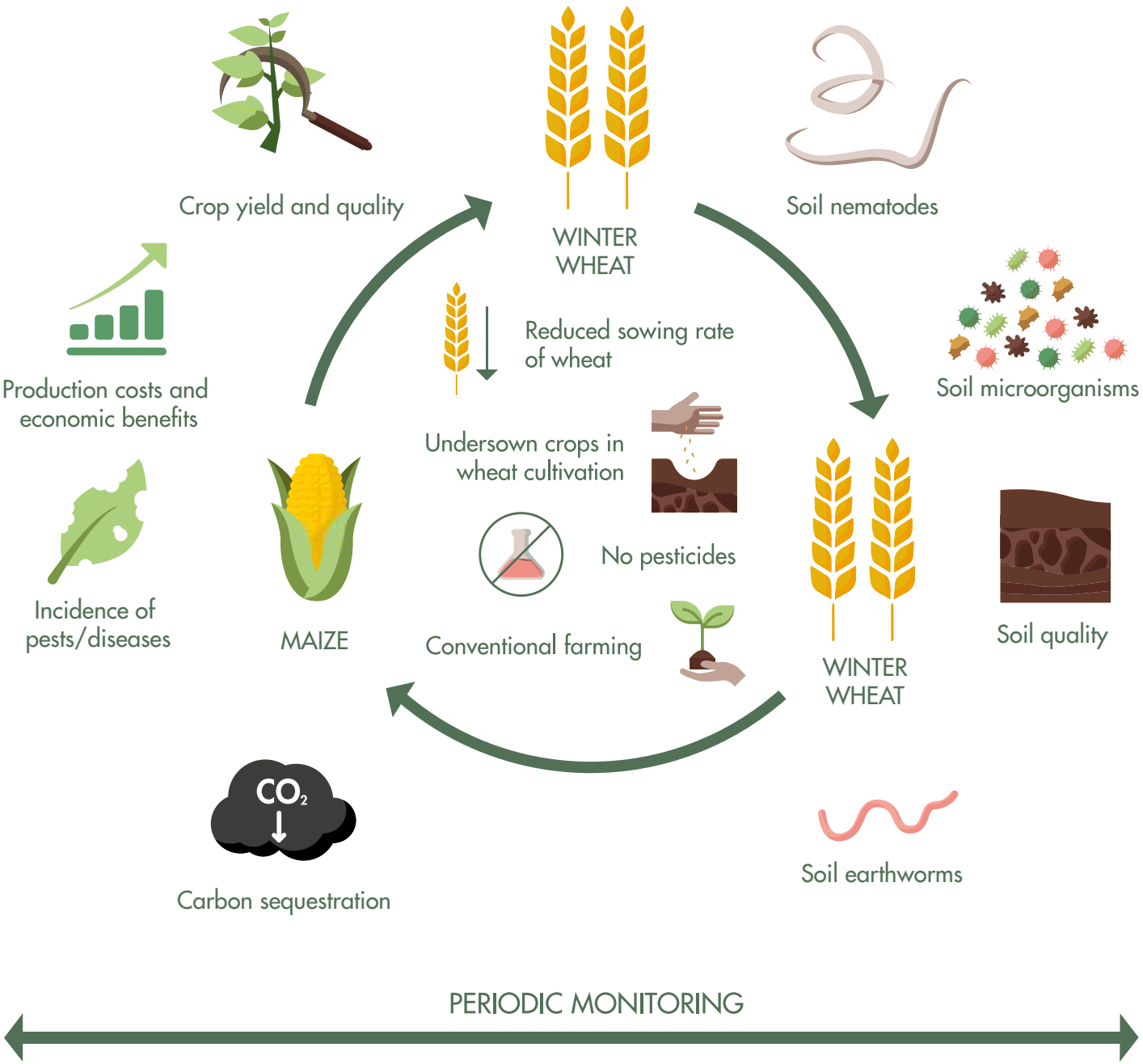
PARTNERS

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 WHEAT
Soil quality
Conventional farming
Soil earthworms
CO_2
Carbon sequestration
PERIODIC MONITORING

→ *Infographic for case study 11 made by FAR*

NEMORAL

RESPONSIBLE PARTNER

EULS, (Estonia)

COORDINATION

Merrit Shanskiy

PhD in field crop husbandry, associated professor of soil science at Estonian University of Life Sciences, Chair of Soil Science. Main fields of research are related to soil science and soil biodiversity, plants-soil interactions. EULS researcher-in-charge in the SoildiverAgro project, WP2 leader and involved in several WPs.

