CONTROL OF WALNUT SOILBORNE PHYTOPATHOGENES USING ANAEROBIC SOIL DISINFESTATION

SL Strauss, G Browne, and D Kluepfel

USDA-ARS Crops Pathology and Genetics Research Unit, 1 Shields Avenue, University of California, Davis, CA 95616, USA

Anaerobic soil disinfestation (ASD) is a fumigation-independent strategy for controlling soilborne pathogens. While ASD has been shown to suppress soilborne pathogens for several vegetable crops, it has not been examined for tree-crop diseases. We investigated the potential of ASD to manage soilborne populations of *Agrobacterium tumefaciens* and *Pythium ultimum* under walnut nursery conditions. The following experiment was performed in the late summer of 2013 and 2015: rice bran at 20 metric tons/ha was applied to ASD plots, irrigated for 24 h (13 cm of water, 1 drip emitter per 930 cm^2), and covered by TIF plastic for 6 weeks. Mesh bags of sterile soil infested with either *A. tumefaciens* or *P. ultimum* were buried at 15 cm (both trials), 30 cm (first trial), 45 cm (second trial), and 76 cm (second trial) depths prior to ASD treatments. Anaerobic conditions were generated down to 76 cm depth within 1 week and maintained for 6 weeks. To serve as a comparison, in both years, mesh inoculum bags of *A. tumefaciens* and *P. ultimum* were buried at the same depths as in our ASD trials in adjacent fields that were fumigated with Telone C-35 at the maximum allowable rate.

In both field trials, ASD exhibited pathogen suppression similar to traditional chemical fumigation. *A. tumefaciens* and *P. ultimum* populations were reduced below detection limits during both chemical fumigation and ASD in all treatment replicates at 15 cm and 30 cm. At soil depths of 45 cm, *A. tumefaciens* and *P. ultimum* populations dropped below detection limits in 52% and 40% of the samples, respectively. The remaining replicates had populations that were significantly lower than the no-treatment control populations. All fumigated samples of *A. tumefaciens* and *P.ultimum* populations at 45 cm soil depths were below detection limits. However, at soil depths of 76 cm, fumigation and ASD exhibited similar levels of suppression of *A. tumefaciens*. In the ASD treatments, 30% of the samples had *A. tumefaciens* populations below detection limits, while the remaining replicates had populations that were significantly lower than the no-treatment control populations. In fumigation treatments, 63% of the samples had *A. tumefaciens* populations below detection limits.

Next-generation sequencing of soil bacterial 16S rRNA genes revealed that the soil bacterial community composition is significantly altered at all depths after ASD. In particular, there were increases in several facultative and obligate anaerobic organisms, such as *Clostridia* sp., and decreases in other common soil bacteria such as *Bacillius* sp.,

and *Actinobacteria* sp. The ability of ASD to alter the soil microbial community and suppress specific pathogens down to depths of 76 cm indicates great potential for ASD as a fumigant-alternative for nursery tree-crops that require pre-plant pathogen suppression to at least 76 cm soil depths. The specific changes in the soil bacterial community provide a basis to determine whether these taxa contribute to soilborne disease suppression in ASD.