



Project Case Study:

Understanding Resilience of Soil Beneficials to Combat Apple Replant Disease (ARD) – Chris Cook

The challenge

Previously high yielding apple orchards producing unsatisfactory growth and yield in replanted trees, termed “apple replant disease” (ARD), is becoming an increasing problem as virgin land for new orchards becomes difficult to locate. ARD is caused by a complex of pathogens and current treatments rely on expensive pre-plant fumigation treatment, which has become unsustainable due to government legislation. Current research focus is therefore aimed at identifying biological alternatives to improve the health of soil and in turn aid tree growth and productivity.

Setting out the plan

My project aims to identify beneficial microorganisms for pre-planting amendment of soil to improve soil health and hence to reduce/eliminate ARD. Microbial population structure in treated and non-treated soil is analysed and correlated with tree growth and resilience to abiotic stresses (e.g. drought, temperature, CO₂), leading to identification of key beneficial microbes.



ARD symptoms vs healthy tree



Healthy and diseased root system

How we went about it

- ❖ Beneficial microorganisms for apple growth will be selected from literature to amend soil at the planting time.
- ❖ Tree growth will be recorded over multiple growing seasons.
- ❖ Rhizosphere soil will be collected and sequenced for each amendment.
- ❖ Population changes between amendments will be analysed for differences in pathogenic and beneficial populations.
- ❖ Functionality of soils tested to correlate tree growth with soil productivity.
- ❖ Abiotic stresses (increased temperature and CO₂ concentration, and drought) on soil microbial populations investigated.

Delivering results

- ❖ Apple trees replanted in pre-amended soil with beneficial microorganisms and non-chemical alternatives.
- ❖ 2 year growth and fruiting assessed with following 1 year to be measured.
- ❖ Rhizosphere soil sampled from trees, and microbial population and functional differences measured.
- ❖ Soil cores exposed to elevated CO₂ and temperature, and microbial population and functional differences due to be investigated.
- ❖ Drought impact on native soil populations and applied amendments tested
- ❖ Trees with rootstock closely related to the previously planted rootstock perform better in the aisle than the corresponding previous tree station when grafted to a cider variety scion (Worcester Pearmain)

Quality	Food Safety	Environment
✓	X	✓
People	Productivity	Finance
X	✓	✓