merrit.shanskiy@emu.ee

Objective

The agriculture is important and traditional economic activity in Estonia. The sector has long traditions as food and job provider and it is continuously important to Nemoral region. The grain and rape cultivation are the main agricultural crops at local scale. For cultivation, the input by mineral- and organic fertilizers is needed in combination with right soil tillage system. Nowadays, the problem has risen due to the high use of pesticides and monocultures are increasing pest/disease spreading. That is causing the wider use of agrochemicals and different products usage on fields for yield protection, which consequently have impact on soil biology and soil organisms. Soil biological properties are found to be more sensitive toward changes compared to physical and chemical properties, which can be used as an early indication of changes in soil quality and the sustainability of agricultural management practices. Soil is one of the most species-rich, yet one of the most poorly researched habitats of our planet. However, soil organisms have been "out of sight, out of mind" for too long. Several properties or functions of soil fauna can be used to indicate soil quality: the presence of specific organisms and their populations or community analysis (functional groups and biodiversity) and biological processes such as soil structure modification and decomposition rates.

On recent years the weather conditions are very changing, there is rarely two similar years by precipitations and temperatures, which is causing an extra losses in yield, that could be alleviated by the right choice of cultivated crop and agrotechnology. The intensive soil management are replaced nowadays very often by soil sustainable management technologies as minimized tillage or direct sowing. But even with soil sustainable management applications there is still need for pesticide use. Furthermore, no-tillage systems often depend more on the usage of pesticides for plant protection compared to conventional or minimum tillage, which might result in higher number and different combinations of pesticide residues in the soil. However, the combined effects of residue mixtures on soil organisms and the processes they alleviate are unknown. The effect of pesticide residues on non-target soil organisms is not well established due to the diversity of the products and variety of breakdown pathways.

Our case studies are designed to solve the questions about pesticides accumulation rate in the litter layer of no-till cereal fields and on management impact to soil biodiversity with the goal to improve pesticide application and soil biodiversity. Pesticide accumulation in the mulch layer might inhibit their biological degradation, thus could potentially increase their persistence in the soil environment. To reduce the pesticide usage one possibility is to monitor plant health and detect plant diseases before their wider spreading. To solve this problem the control of phytopathogenic fungi by studying the spreading of spores by air in order to improve the pest monitoring and control system.

These are the main challenges for Nemoral agriculture, the results of current project will contribute to the better understanding of soil-plant management systems while transferred to different parties; farmers, producers, policy-makers and land owners. Soil is a living and dynamic entity that requires a unique balance between its physical, chemical and biological components in order to remain productive.

Stakeholders consultations

DISCUSSION GROUP

03.07.2020 | Rapla county, Estonia

Discussion about field crops performance, soil biodiversity, soil fertility, soil biodiversity management, project introduction

19 PARTICIPANTS: Farmers, researchers, agribusiness

REGIONAL MEETING

30.10.2020 | Tartu, Estonia

Solutions for the cultivation of grains, case study 12 content-pesticides residues in soil, impact to soil biodiversity, phytopathogenic fungi, management of soil biodiversity, searching to find the relationship between soil biological groups, crop production and quality

26 PARTICIPANTS: Farmers, researchers

OTHERS

11.03.2020 | Tartu, Estonia

Poster and paper about earthworms abundance, soil quality on projects selected farms

