

Purpose:

Replant disease (RD) is characterized by reduced tree fruit productivity resulting from repeated plantings of genetically related tree fruit or nut crops. This globally relevant disease is thought to be primarily caused by soil borne pathogenic microorganisms with specialized antagonistic traits towards a specific tree fruit.

Peach replant disease

CSU_Pomology

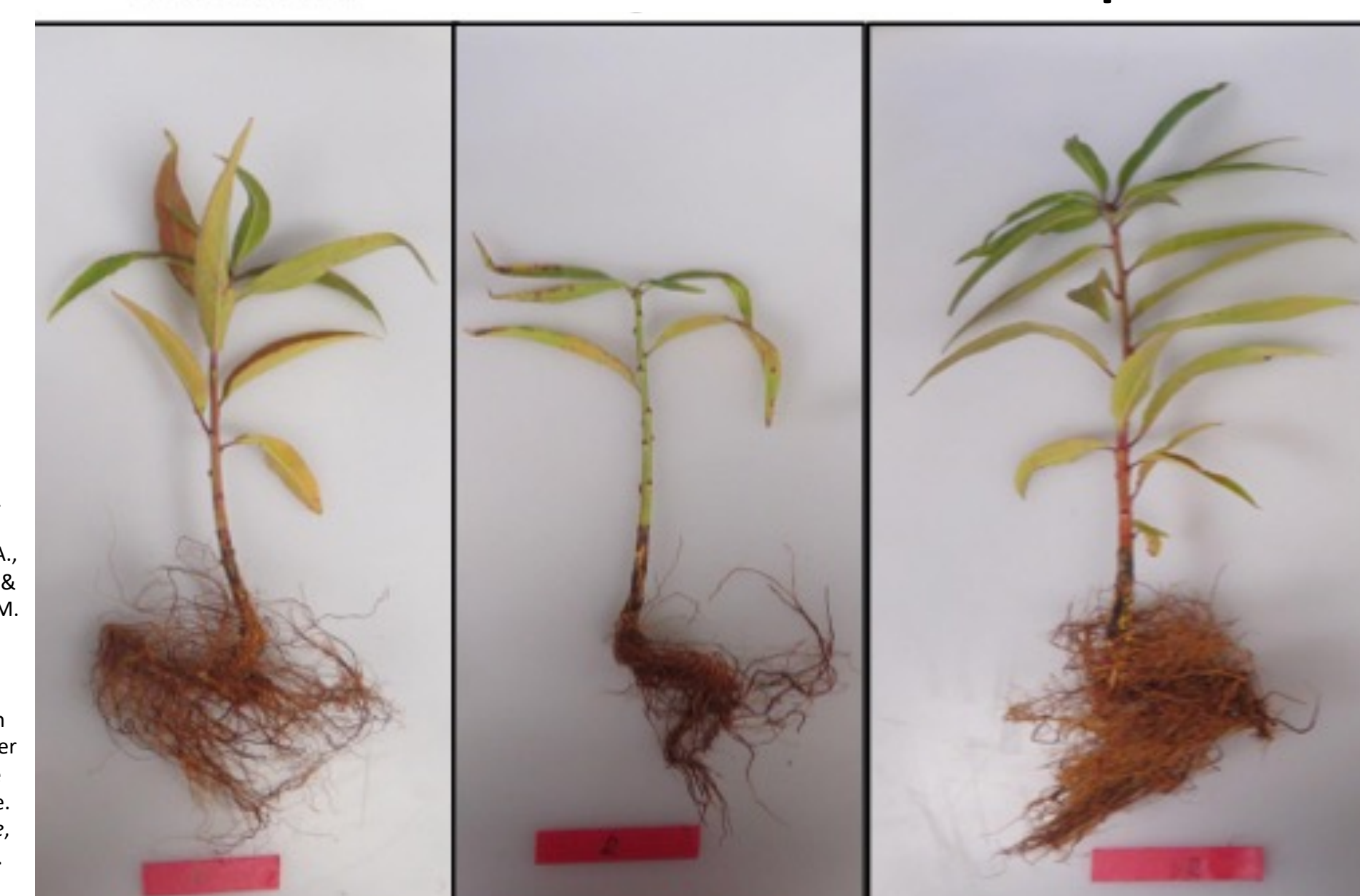


Fig. 1(A) Peach Trees grown in Non-RD soil. Soils that did not previously have a peach orchard established had trees with typical



