A sustainable solution to protect the century-old tradition of Colorado peaches from replant disease (RD)

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Main Findings

1. Orchard replant soil disruption significantly increased cover crop height, flowering, and biomass
2. Peach trees grown in non-disrupted soils were significantly healthier (leaf health, biomass)
3. Best treatment for peach was alfalfa in non-disrupted soils (peach height, leaf health, and biomass)
4. Higher available nitrogen in alfalfa and tomato soils were positively correlated with peach biomass
5. Rootstocks had higher biomass in disrupted soils but only 'Lovell' was significantly different

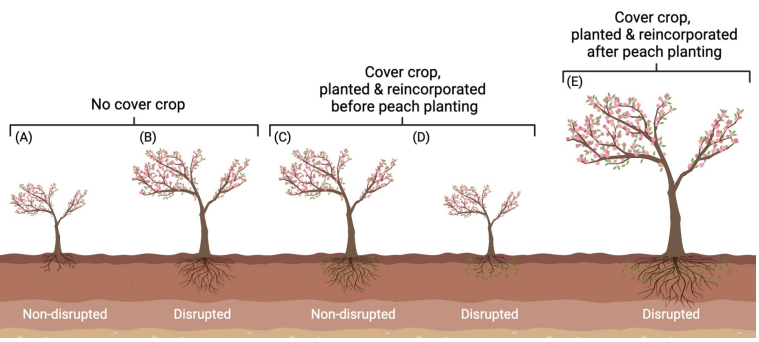

Figure 1.
(A) Field conditions: Growers experience symptoms of RD when no action is taken.
(B) Previous study: Symptoms of RD are reduced when soil has been disrupted.
(C) Present study: Symptoms of RD are reduced when cover crops (CC) like alfalfa are used.
(D) Present study: Symptoms of RD are observed in disrupted soils where cover crops were used.
(E) Hypothesis: Planting peaches in disrupted soils followed by nitrogen storing CC will further reduce RD.

Problem: Replant Disease (RD)

- Reduced tree fruit growth
- Instigated by monocropping, certain abiotic factors, and soil borne pathogenic microorganisms

Sustainable Solutions

- Soil Disruption: reduce microbes in soil by chemical fumigation/solarization, steam autoclave, or replacement of soil entirely
- Crop Rotation: Cash or cover crops with different benefits
- Rootstocks: Different genotype and tolerance to calcareous soils, waterlogging, and RD
- Beneficial Microbes: pathogen resistance, nutrient sequestration, growth promoting

Crop Rotation & Rootstock Methods

- Used steam autoclaving to disrupt RD soils from Grand Junction, Colorado, USA
- Grew cover crops (CC: corn, tomato, fescue, & alfalfa) and 8 different rootstocks in disrupted and non-disrupted soils
- Reincorporated CC into the same pot and then planted RD susceptible Lovell peach saplings grown from seed
- Hypothesis: CC and rootstocks grown in disrupted soils could be employed to beneficially alter the microbiome of soil from peach orchards suffering from RD

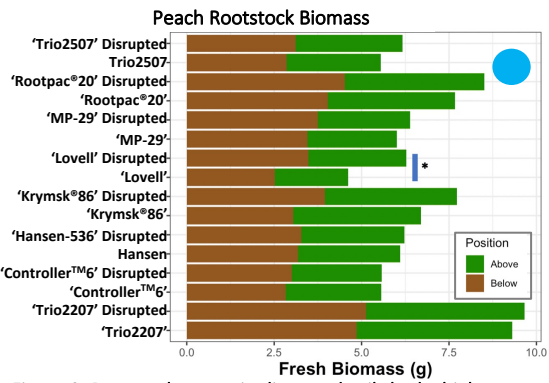

Figure 2. Rootstock grown in disrupted soils had a higher biomass except for 'Controller™6' (equal in both soils) and 'Hansen-536'. Lovell' was the only rootstock to show significant biomass increase by soil disruption (RD susceptibility).

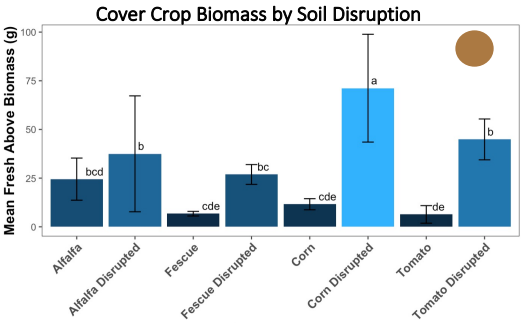

Figure 3. Soil disruption significantly increased CC biomass except of alfalfa or fescue

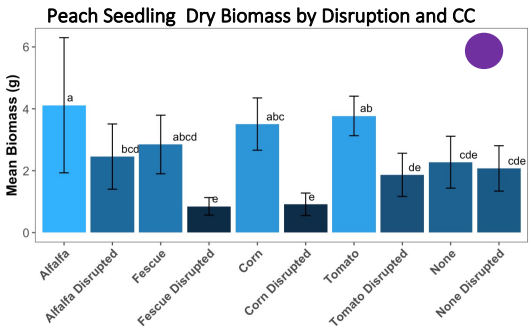

Figure 4. Total dry peach biomass was higher for trees grown in non-disrupted soil for every cover crop treatment. Alfalfa in non-disrupted soil had the highest biomass, but the difference was not significant.

Conclusion

- As supported in other studies, soil disruption increased biomass for all crops, alfalfa, corn, tomato, and fescue
- Findings did not support the hypothesis that soil disruption with rotations crops would reduce RD symptoms
- Alfalfa in non-disrupted soils was the best treatment (peach height, leaf health, and biomass)
- Bulk and rhizosphere soil samples from crop rotation, reincorporation, and peach tree time points to identify bacterial taxa which correlate with increased peach biomass