



WAGENINGEN  
UNIVERSITY & RESEARCH



# Microplastics in agroecosystem– effects of plastic mulch film residues on soil–plant system

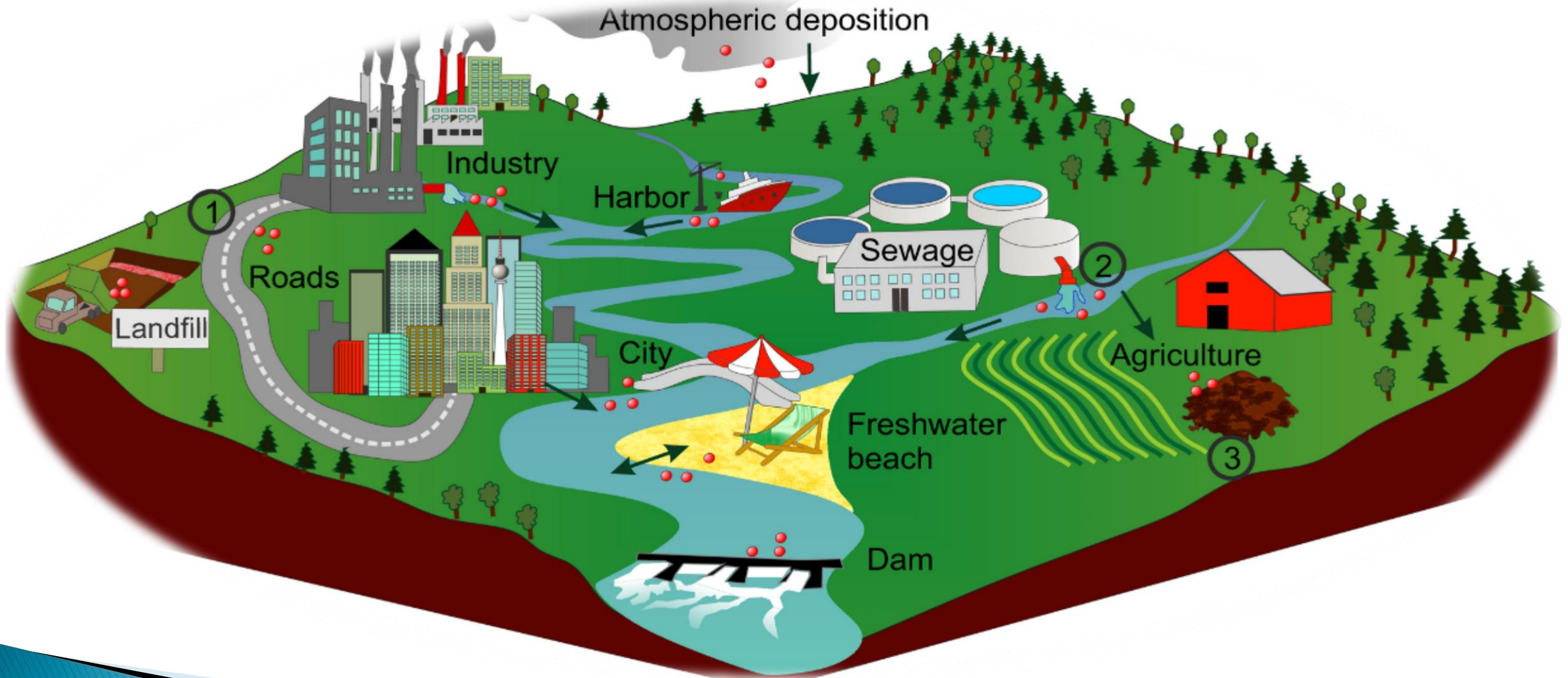
Yueling Qi

Promoter: SLM/WUR – Violette Geissen

Co-promoter: ME/NIOO – Paolina Garbeva

2016.10–2020.9

# Agriculture soil: one of the major entry point for microplastics



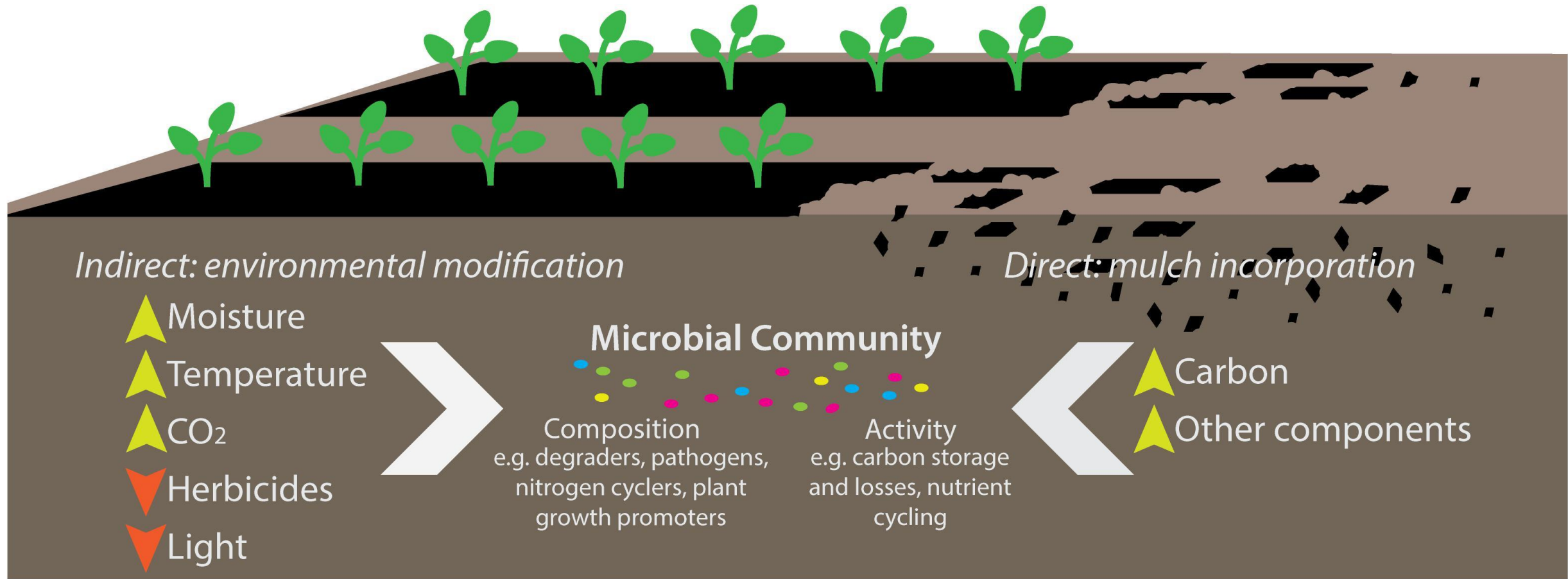


# plastic mulch film residues



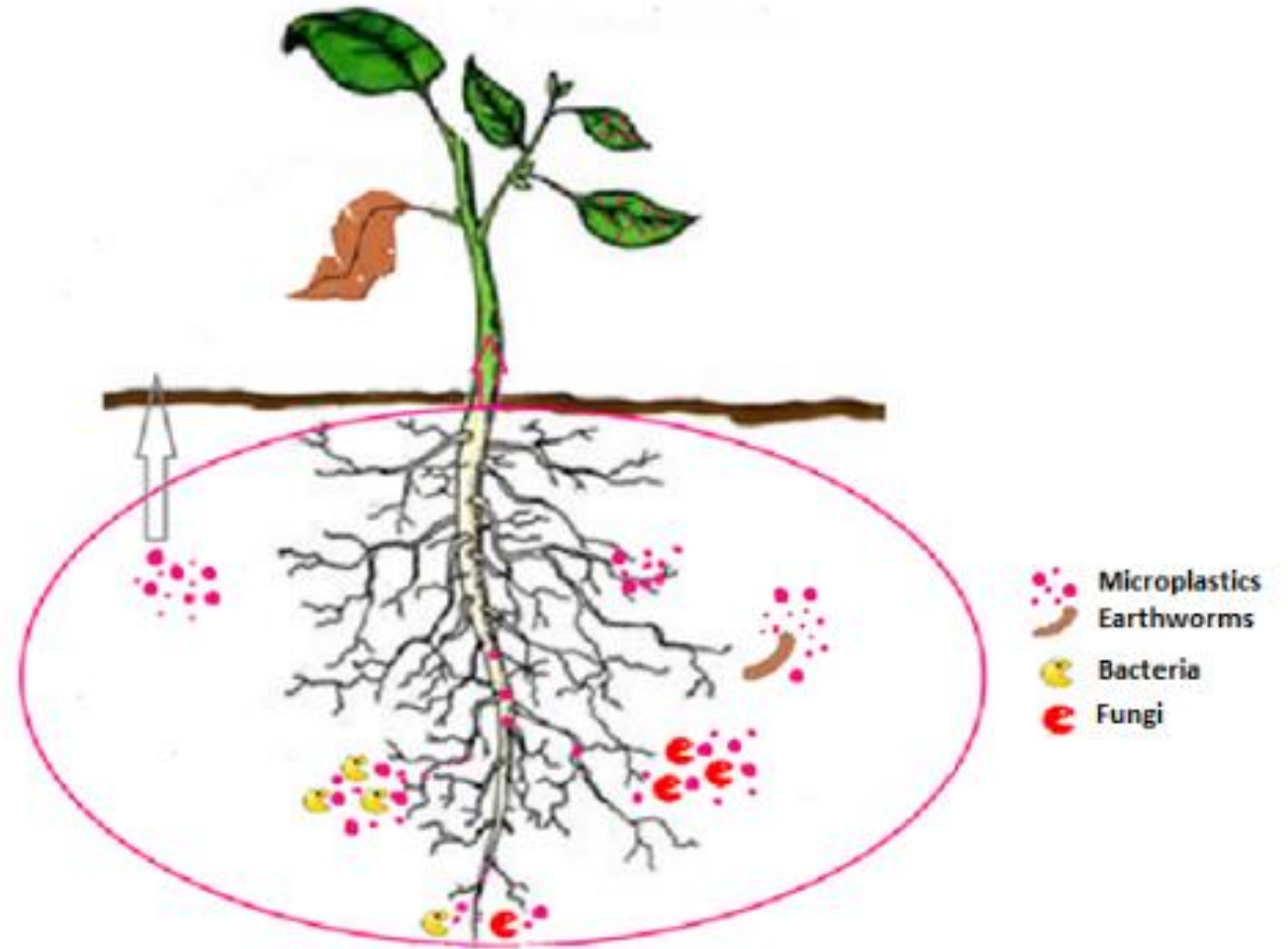
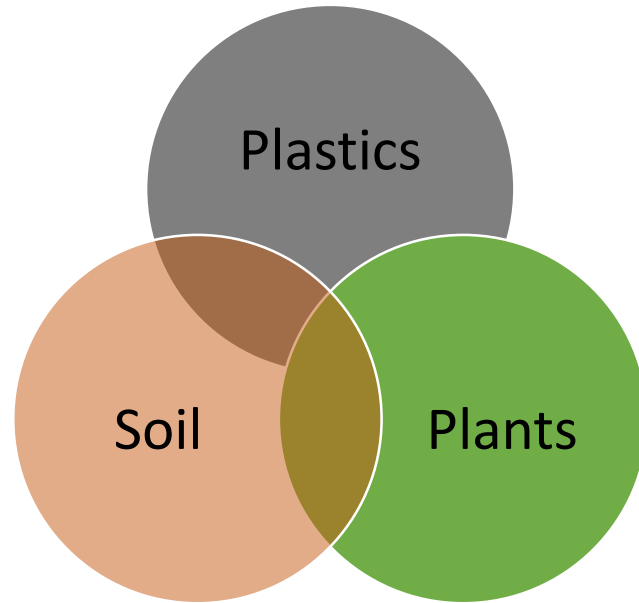


Large is unknown about effects of plastic mulch film residues incorporation on soil ecosystems.



# Scientific question:

How plastic mulch film residues effect the soil–plant system?