Fig. 1(B) Peach Trees grown in RD soil. Soils that previously have a peach orchard established had trees with reduced growth

Control Non-Disrupted Soil Disrupted Soil



Li, K., Dilge, M., J., Minas, I., S., Hamm, A., Mantel, D., & Vivanco, J. M. (2019). Soil sterilization leads to re-colonization of a healthier rhizosphere microbiome. *Rhizosphere*, 12, 100176.

Fig. 2 Peach saplings grown in replant diseased (RD) soil grew the least while the peach saplings planted in soils disrupted by steam autoclave grew the most, supporting that replant disease has a biological component.

Procedure:

We hypothesize that cover crops grown in disrupted soils could be employed to beneficially alter the microbiome of soil from peach orchards suffering from RD. To test this hypothesis, four different crops (corn, tomato, fescue, and alfalfa) were grown in disrupted and non-disrupted RD soil from Grand Junction, CO under greenhouse conditions. Steam autoclaving was used to disrupt the soils to diminish microbial abundance and to amplify beneficial plant - microbiome interactions. The cover crops were reincorporated into the soil and subsequently RD susceptible Lovell peach saplings were planted. Fig. 3 The microbiome of replant diseased soils were disrupted using the high temperature and pressure of an autoclave.



https://commons.wikimedia.org/wiki/File:AUTOCLAVE_4210.jpg

Main Findings:

Soil disruption significantly increased cover crop health

(Flowering (alfalfa $p = 0.0401$, tomato $p < 0.0001$), Height (corn $p < 0.0001$, tomato $p < 0.0001$), Biomass (alfalfa $p = 0.0415$; corn $p < 0.0001$, fescue $p = 0.0019$, and tomato $p < 0.0001$))

Peach trees grown in non-disrupted soils were significantly healthier.

(Height $p = 0.0055$, Diameter $p < .0001$, Number of Total Leaves $p < .0001$, Number of Healthy Leaves $p < .0001$)

Considering both peach height and diameter, the best treatment was alfalfa in non-disrupted soils

(Alfalfa Non-Disrupted Height $p < 0.05$ for all other treatments, Alfalfa Non/Disrupted Diameter $p < 0.05$ for sterilized corn, fescue, and tomato)

Future Directions:

These preliminary results suggest that alfalfa could alleviate peach trees in RD soil. Future studies will reveal if a shift of the microbiome can be correlated with peach and soil health under alfalfa cultivated under non-disrupted conditions. Additionally, leaf nutrient analysis will be conducted to determine if nitrogen can explain the difference in peach health between a legume cover crop and the other treatments. In summary, we aim to provide scientific background to develop a cropping technique to reduce replant disease in tree fruit systems.



Fig. 7 Peach saplings in non-disrupted soils that previously had alfalfa as a cover crop (left) grew better than peach plants in disrupted soils that previously had alfalfa as a cover crop (right)

Results:

