The resilience of soil systems towards microplastics

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Introduction

Main Project: DIMISOR: Defining the Impact of Microplastics (MP) on Soil Resilience

- Soil resilience is the ability of soils to maintain their properties despite disturbances. It's crucial for sustaining ecosystem functions and human livelihoods.
- Resilient soils are important to mitigate the impacts of climate change on soil erosion and nutrient depletion.
- Microplastics threaten soil resilience by disrupting soil structure and functioning and altering soil properties critical for resilience.
- Finding thresholds of MP concentrations and improving soil management practices can protect soil resilience to microplastics.

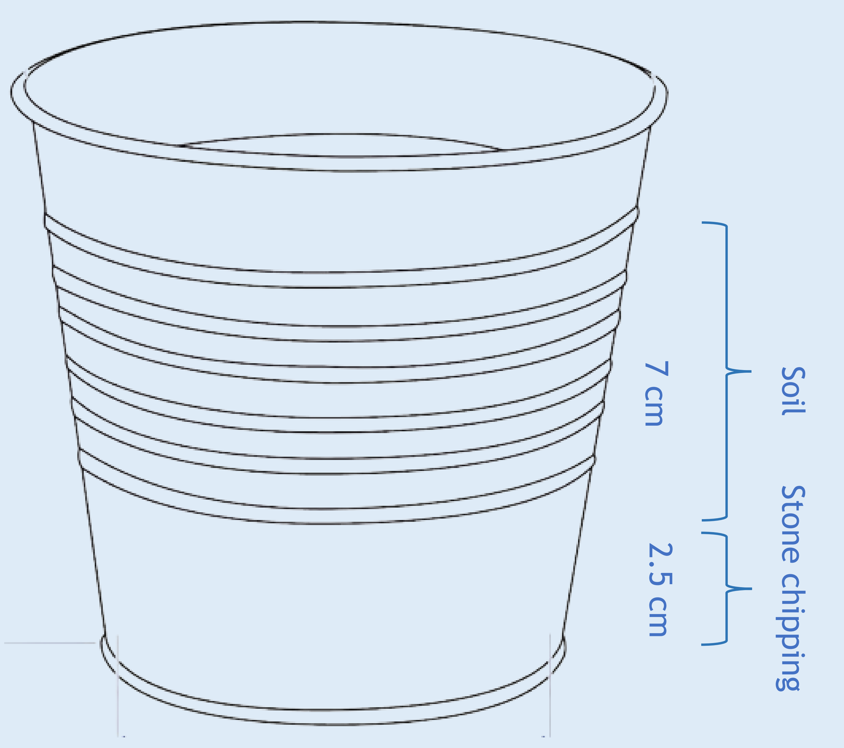
Objectives

- To assess the impact of MP on soil properties.
- Evaluate time-dependent changes in soil properties and their recovery potential from MP-induced disturbances.
- To assess disturbance characteristics and establish thresholds of soil resilience associated with MP exposure.

Methodology

- Soil type
  - Norwegian Loamy soil
  - Stone chipping
- Soil Properties
  - Organic matter
  - pH
  - Water holding capacity
  - Bulk density
  - Porosity
- Soil enzyme activity
  - Urease
  - Phosphatase
  - Fluorescein diacetate hydrolase
- Polymer types
  - Polybutylene adipate terephthalate (PBAT)
  - Linear Low-density polyethylene (LLDPE)
- Microplastic concentrations
  - Control, 0.005%, 0.05%, 0.50%, 1%, and 1.50%
- Time Interval for measurements
  - 2, 4 and 6 months
- Watering after every 5 days, and temperature 22° C ±1

