LONG-TERM EFFECT OF ANAEROBIC SOIL DISINFESTATION ON THE SOIL MICROBIOME

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Anaerobic soil disinfestation (ASD) is a pre-plant soil treatment alternative to chemical fumigation. It has previously been demonstrated that ASD soil treatment results in similar or greater marketable yield and plant pathogen suppression as chemical fumigation. In Florida, ASD consists of working composted poultry litter (CPL; 13 Mg ha^{-1}), and feed grade sugar cane molasses (13.9 m^3 ha^{-1}) into the soil. Then the soil is tarped with a plastic mulch and saturated with water. During this process, the soil pH decreases while the anaerobic bacteria population increases, especially members of the Firmicutes phylum. While most studies have only compared post-treatment/pre-plant soil samples, the goal of this study was to determine the long-term effects of ASD on the soil microbiome. Shifts in the soil microbiome were observed by extracting total microbial DNA from soil samples and utilizing a DNA fingerprinting method, length heterogeneity PCR (LH-PCR). This presentation will highlight the long-term effects of ASD on soil microbiome from two different experiments.

In the first experiment, various combinations of each soil amendment and water rates were applied to the soil and tarped with solarization plastic mulch (Butler et al, 2012). The experiment was conducted over two-years in a pepper-eggplant double crop study in which the same treatments were applied to the same plots the second year. Methyl bromide (MeBr) was the fumigation control, as well as a no amendment no water treatment, which served as the untreated control (UTC). Soil samples were taken at pre-treatment, post-treatment, and at harvest for both crops. Typically, for each sampling point, MeBr had the greatest influence on the microbiome. Considering the different rates of amendments and observed shifts in the soil microbiome, CPL had the greatest influence on the microbiome for each sampling point except for post-treatment pepper in the second year. Molasses was a main factor that influenced the microbiome for the post-treatment pepper in the second year. This could indicate that when ASD is first applied CPL either influences or adds bacterial populations to the soil, and by the second year these populations are more responsive to the carbon source.

In the second experiment ASD was applied in the field before planting citrus grafted onto rootstocks ‘Sour Orange’, ‘Swingle’, and ‘Kuharske’. Standard ASD was compared to UTC as mentioned previously. This experiment did not have a chemical fumigant control. Soil was sampled at three weeks and two years post treatment. The microbiome of ASD treated soil differed from the UTC for both sampling periods; however, the difference, as expected, was more significant for the three-week samples than the two-year samples. The microbiome was slightly influenced by the rootstock, however pre-plant soil treatment had the greatest effect on the soil microbial community.

It appears that ASD has an immediate and a long-term effect on the soil microbiome. It was previously reported that four-years after treating soil with a version of ASD (biological soil disinfestation) using grasses incorporated into the soil, the ASD treated soils had lower levels of *Verticillium dahliae* than the non-treated soils (Goud et al, 2004). The reduction of the soilborne pathogen could have been influenced by the long-term effect of ASD on the soil microbiome.

References

Butler, D.M., Kokalis-Burelle, N., Muramoto, J., Shennan, C., McCollum, G., and Rosskopf, E.N. 2012. Impact of anaerobic soil disinfestation combined with soil solarization on plant–parasitic nematodes and introduced inoculum of soilborne plant pathogens in raised-bed vegetable production. Crop Prot. 39: 33-40.

Goud, J.C., Termorshuizen, A.J., Blok, W.J., and van Bruggen, A.H.C. 2004. Long-term effect of biological soil disinfestation on Verticillium wilt. Plant Dis. 88:688-694.