152 PARTICIPANTS: Farmers, researchers, policymakers agribusinesss

TRAINING DAYS

Planned to forthcoming 2022 season

FIELD DAYS

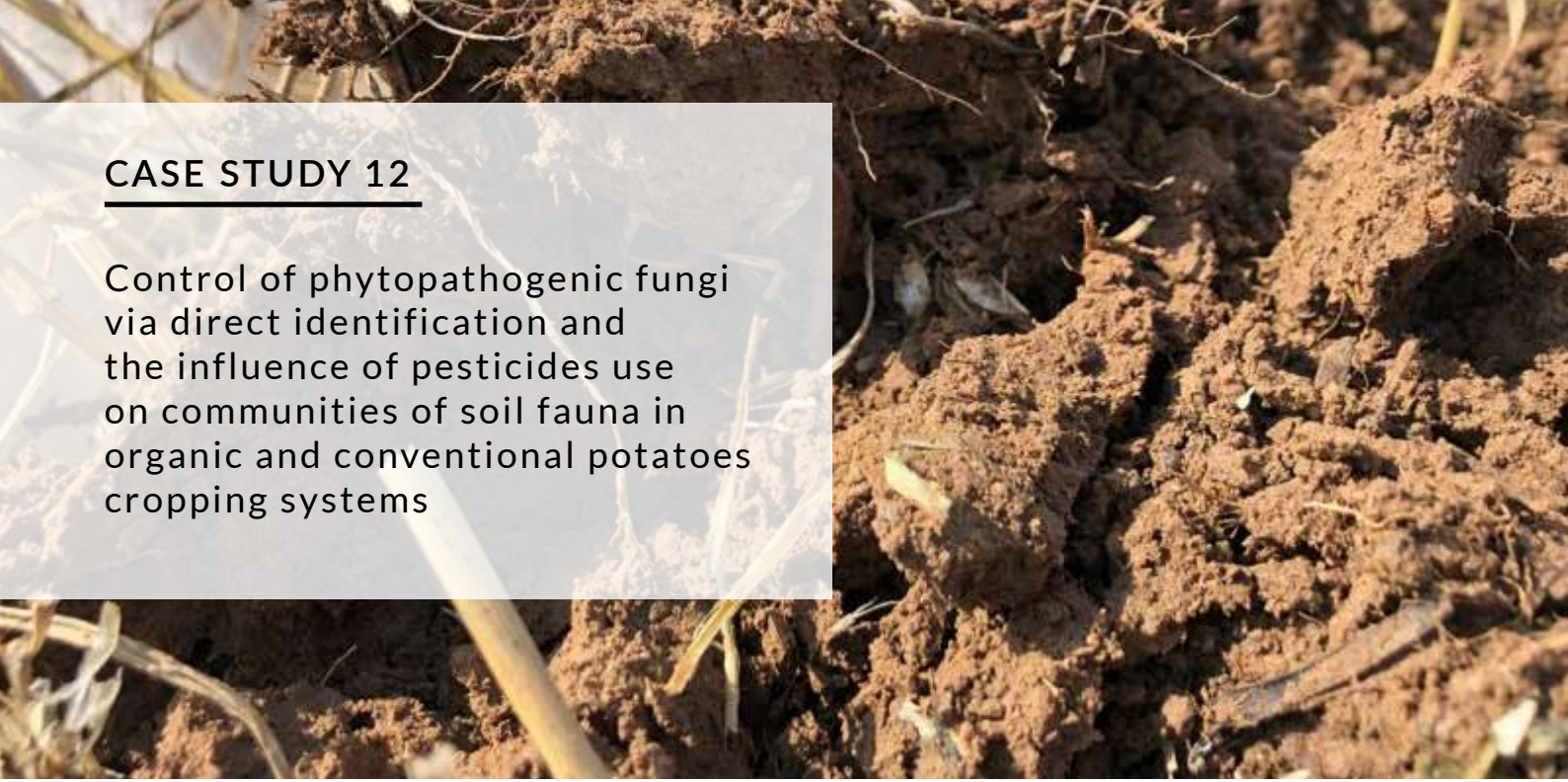
3.7.2020 | Rapla county, Estonia

Organic grain cultivation and related problems solutions. SoilDiverAgro project was introduced to the participants. Active discussion related to crop rotation, soil biology, earthworms was conducted. Overview and final decisions to the questionnaires in Nemoral region.

17 PARTICIPANTS: Farmers

NEXT STEPS

More information will be shared with local project partners and the project community.



CASE STUDY 12

Control of phytopathogenic fungi via direct identification and the influence of pesticides use on communities of soil fauna in organic and conventional potatoes cropping systems

OBJECTIVE

The objective of this case study is (i) to study the role of airborne inoculum on disease development in relation to climatic conditions (ii) to find out pesticides accumulation rate for no-till fields and impact to soil fauna.

PROPOSED PRACTICES

It is aimed through monitoring system to set up more precise management practices for targeted pesticide application and promote in wider sense the soil fauna in conventional and organic farming. The management practices to be tested in cooperation with farmers including changes in soil management and pesticide application. Burkard 7-day recording volumetric sampler have been used to collect the air-borne fungi present in the air.

STATE OF THE ART

In order to deal with the problem of fungal pest occurrence the higher input of pesticides are used (conventional farming, no-till farming) and high tillage intensity (conventional and organic farming), which reduces functional soil biodiversity. Farmers are advised to follow the crop rotation with cover crops and grains. Following potato, cover crops are sown then cultivated grains are contaminated with mycotoxins. In no-till farming system the soil is covered with a litter layer, that is accumulation point for pesticides from where those are released into soil. For economic reasons, the rotation sequence is 2-3 years. In the long-term, soil conditions are threatened and soil biodiversity lost.