Aboveground Biomass Considering Disruption and Crop

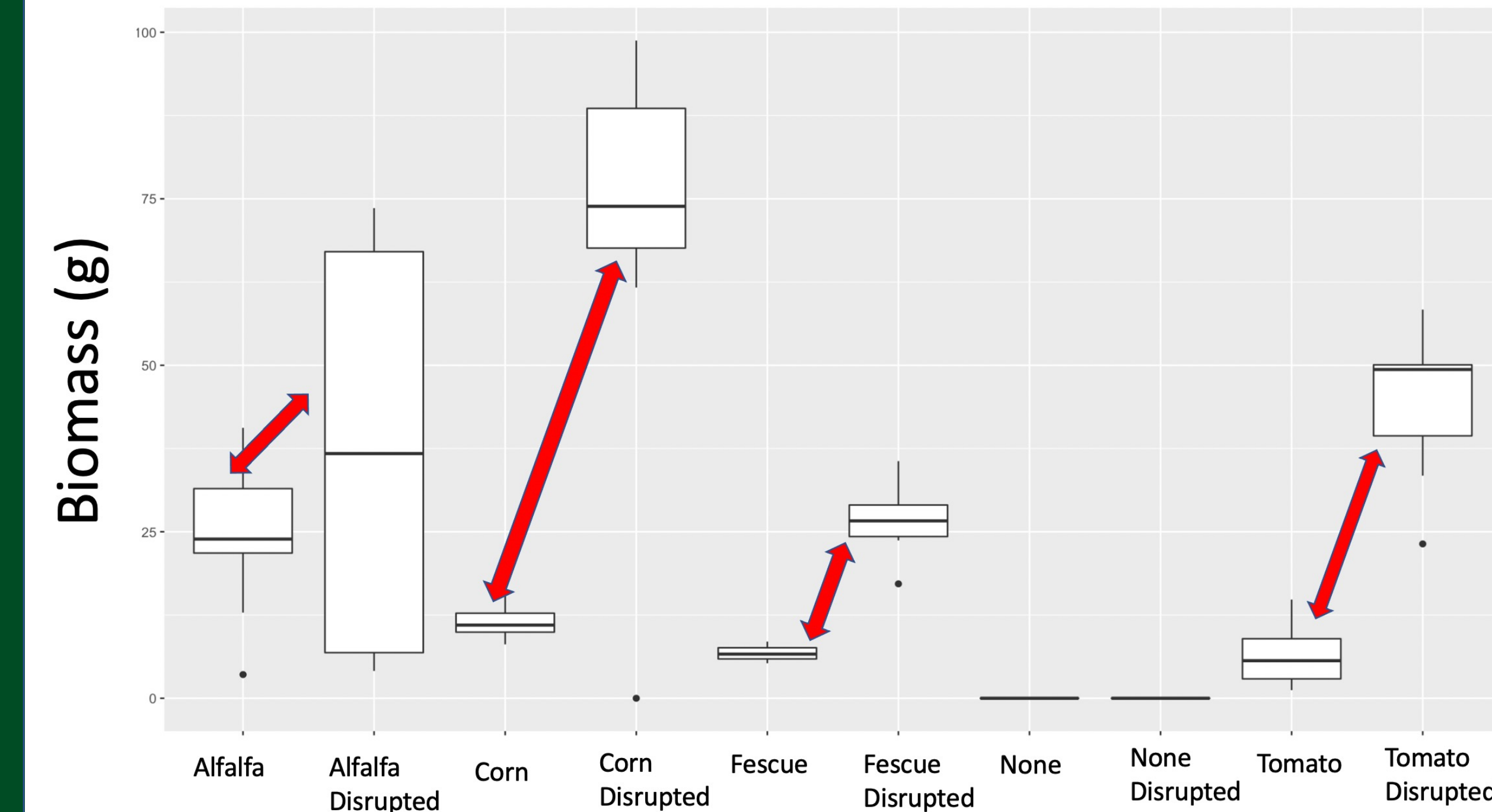


Fig. 4 RD Soil disruption significantly increased cover crop biomass. Between the two soil treatments, alfalfa's biomass overlapped indicating that soil treatment had less of an effect than other crops.