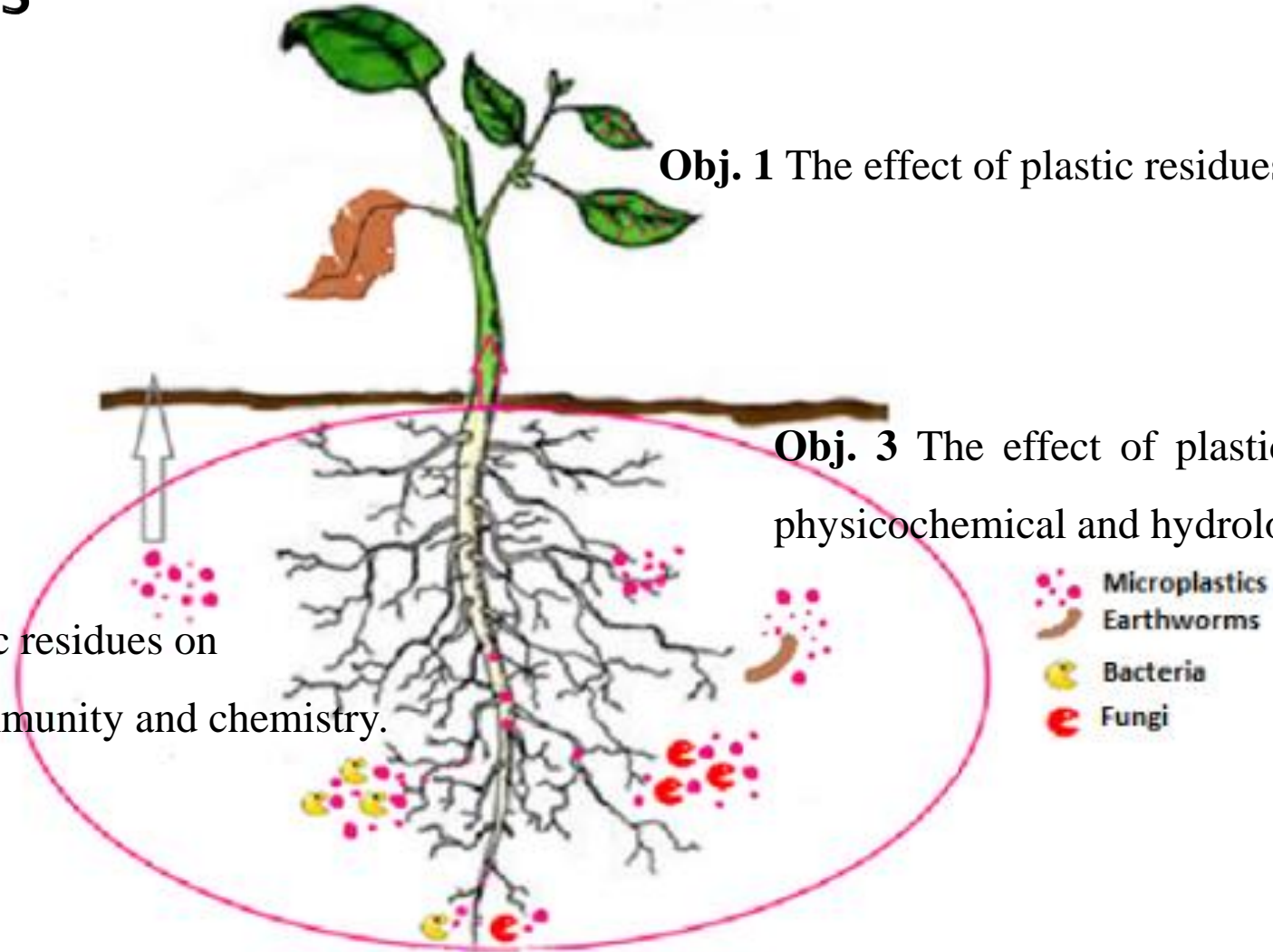
# Objectives

**Obj. 2** The effect of plastic residues on rhizosphere microbial community and chemistry.

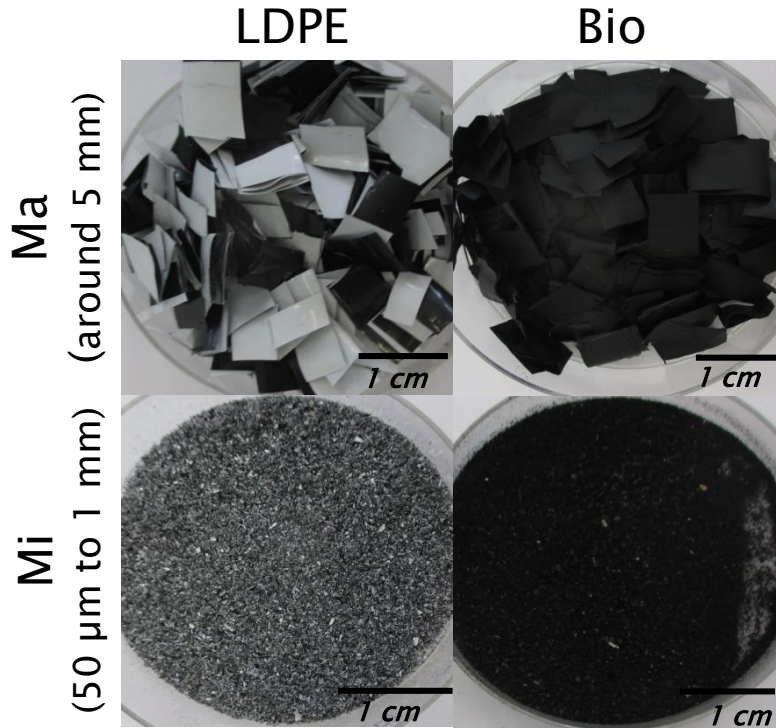
**Obj. 1** The effect of plastic residues on plant growth.

**Obj. 3** The effect of plastic residues on soil physicochemical and hydrological properties.

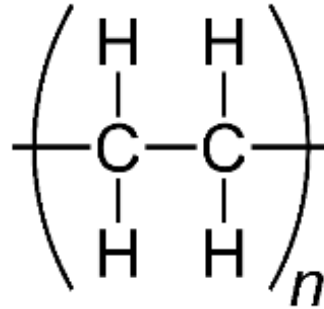
**Obj. 4** The effect of plastic residues on soil suppressiveness and soil-borne plant pathogens.



# Plastic materials

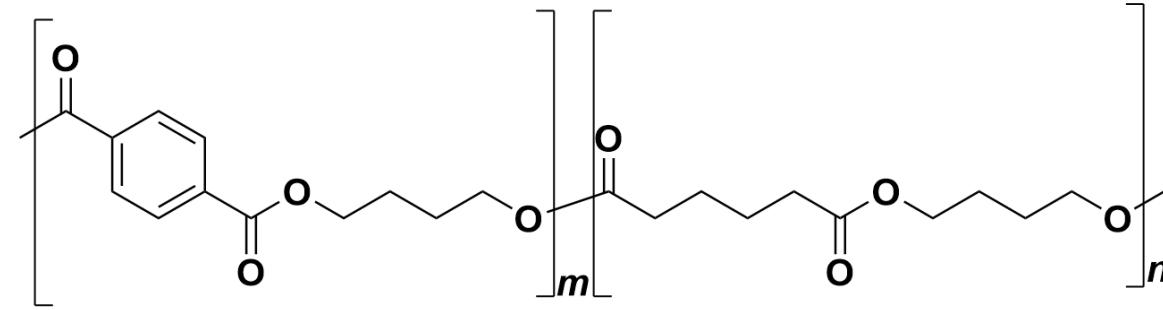


LDPE mulch film



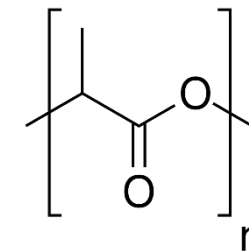
PE\*: polyethylene

Bio mulch film



PBAT: polybutylene adipate terephthalate

starch



PLA: Polylactic acid (~5%)