Microplastic particles



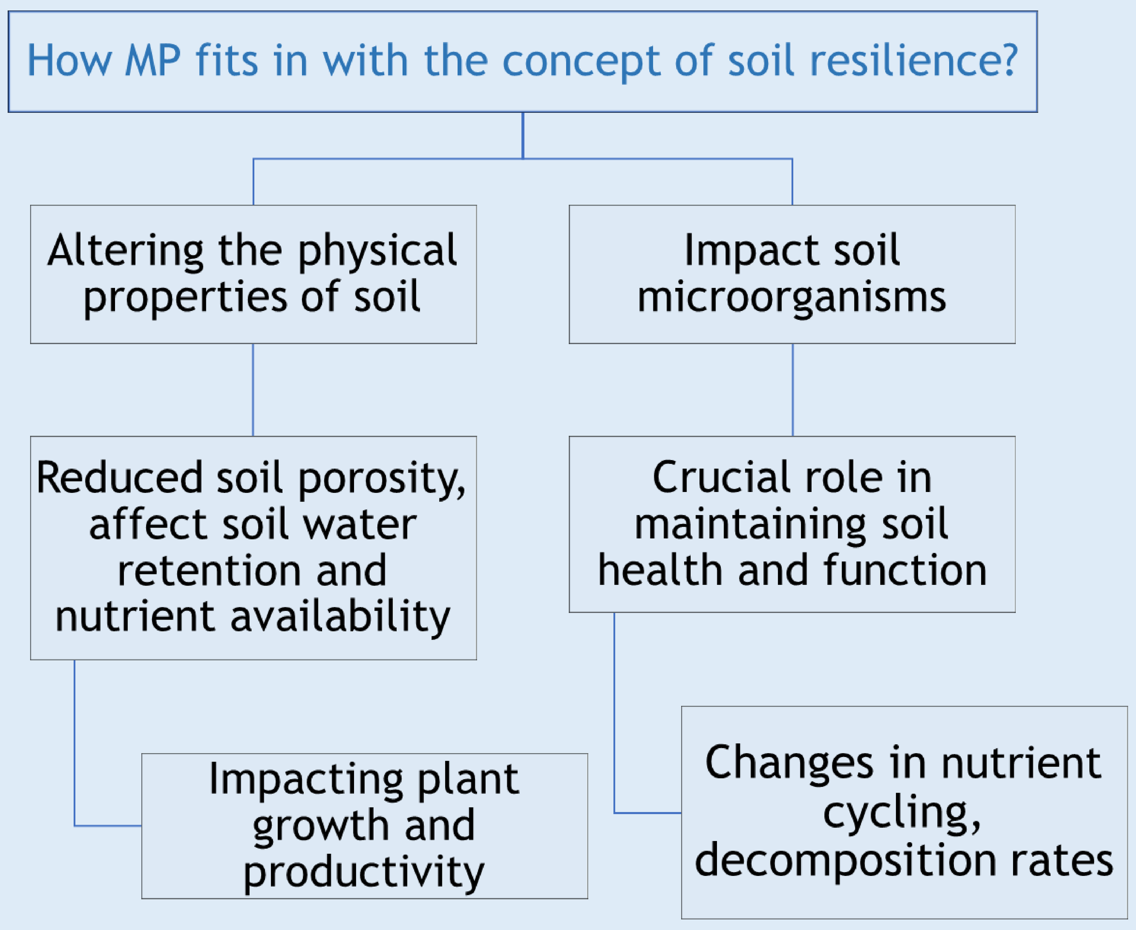
Assessment of Soil Resilience

There are several methods that have been applied to assess soil resilience. E.g.,
The variable was measured in the soil (undisturbed and disturbed)

- at time 0 (immediately after disturbance) or
- at time x after disturbance

Few examples, $\frac{V_{post}}{V_{Pre}}$ or $\frac{V_{post} - V_{dist}}{V_{Pre}}$ or $\frac{(SQI\_C - SQI\_S)}{SQI\_C}$

Post-disturbance steady state V_{post} to pre-disturbance Steady-state V_{pre}, No disturbance impact term $V_{dist,}$ SQI_C; Soil quality index control, SOI_S; soil quality index stress.



Intended approach

Soil Resilience = (SQI_Control - SQI_Stress) / SQI_Control

Where:

- SQI_Control = Soil Quality Index of control sample
- SQI_Stress = Soil Quality Index of sample exposed to microplastics

To calculate the Soil Quality Index (SQI), we will use the following formula:

SQI = [(S1/S1max) + (S2/S2max) + (S3/S3max) + ... + (Sn/Snmax)] / n

where:

- S1, S2, S3, ..., Sn are the measured soil properties at a specific time point and microplastics concentration
- S1max, S2max, S3max, ..., Snmax are the maximum values of each soil property, of the baseline samples
- n is the total number of soil properties measured

Approach to find threshold:

- Plot the Soil Resilience values against MP concentrations for each time point
- Determine the point at which Soil Resilience starts to significantly decrease
- The MP concentration at this point is the threshold for soil resilience based on the SQI index

Conclusions

- New knowledge gained on the impact of MP exposure on soil resilience parameters and future contamination scenarios
- The results will provide essential new insights into the impact of MP contamination on a vital ecosystem's functioning
- Identification of potential soil resilience indicators
- New potential to assess soil MP contamination at broader spatial and temporal scales

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