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

Providing evidence that targeted disease management with reduced input of pesticides should rely on monitoring the phytopathogenic fungi present in the air. The case study also illustrates pesticides behavior on direct sowing fields through the debris layer and influence to the soil fauna and soil quality.

PROBLEM TO SOLVE

The measures of current study will help to reduce the external input, through sustainable agricultural management and substantial improvement of soil fauna services for fungal plant pest control. In the results, agroecosystems are more resilient and managed with less monetary costs; while with higher soil biodiversity the yield reductions are avoided and healthier crops are obtained. For targeted IPM implementation the causal agents of the airborne phytopathogenic fungi must be identified fast and accurately. Many phytopathogenic fungi spread long distances through wind dispersal of spores and cause outbreaks far from the source location and also remain viable for several growing seasons.

CROPS

LOCATION

Lääne-Viru County / Põlva County / Pärnu County / Saare County / Viljandi County (Estonia)

PARTNERS

EULS

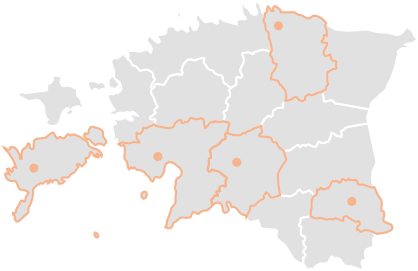
NGO Soil Innovation Cluster

MTÜ Põllukultuuride klaster

CROPPING SYSTEMS

Crop rotation and crop diversification

MONITORING



WINTER WHEAT

POTATO

PESTICIDES ACCUMULATION RATE

FIELD EXPERIMENT

Non-inversion tillage

Inverting tillage

Control

MANIPULATING WITH PESTICIDE CONCENTRATIONS

Airborne spore sampling

IMPACT OF PESTICIDES ACCUMULATION ON SOIL ORGANISMS

Soil earthworms

Soil microorganisms

Soil nematodes

Soil quality

IMPACT OF PESTICIDES ACCUMULATION ON CROP YIELD AND QUALITY

Crop yield and quality

→ *Infographic for case study 12 made by EULS*

BOREAL

RESPONSIBLE PARTNER

Luke, (Finland)

COORDINATION

Doctor (PhD) Krista Peltoniemi is a senior scientist and has expertise on soil microbiomes. She has experience on studies of soil microbial communities (fungi, bacteria, actinobacteria, methanogenic archaea and methanotrophic bacteria), their diversity after environmental changes and their relationships in various environments. Her main task in the projects is to act as a regional coordinator for Boreal region on behalf of all Finnish partners Luke, Petla, Kilpiä and Tyynelä farms. She is involved in all WPs, and her expertize will be utilized in the soil microbiological anayses concerning WP3 and WP5.Deputy coordinator of WP3.

+358 29 532 5585 | krista.peltoniemi@luke.fi

Objective

Early potato is one of the most important crops grown in the Boreal region. Since it has a very short growing period, there is always a long period of time after the harvest when the soil is left bare without vegetation cover. Therefore, the soil in early potato fields is especially vulnerable to erosion and therefore also loss in carbon and nutrients which in turn are actively recycled or retained by soil organisms. With SoildiverAgro we aim to enhance the biodiversity and functionality of soil micro- and macroorganisms responsible for carbon and nutrient cycles.

Two different approaches are investigated in boreal case studies with early potato to maintain soil biodiversity which in turn enhance soil health and productivity:
1) keep the fields covered with cover (or catch) crops,
2) use of organic forest-based amendment to prevent carbon and nutrient loss after the early potato harvest.

Traditionally most of the cultivated soils in the Boreal region have been under intensive conventional tillage which often means mouldboard ploughing. Ploughing is used to control weed growth and to aerate soil before sowing, although it also disrupts the natural soil layers and structure. Intensive tillage may result in compaction and degradation of soil causing losses of soil organic matter affecting soil biodiversity and water availability and thus to overall soil health and productivity. In SoildiverAgro we aim to tackle these problems by investigating less intensive tillage management practices combined with direct sowing in the fields of the Boreal region. Case study fields under tillage experiments are focused to finding the best management practices to create a good soil structure that will enhance the environment for soil biodiversity and microbial activity, and thus also better nutrient cycling and their availability for crop plants.

The overall goal of SoildiverArgo is to enhance sustainable agriculture also in the Boreal region, where northern location and long wintertime create extra challenges for farmers.