blended with a black Carbon masterbatch  
using copolyester as carrier resin

Type

Size



# Obj. 1 The effect of plastic residues on plant growth

## Treatments:

- I. LDPE-Ma
- II. LDPE-Mi
- III. Bio-Ma
- IV. Bio-Mi
- V. Control

Earthworms: WE/NE

Two time points:  
2 & 4 months

Model plant:  
Wheat

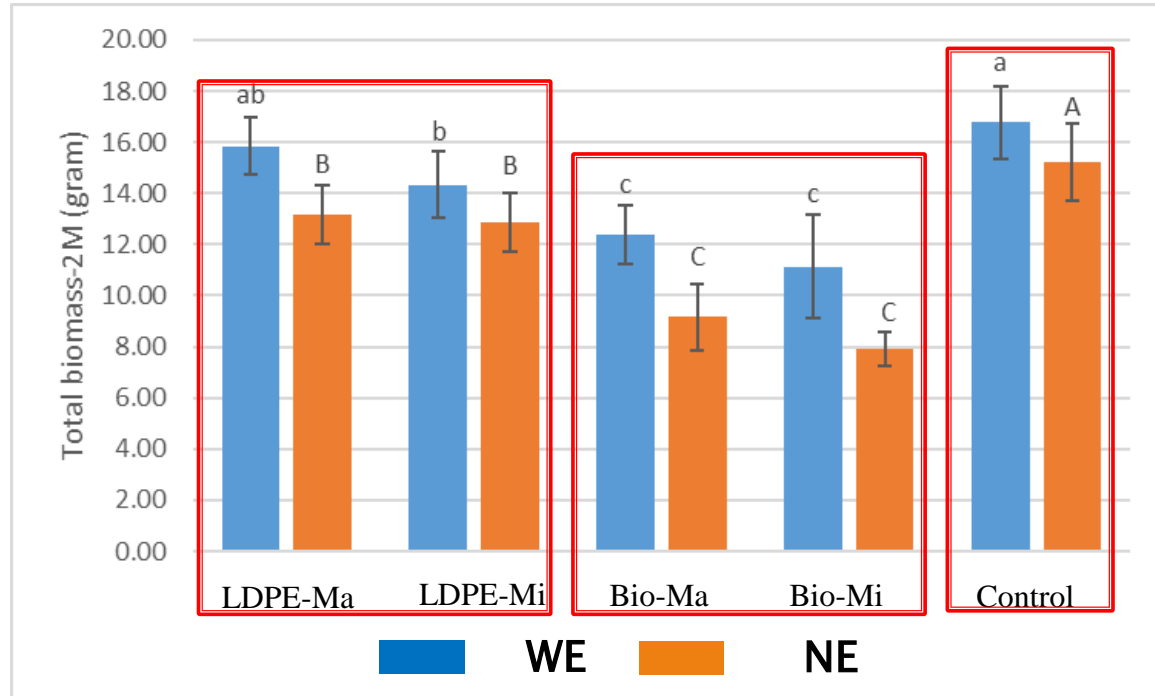
Plastic content:  
1% w/w



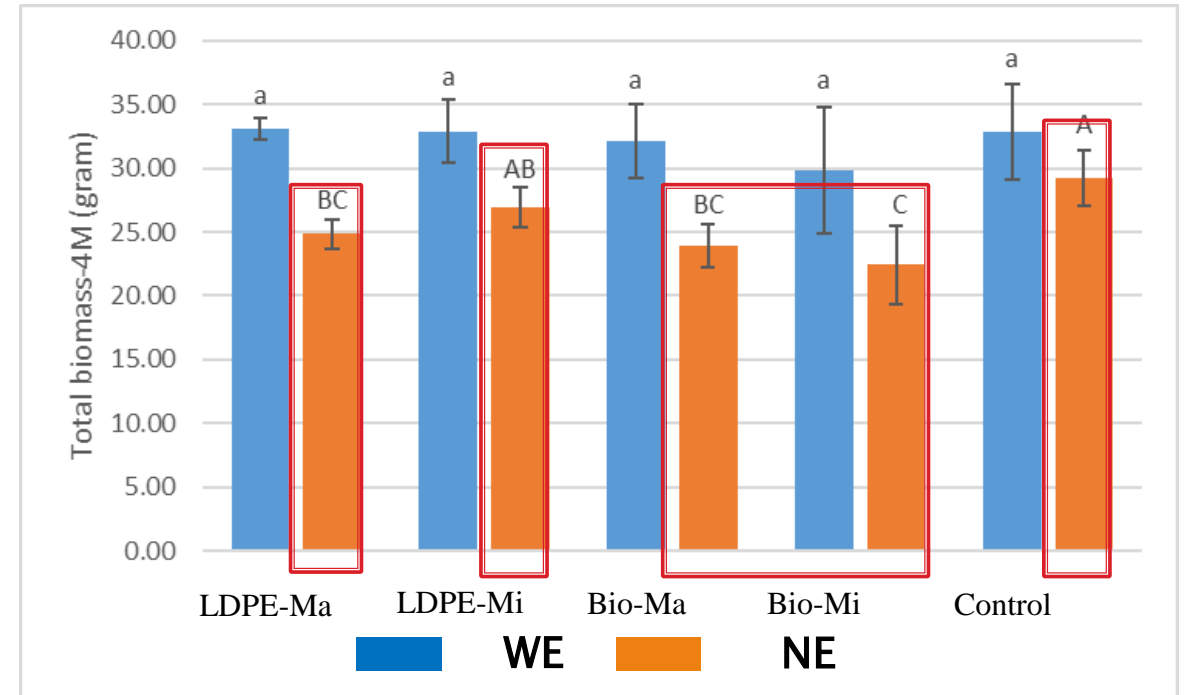


# Results

## Total biomass at 2 months



## Total biomass at 4 months



## Conclusions for Obj.1

- ▶ Type: Biodegradable plastic stronger negative effect than LDPE
- ▶ Size: no significant difference on biomass
- ▶ Earthworm: positive effect on wheat growth, reduce the negative effect LDPE and Bio



# Obj. 2 Effect of plastic residues on rhizosphere microbial community and chemistry

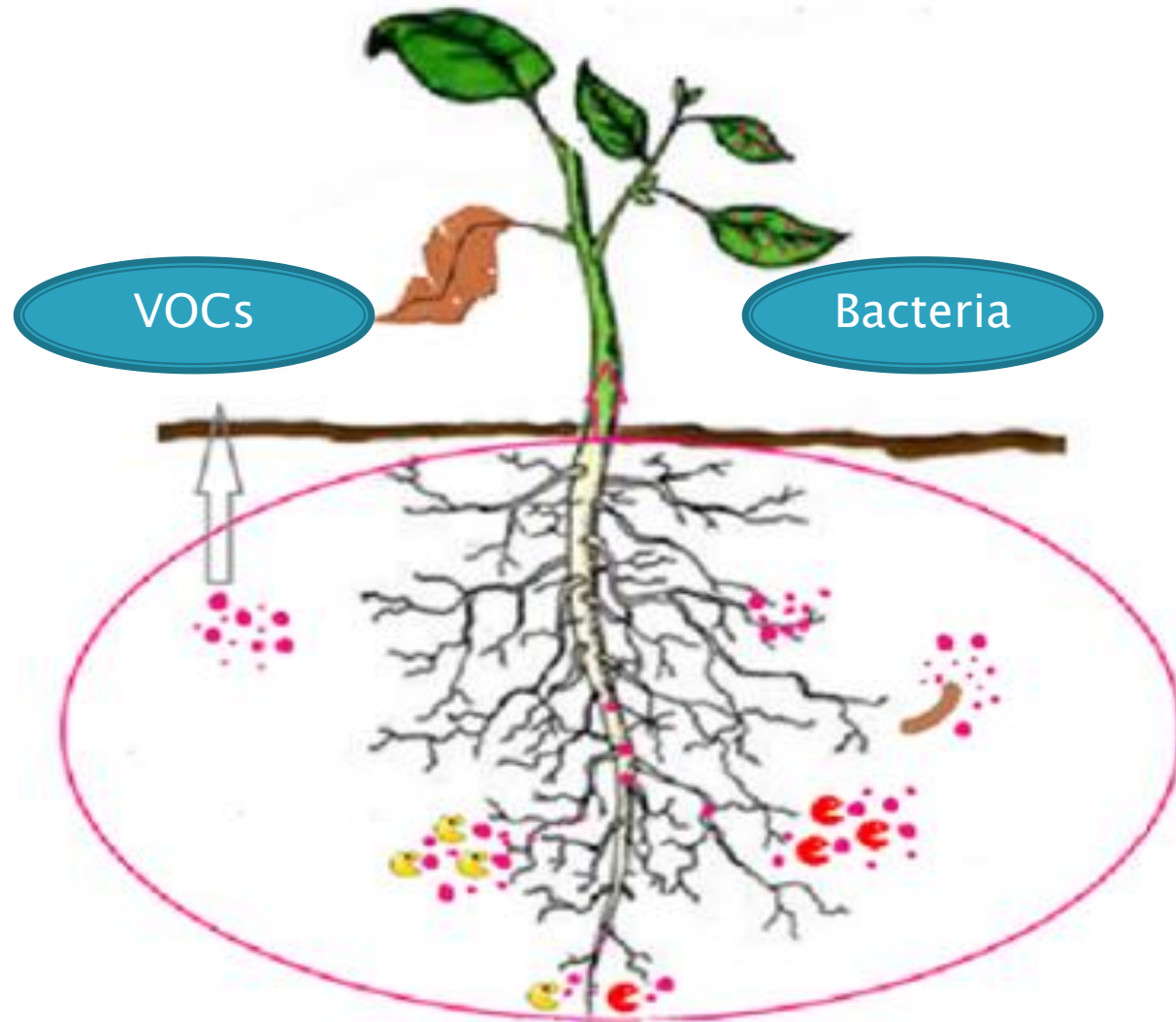
## Treatments:

