



Final report regarding the project with a project title:” Impact of compost of circulated streams on soil and plant health in apple cultivation”. Project number PA 1486

Project leader:

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Abstract

Modern agriculture and horticulture depend on the use of pesticides and mineral fertilizers that cause pollution and negative environmental impacts. With changing climate and legislation, there is a great need to develop more resilient systems. One of the potential strategies to limit the use of mineral fertilizers while creating more resilient cultivation systems is to implement circular aspects and use of the residual flows from various industrial activities. As in many other cultivation systems, implementation of conventional practices in apple orchards tends to cause soil degradation and soil health challenges.

This study investigates the potential of using locally produced residue compost as a fertilizer and its impact on soil health, growth of apples and on the microbial communities around plant roots. The compost consisted of apple (residues from apple cultivation), spent mushroom compost (residuals from mushroom cultivation) and wood fibers (residuals from apple trees and nearby forest around the apple cultivation). For nine weeks, apple branches (*Malus domestica*) of rootstock A2 were grown in pots in a polytunnel. The treatments consisted of a control treatment where the apple branches were grown in a soil commonly used in apple cultivation (AOS) and a treatment using soil mixed with residual product compost (RPC) in a ratio of 20:80 to match commercial basal fertilization. Control was fertilized with mineral fertilizer. Growth measures such as plant height, number of leaves and accumulated shoot growth were investigated, as well as soil physical properties before and after cultivation. Microbial communities were monitored during cultivation via the microfluidic soil chip and examined under a microscope. The abundance and diversity of different microbial groups were investigated.

Statistical analyses were applied to evaluate growth patterns, microbial abundance and soil physical properties. Growth has been improved by introducing the compost of the residual product into the soil. Significant differences were observed in shoot length and number of leaves. Significant differences were found between the treatments in microbial groups such as hyphae, amoebae, lobose amoebae, ciliophora and flagellates. Water holding capacity and porosity of the soil have been improved due to compost treatments. These findings suggest that RPC can improve soil and growth, contributing to more sustainable apple growing practices.

Conclusions

- Introduction of compost material consisting of residuals of spent mushroom compost, apple and wood chip is a strategy with potential to improve soil health in apple cultivation
- The impact of compost material on soil health is indicated through the enhancement of microbial diversity in soil, water holding capacity and porosity of soil, nutrient availability and plant growth and development
- The results need to be evaluated in experiments with longer period and with a broader screenings parameter in order to confirm the sustainable impacts of the used compost material

Projects output

- 1- Master thesis, defended in Jun 2024
- 2- Poster presentation performed during thesis days Maj 2024
- 3- International publication, under development to be submitted during fall 2024
- 4- Fact sheet, under development to be published August/ September 2024
- 5- Developed collaboration with Lunds University regarding soil microbial analyses and research

Boundaries

The project was performed within the frame of master thesis. Publication is planned and under development. The publication in Epsilon is not performed yet due to the planned international publication and will be conducted after the acceptance of the publication.

Background

Climate change, use of synthetic fertilizers and pesticides are challenges facing cultivation systems in general and apple cultivation in specific. In apple cultivation, low organic soil content is another challenge searching for solutions. Strategies with potential to contribute to a sustainable nutrient content that improves soil health and lead to better water retention capacity as well as favoring the general resilience of the cultivation system is thus crucial. The project targets the optimization of fertilization ratio and soil health in apple cultivation through the development of compost consisting of mushroom compost rest products, spent mushroom compost (residuals from mushroom cultivation), apple waste and wood chips (residuals from apple cultivation and forest nearby). These components are currently available in apple cultivation without any effective use. They are rich in nutrients and microorganisms with the potential to protect against plant diseases. Ours primary studies showed the potential of mixing these recycled streams into a compost mix with good chemical, physical and biological quality. However, the effect of the compost mixture in the cultivation needs to be evaluated. The project focuses on the effect of the compost mixture (SMC, apple waste, wood fibers) mixed with soil on the growth of apple branches, soil chemical and physical parameters during cultivation. Biological properties will also be followed up using the microchip method where microbial diversity in relation to nutrient assimilation is artificially analyzed to get a detailed picture of microbial processes in the soil. The microchip in the thesis will be analyzed at the beginning, middle and end of the cultivation period. Microbial analyzes are carried out in collaboration with researchers at Lund University. The project is expected to contribute to increased knowledge about tools that can improve soil health in apple and fruit cultivation regarding fertilization and healthy microflora. Furthermore, the work provides growers with tools that can be easily implemented in the cultivation system.

Methodology

The project performed using the following methodology:

- 1- The projects performed in tunnel in trädgårdslab using two treatments
 - a. Soil usually used in apple cultivation as a control treatment
 - b. Soil mixed with compost material contains SMC, apple wastes and wood chip.
- 2- Analyses
 - a. Physical parameters of the compost: soil proportions with respect to bulk density, porosity, electrical conductivity
 - b. Chemical parameters regarding nutrient content and pH
 - c. Biological parameters in relation to microbial function and enzyme activity, metagenomics analyses and biodiversity as soil health parameters.