Peach Height Change Considering Disruption and Crop

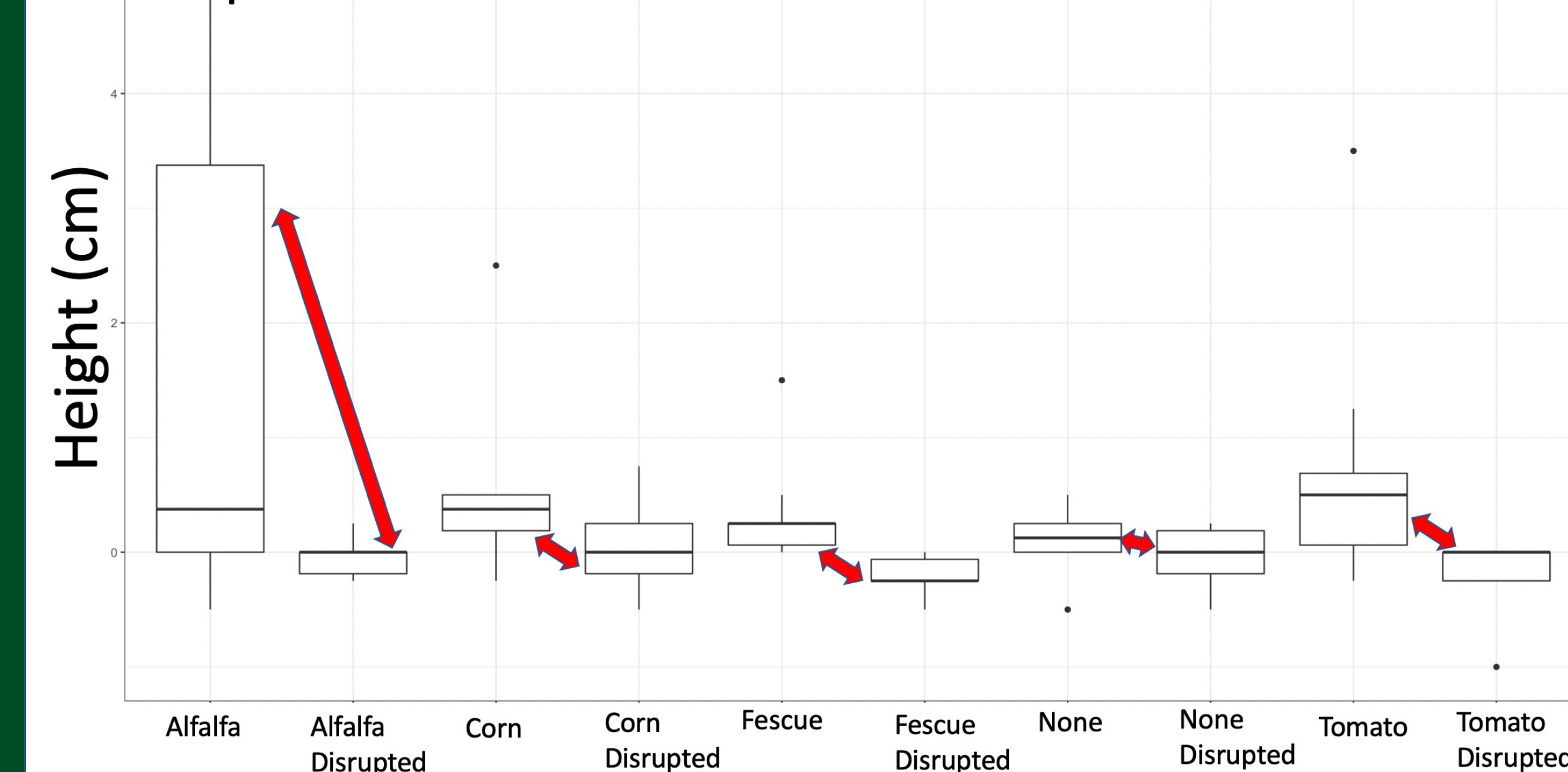


Fig. 5 Peach trees grown in soil that previously had alfalfa in non-disrupted RD soil grew the tallest.