- I. LDPE-Ma
- II. LDPE-Mi
- III. Bio-Ma
- IV. Bio-Mi
- V. Control

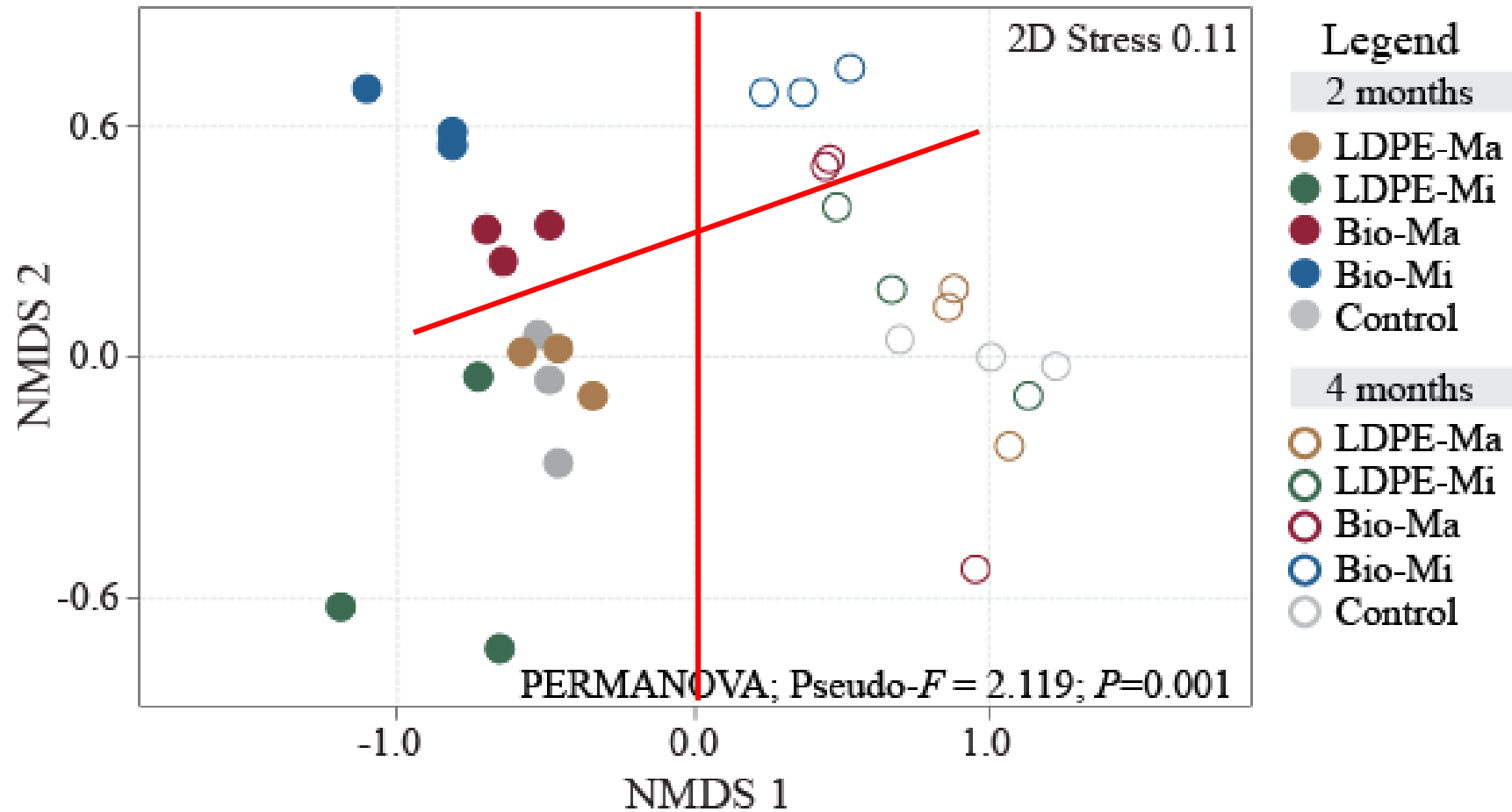
**Two time points:**  
2 & 4 months

**Model plant:**  
Wheat

**Plastic content:**  
1% w/w



# Rhizosphere bacterial community: 16S rRNA gene analysis



Beta-diversity biplot of bacterial communities displayed by non-metric multidimensional scaling (NMDS)



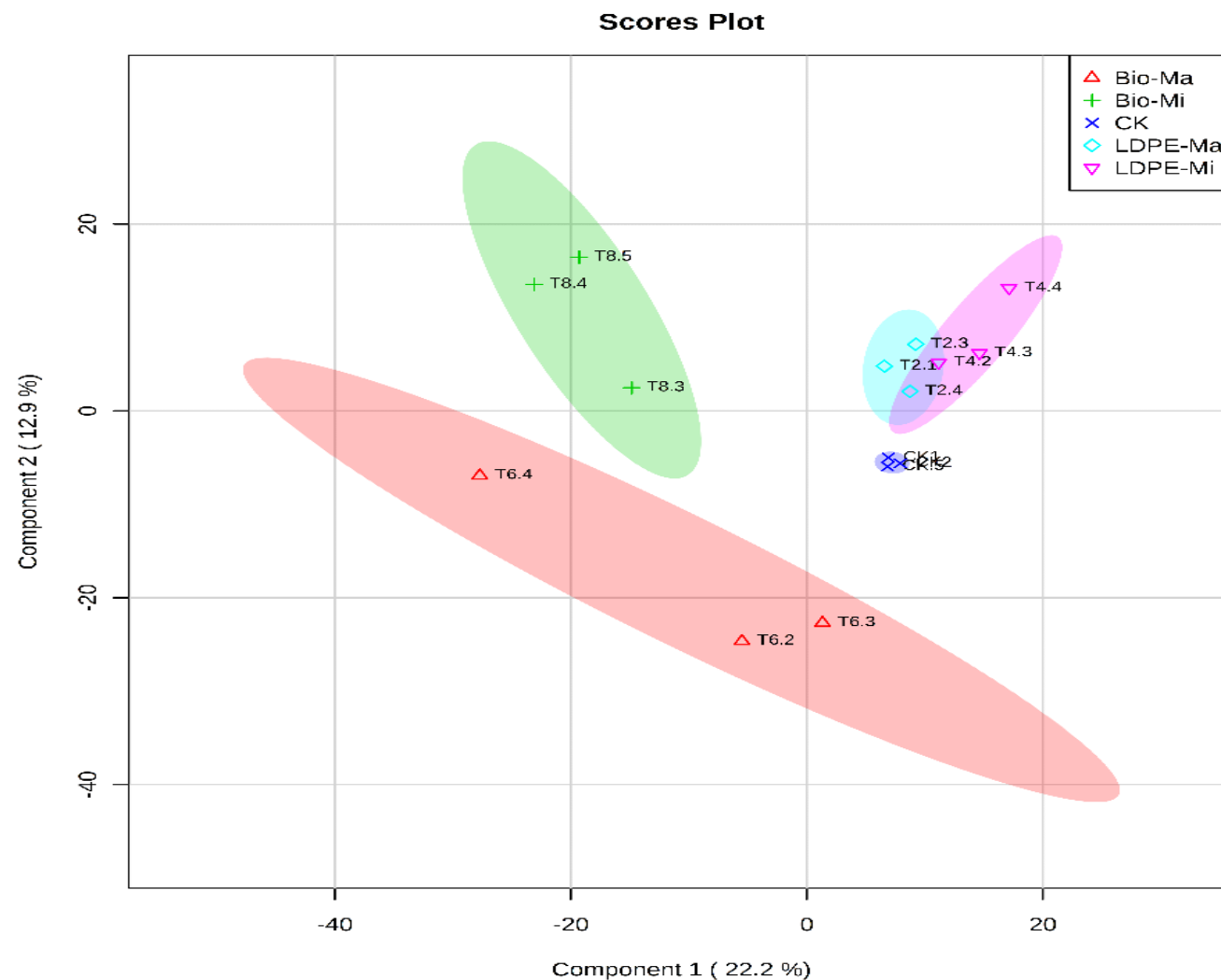
# Analysis of volatile organic compounds



Polydimethylsiloxane (PDMS) silicone tubes



GC/MS-Q-TOF measurement



Partial least square-discriminant analysis (PLS-DA) score plots

## Conclusions for Obj. 2

Both LDPE and Bio plastic mulch film residues have strong effects on:

- rhizosphere bacterial community composition and structure
- rhizosphere volatile profiles
- soil chemical properties (pH, EC and C:N).