Stakeholders consultations

DISCUSSION GROUP

05.03.2020 | Finland

Implementation of possible more sustainable agricultural management practices in Finland
22 PARTICIPANTS: Farmers, researchers, agribusiness, policymakers, industry advisors

REGIONAL MEETING

25.7.2019 | Finland
Overview and decisions about the final experimental design of the boreal case studies in Finland.
17 PARTICIPANTS: Boreal region partners (farmers, project members)

FIELD DAYS

25.7.2019 | Finland
Cover and companion crops were introduced to participants. Active discussion related to crop rotation, soil structure or protective and companion crops
75 PARTICIPANTS: Farmers

21.10.2019 | Finland
Introduction to winter crops, including case study where winter wheat is directly drilled into the green manure crop
30 PARTICIPANTS: Farmers

23.07.2020 | Finland
Trial establishment and intermediate crops
240 PARTICIPANTS: Farmers

TRAINING DAYS

To be confirmed

OTHERS

To be confirmed

NEXT STEPS

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

CASE STUDY 13

Increase of soil biodiversity through amendment of forest based organic material in potato crops.

OBJECTIVE

The objective is to test if forest based carbon addition increases soil biodiversity and carbon stocks in the soil.

PROPOSED PRACTICES

We will compare potato harvest, compare microbiome diversity, carbon storage and disease occurrence between treatments in relation to forest based carbon addition.

STATE OF THE ART

Potato cultivation in the boreal area is intensive using deep ploughing, irrigation and mineral fertilization. Eutrophication risk of nearby waters/ground water is high.

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

Finding adequate forest based material addition is the first step of a new fertilization improving biodiversity and carbon storage of soil.

PROBLEM TO SOLVE

Potato cultivation has the risk to loose soil organic carbon due to deep ploughing and irrigation. Addition of forest based organic products adds carbon to soil.

CROPS

LOCATION

Laitila (Finland)