Peach Diameter Change Considering Disruption and Crop

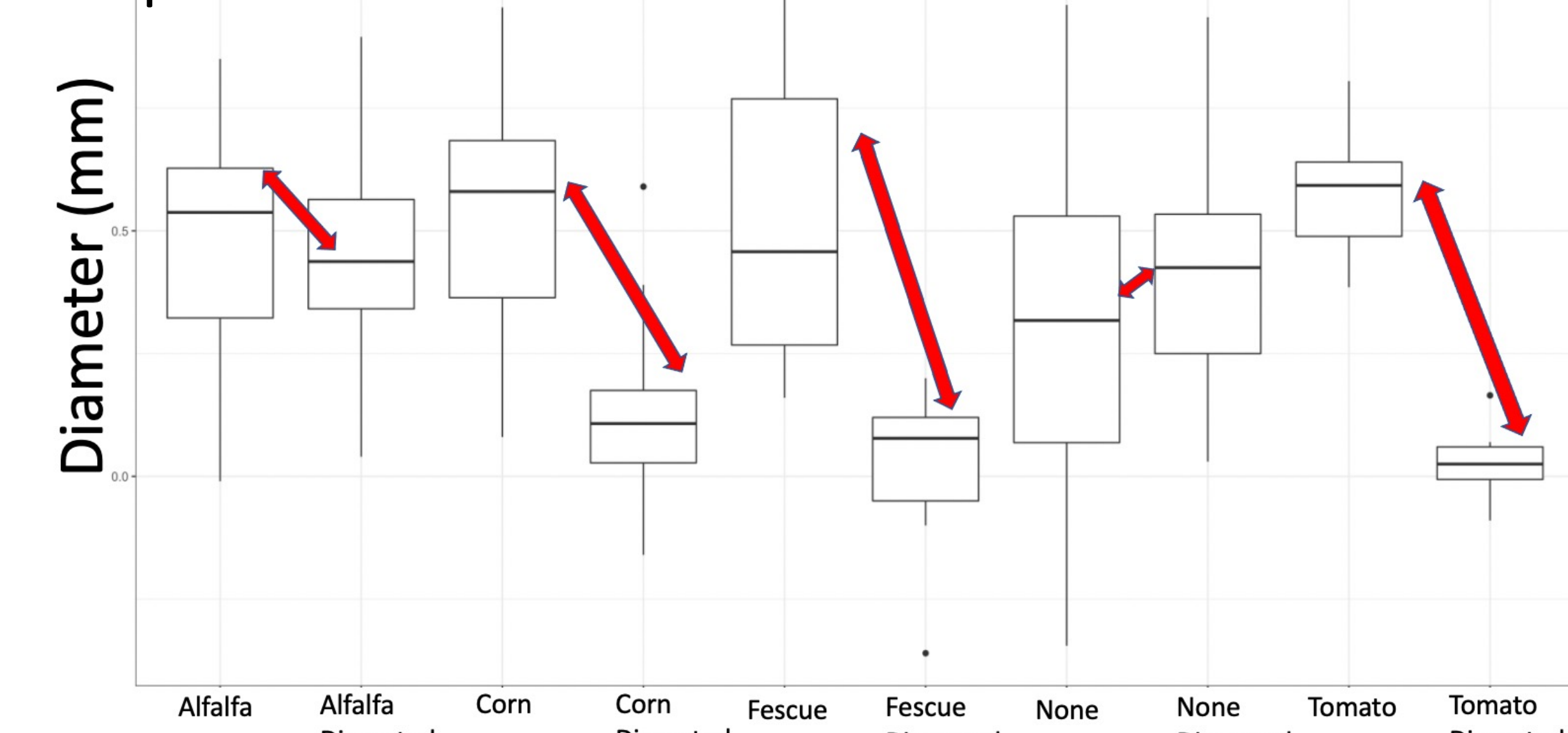


Fig. 6 Peach trees grown in previously disrupted RD soils had significantly less growth than non-disrupted RD soils except for alfalfa. The no cover crop control showed slight increase for disrupted RD soil