# Obj. 3 Effects of plastic residues on soil physicochemical and hydrological properties



## Treatments:

- I. LDPE–Ma
- II. LDPE–Mi
- III. Bio–Ma
- IV. Bio–Mi
- V. Control

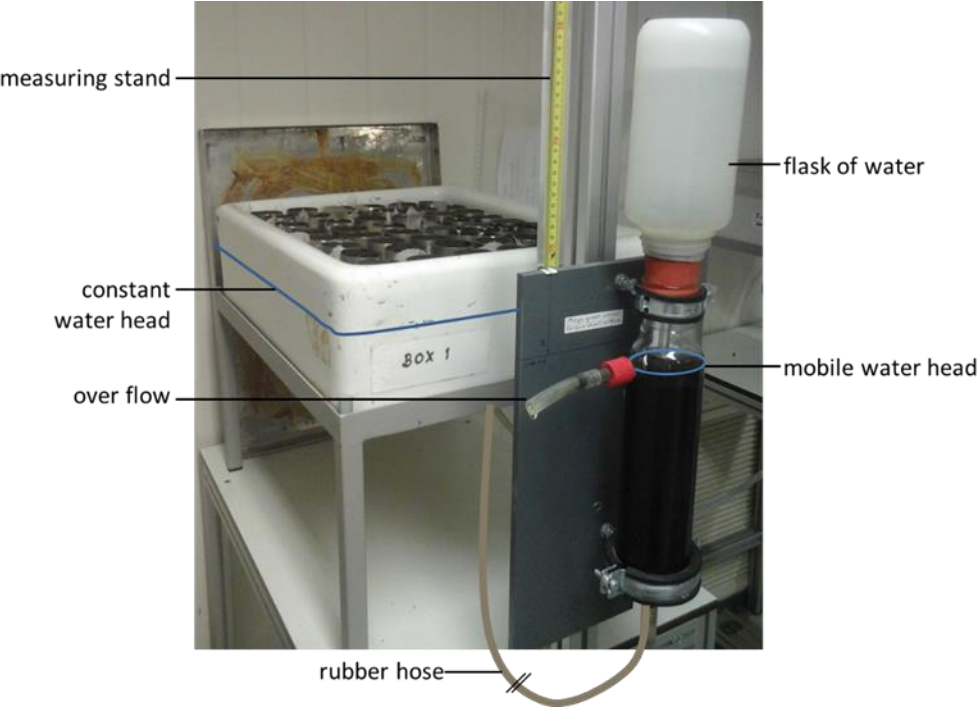
## Three contents:

0.5%, 1%, 2%

One month mesocosm experiment



Measured parameters for soil structure, water infiltration, soil water retention, soil water repellency and soil chemical properties.