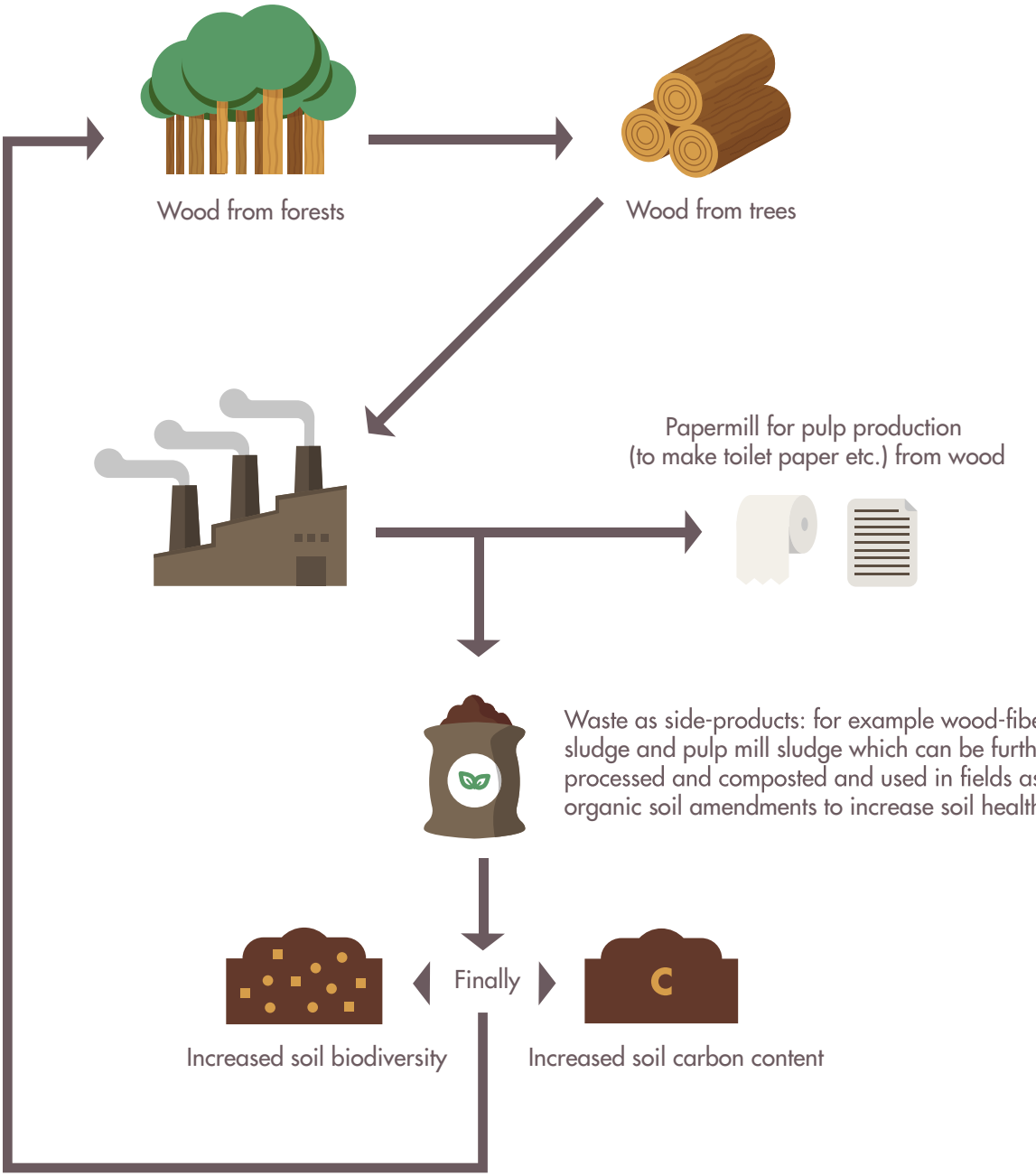
PARTNERS

PETLA

LUKE

CROPPING SYSTEMS

Addition of forest based amendments.


Wood from forests
Wood from trees
Papermill for pulp production
(to make toilet paper etc.) from wood
Waste as side-products: for example wood-fiber sludge and pulp mill sludge which can be further processed and composted and used in fields as organic soil amendments to increase soil health
Finally
C
Increased soil biodiversity
Increased soil carbon content

→ *Infographic for case study 13: Increase of soil biodiversity through amendment of forest based organic material in potato crops*

CASE STUDy 14 A

Contrasting continuous plant cover with inversion tillage in wheat fields.

OBJECTIVE

The objective is to experiment and quantify what inversion tillage does to a soil ecosystem, and how it influences plant nutrient uptake and health.

PROPOSED PRACTICES

The test fields have been managed with organic farming with continuous plant cover and minimum tillage. The experimental plots will be ploughed and the control will continue as it has.

STATE OF THE ART

In spite of the drawbacks, organic agriculture relies heavily on mouldboard plough to control weeds. Farmers have misconceptions on its effectivity, some even suggesting that it improves soil health by increasing water infiltration and storage. Some farmers have tested non-inversion tillage in organic farming, but the benefits have not been quantified.

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

Providing evidence on the damage that inversion tillage does to soil structure, health and biology.

PROBLEM TO SOLVE

Organic agriculture relies on mouldboard ploughing for weed control. Inversion tillage and related overwinter fallow is seen to be detrimental to soil organisms and soil health, but the results are not conclusive. The case study will provide results on what happens to soil health when a continuous plant cover crop rotation with shallow tillage is interrupted with mouldboard ploughing.

CROPS

LOCATION

Uusimaa (Finland)