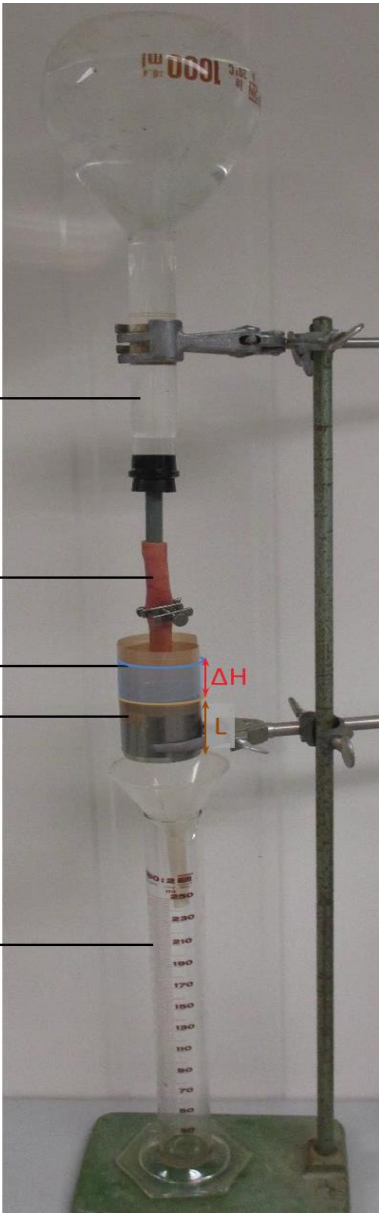
1L Volumetric flask

rubber hose

Water head

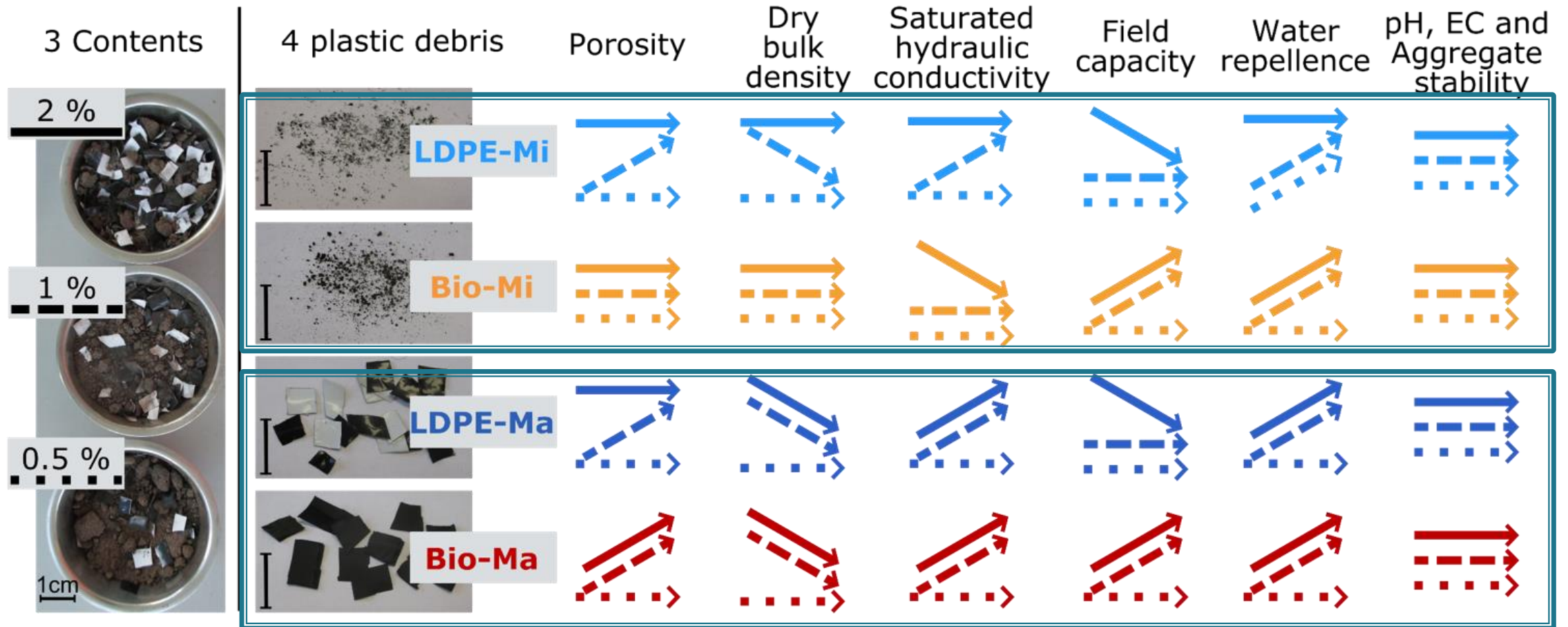
Saturated ring sample and tape cylinder

250 ml graduated cylinder



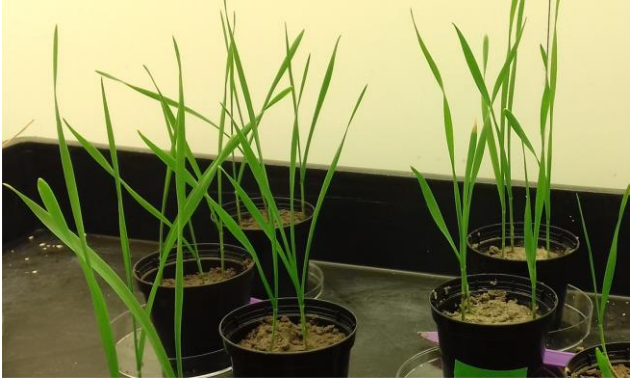


# Results



submitted

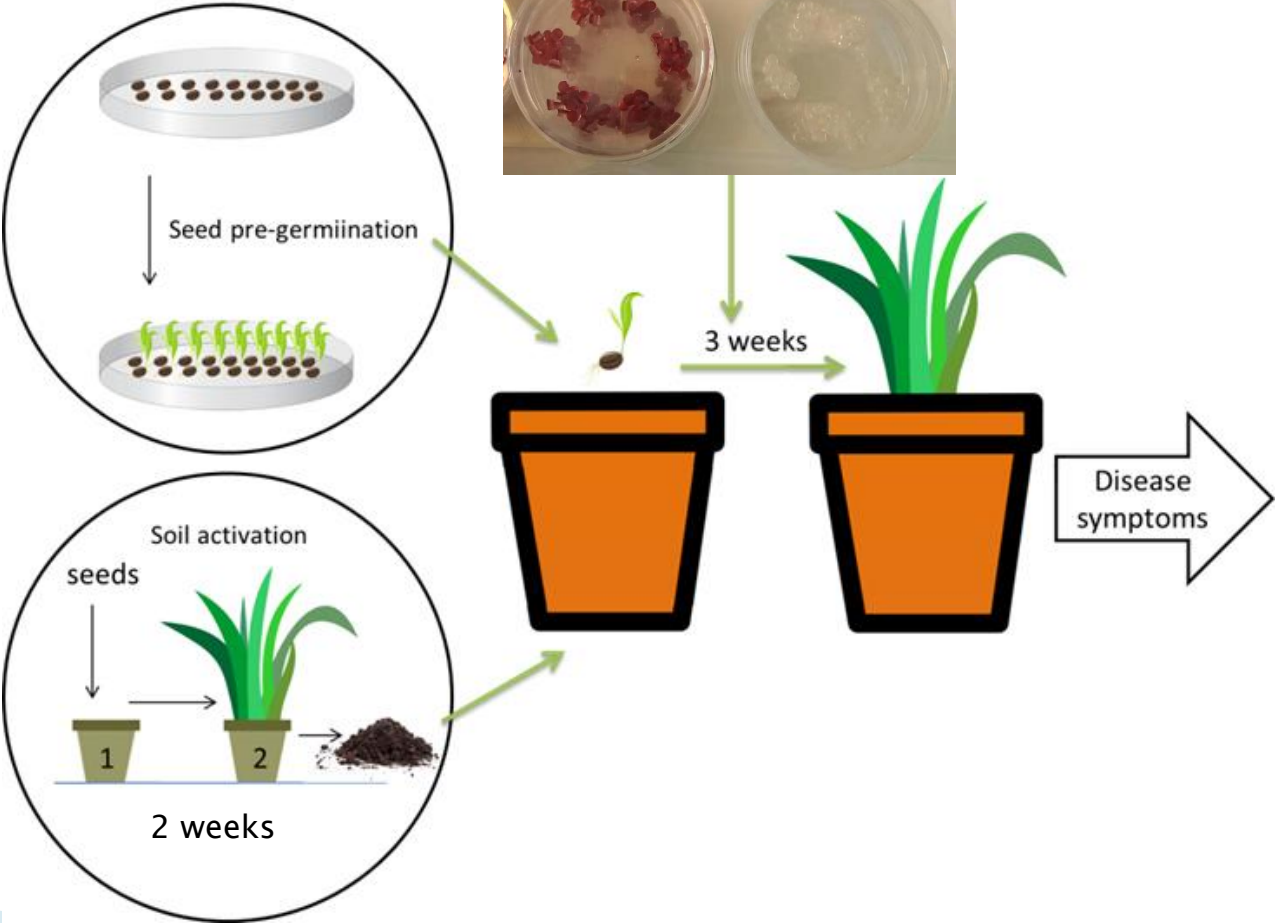
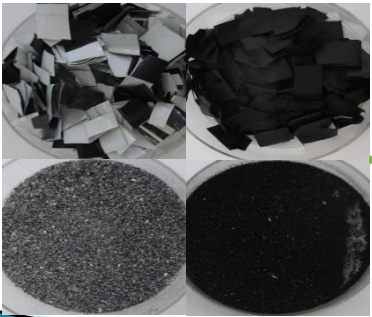
# Obj. 4 The effect of plastic residues on soil suppressiveness and soil-borne plant pathogens



Pathogens added



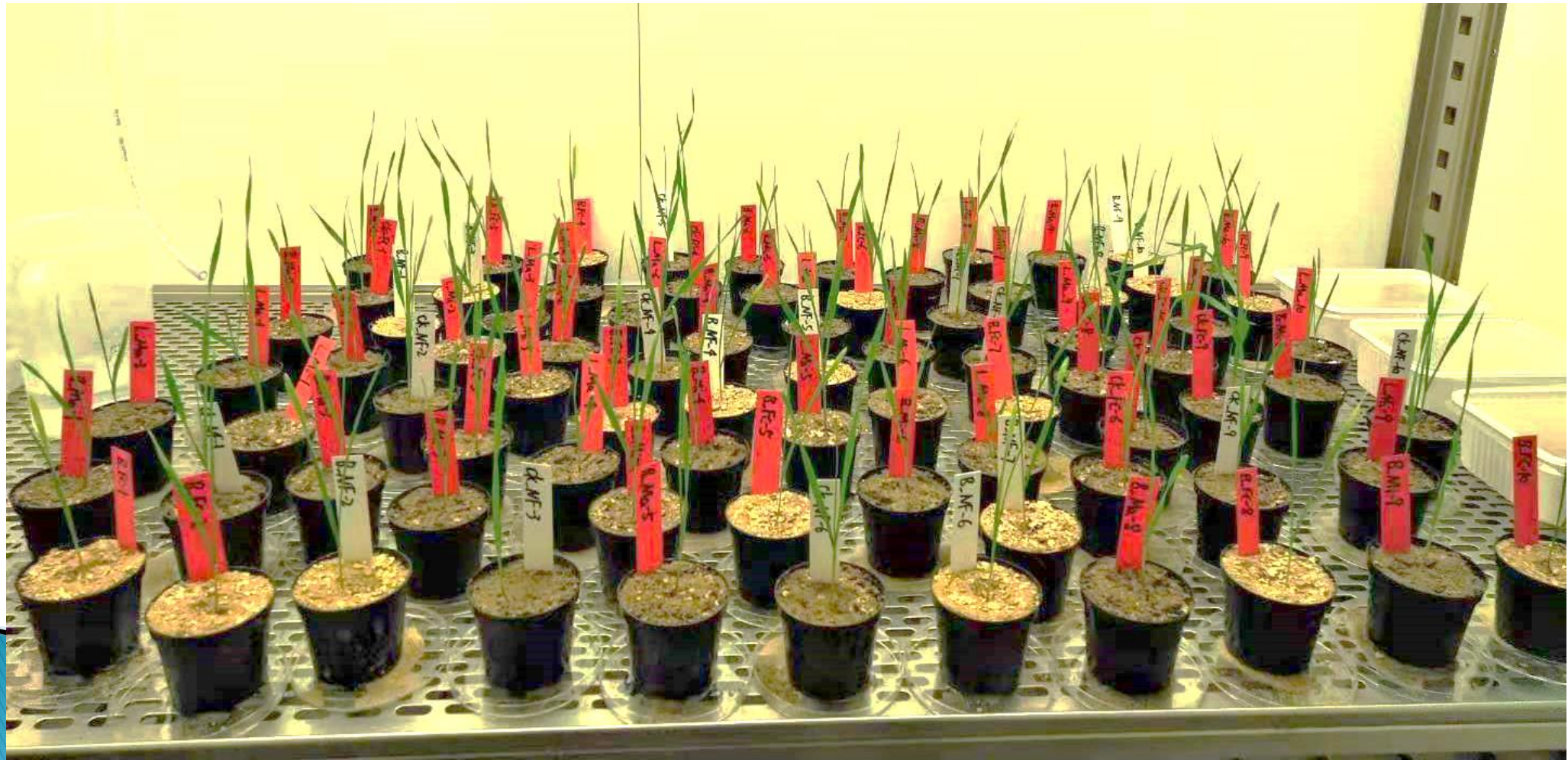
Plastic residues added



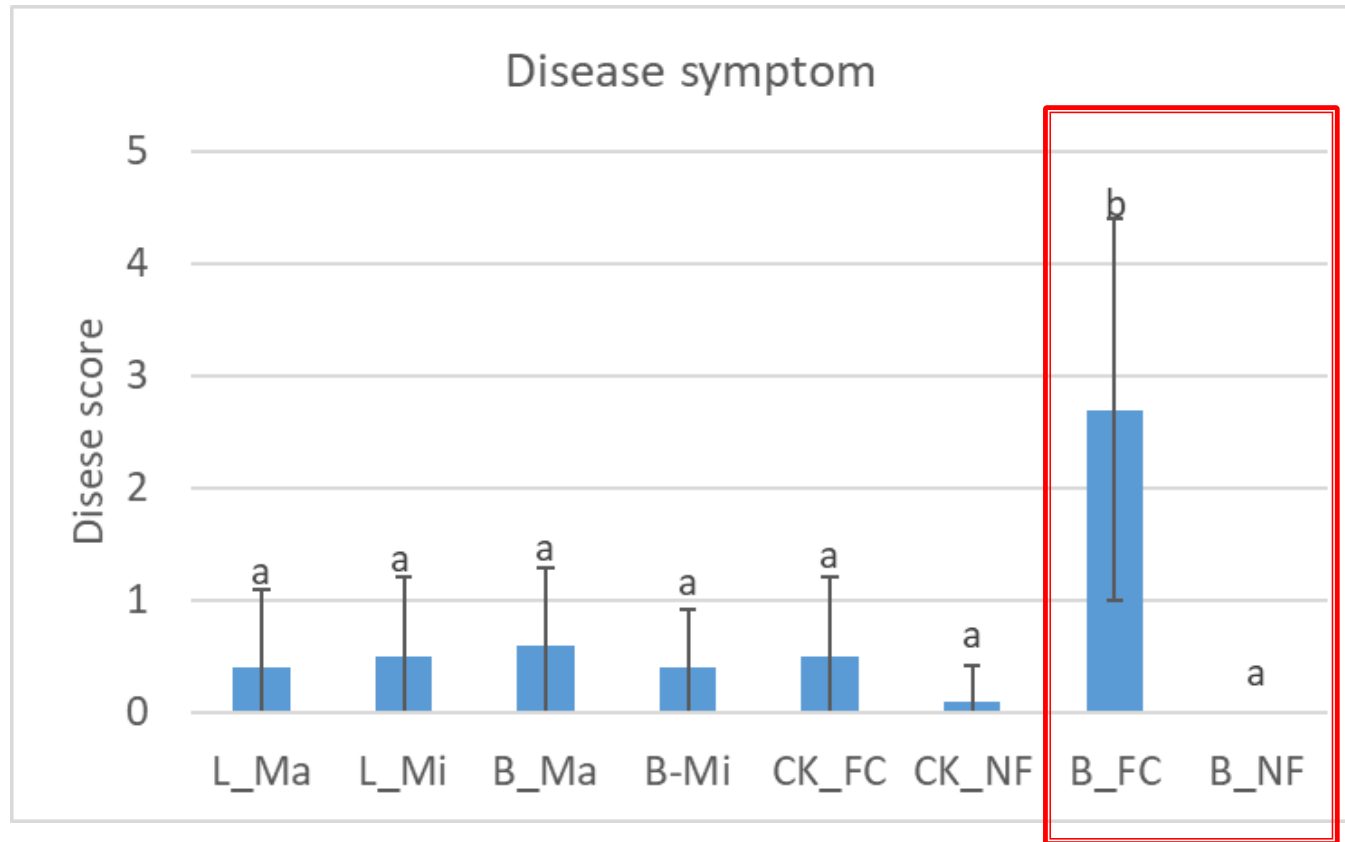


# Research question

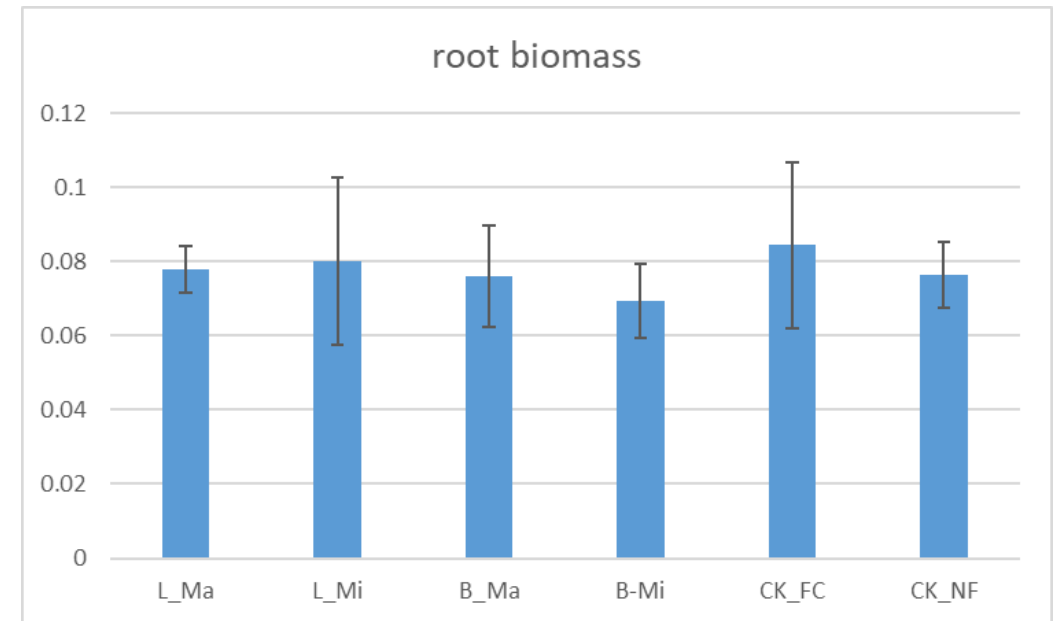
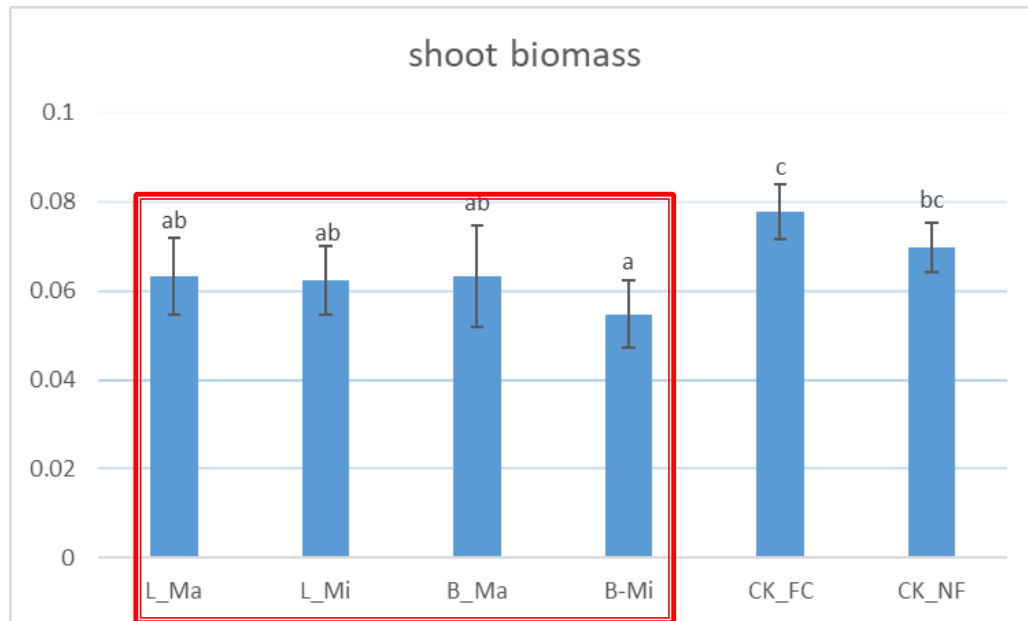
Do plastic residues affect the level of soil suppressiveness and the infections of *F. culmorum* in wheat?



# The presence of plastic residues did not affect the level of soil suppressiveness



# Plant biomass





# Further results and analysis



Bacterial (16S rRNA) and Fungal (ITS) community based on amplicon sequencing

rhizosphere

plastisphere

# Thank you... ..