PARTNERS

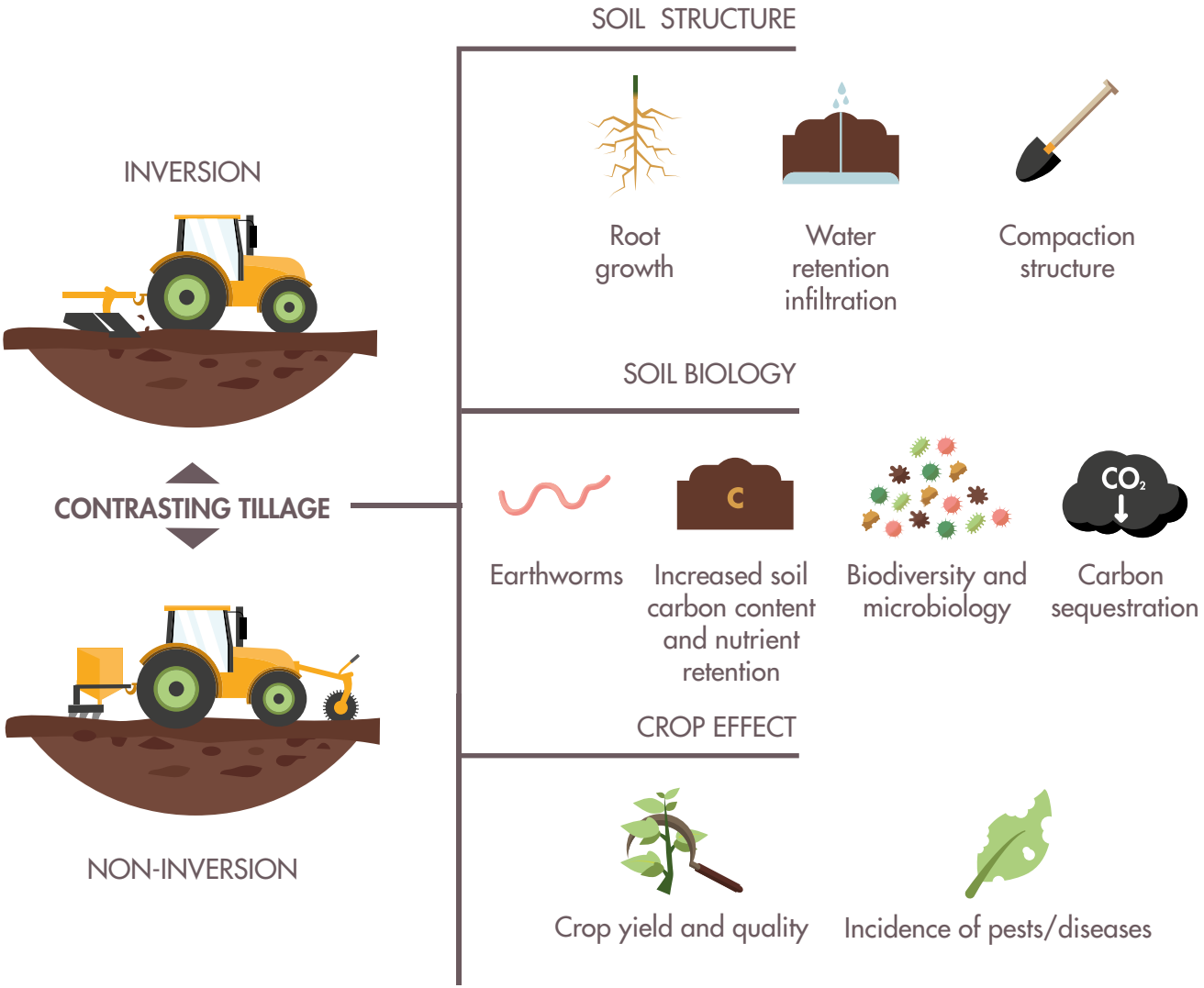
MTJ

TT

LUKE

CROPPING SYSTEMS

Minimum tillage, and inversion tillage.


INVERSION
CONTRASTING TILLAGE
NON-INVERSION
SOIL STRUCTURE
Root growth
Water retention infiltration
Compaction structure
SOIL BIOLOGY
Earthworms
C
Increased soil carbon content and nutrient retention
Biodiversity and microbiology
CO2
Carbon sequestration
CROP EFFECT
Crop yield and quality
Incidence of pests/diseases

→ *Infographic for case study 14 A and 14 B made by MTJ & TT*

CASE STUDY 14 B

Contrasting minimum tillage with inversion tillage in wheat fields.

OBJECTIVE

To study differences between minimum tillage and ploughing on soil properties and microbiology on organic farming system.

PROPOSED PRACTICES

The test fields have been managed with organic farming with continuous plant cover and minimum tillage. The experimental plots will be ploughed and the control will continue with developed minimum tillage practices.

STATE OF THE ART

Minimum tillage and direct drilling are not common practices in organic farming but could be utilized with a crimper roller and continuous crop cover.

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

Minimum tillage is presented as a key method for improving soil biological diversity and functioning.

PROBLEM TO SOLVE

Organic agriculture relies on mouldboard ploughing for weed control. Inversion tillage and related overwinter fallow is seen to be detrimental to soil organisms and soil health, but the results are not conclusive. The case study will provide results on what happens to soil health when a continuous plant cover crop rotation with shallow tillage is interrupted with mouldboard ploughing.

CROPS

LOCATION

South Carelia (Finland)

PARTNERS

MTJ

TT

LUKE

CROPPING SYSTEMS

Minimum tillage, and inversion tillage.

CASE STUDY 15

Use of catch crop in farmed potatoes fields.

OBJECTIVE

The objective is to test how catch crops benefit soil biodiversity and biological soil fertility and related ecosystem functions.

PROPOSED PRACTICES

Catch crops will be sown after the harvest.

STATE OF THE ART

Catch crops benefit soil quality especially after the harvest, as they take up nutrients through the summer and autumn, add carbon to soil, contribute to good soil structure, and promote microbial and faunal function and restrict erosion of soil.

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

Finding out whether catch crops would improve soil structure and quality by decreasing nutrient and carbon loss that hypothetically affect soil biodiversity and biological soil fertility.

PROBLEM TO SOLVED

Growing season for early potato cultivation is short. Thus is expected that practices conducted in fields after harvest would be important for soil community maintaining favorable soil conditions.

CROPS

LOCATION

Laitila (Finland)

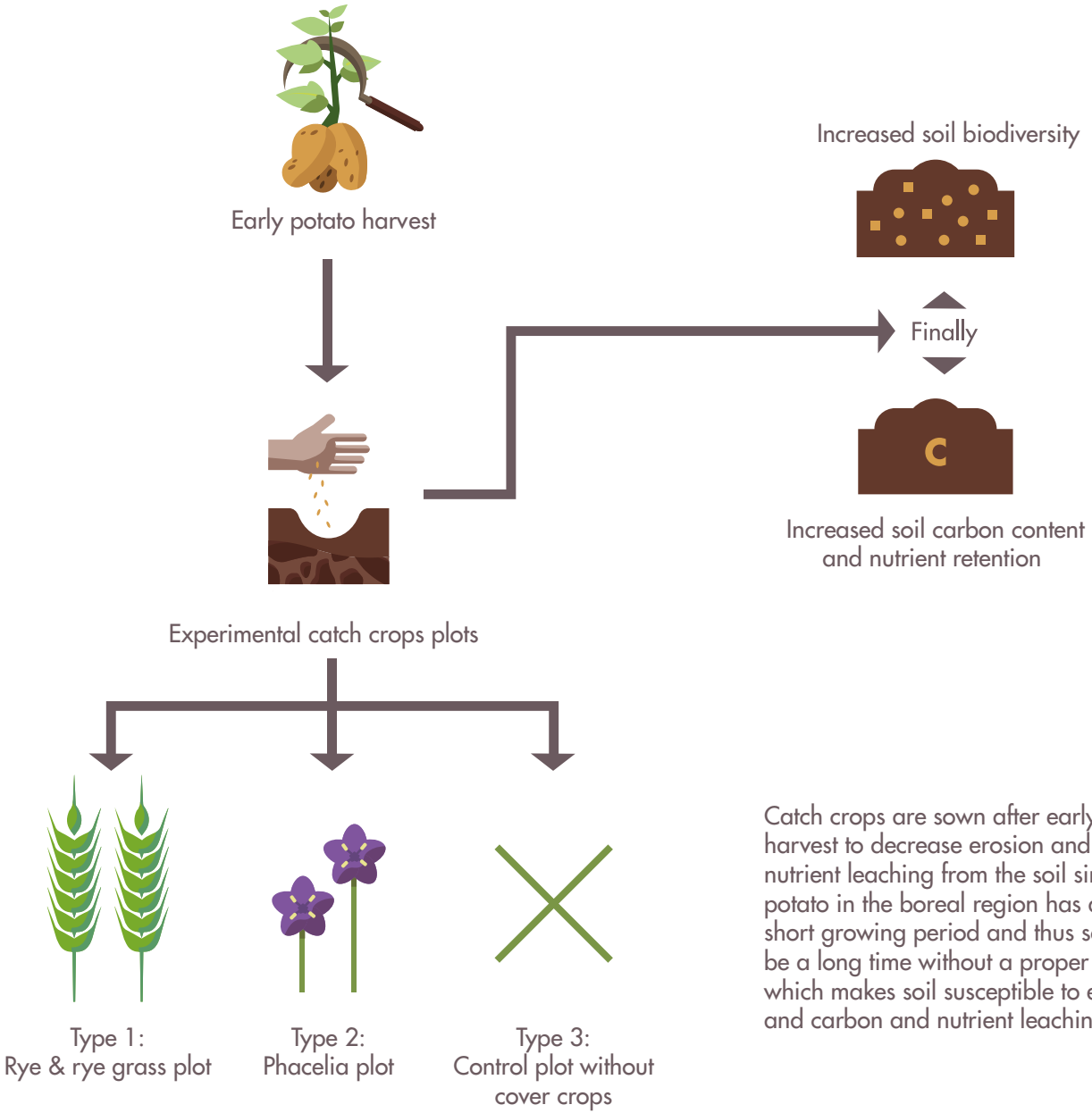
PARTNERS

PETLA

LUKE

CROPPING SYSTEMS

Use of catch crops



Catch crops are sown after early potato harvest to decrease erosion and nutrient leaching from the soil since early potato in the boreal region has a very short growing period and thus soil will be a long time without a proper crop which makes soil susceptible to erosion and carbon and nutrient leaching.

→ *Infographic for case study 15: Use of catch crop in farmed potatoes fields*

Soildiver Agro

STAY TUNED!

www.soildiveragro.eu