Effect of vermicompost, fumigation, and anaerobic soil disinfestation on *Agrobacterium tumefaciens* abundance under walnut nursery conditions

SL Strauss[1,2], AE McClean[1], D Kluepfel[1]

[1]USDA-ARS Crops Pathology & Genetics Research Unit, Davis, CA

[2]UF-IFAS Southwest Florida Research and Education Center, Immokalee, FL

UID: 101865

Introduction

- The primary rootstock in California walnut production, Paradox, is highly susceptible to inflection by *Agrobacterium tumefaciens*, which causes crown gall.
- Chemical fumigation is currently used to control *A. tumefaciens*, other phytopathogenic agents, and weeds. However, chemical fumigants are under increasing regulation and do not prevent re-infection of the soil by *A. tumefaciens*, which can reside on the husk of walnut seeds planted into fumigated soils.
- We examined two methods to increase the soil microbial diversity surrounding walnut seeds to potentially provide greater competition for *A. tumefaciens* and reduce its population: 1) Anaerobic Soil Disinfestation (ASD), a chemical fumigant alternative pre-plant treatment, and 2) amending pre-plant treated soils (chemically fumigated or ASD treated) with vermicompost.

Fig. 1 Paradox walnut seedlings in an organically managed field 30 weeks after planting.

Materials and Methods

- Established 2 sets of field trials with the following treatments:
  1. Chemical fumigation with Telone-C35 (label rates used)
  2. Chemical fumigant alternative Anaerobic Soil Disinfestation (ASD)
  3. No-treatment control
- Vermicompost applied to half of rows in each treatment after fumigation or ASD
- Walnut seeds were coated in a suspension of a rifampicin-resistant mutant of *A. tumefaciens* and planted into all treatments
- *A. tumefaciens* abundance on seed surfaces was assessed over a 12-week period prior to germination using dilution plating
- Germination rates were determined for seeds planted in each treatment

Results

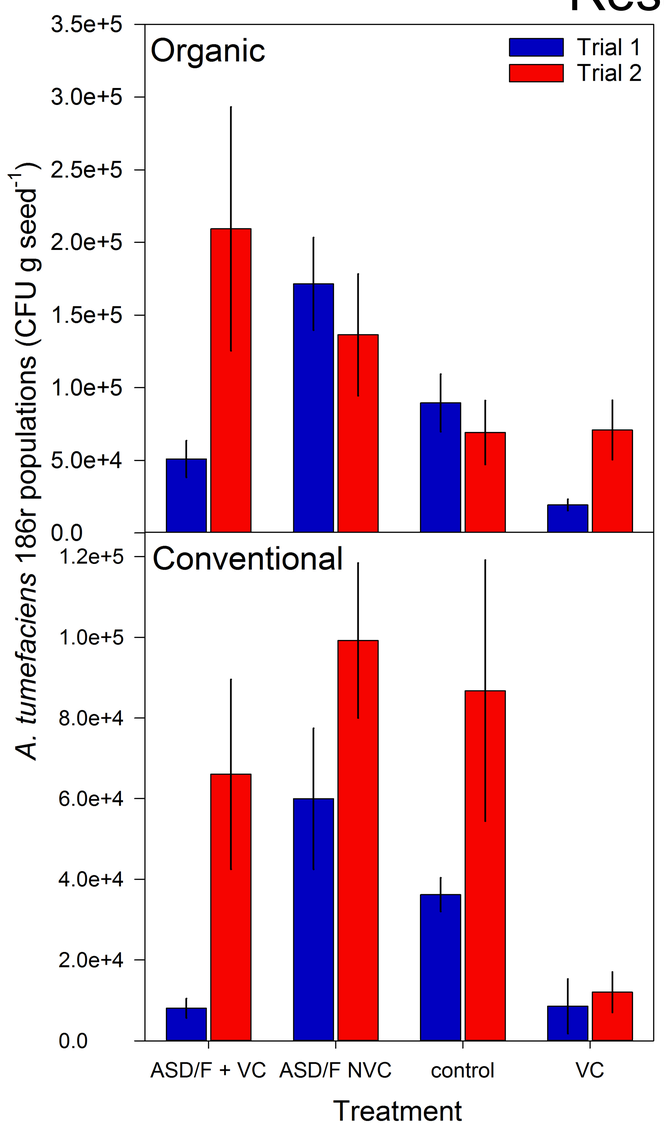

Fig. 2 Abundance of *A. tumefaciens* on walnut seeds 12 weeks after planting. Values are mean ± 95% confidence intervals (n = 5). Means without overlapping intervals were considered significantly different ($P < 0.05$).

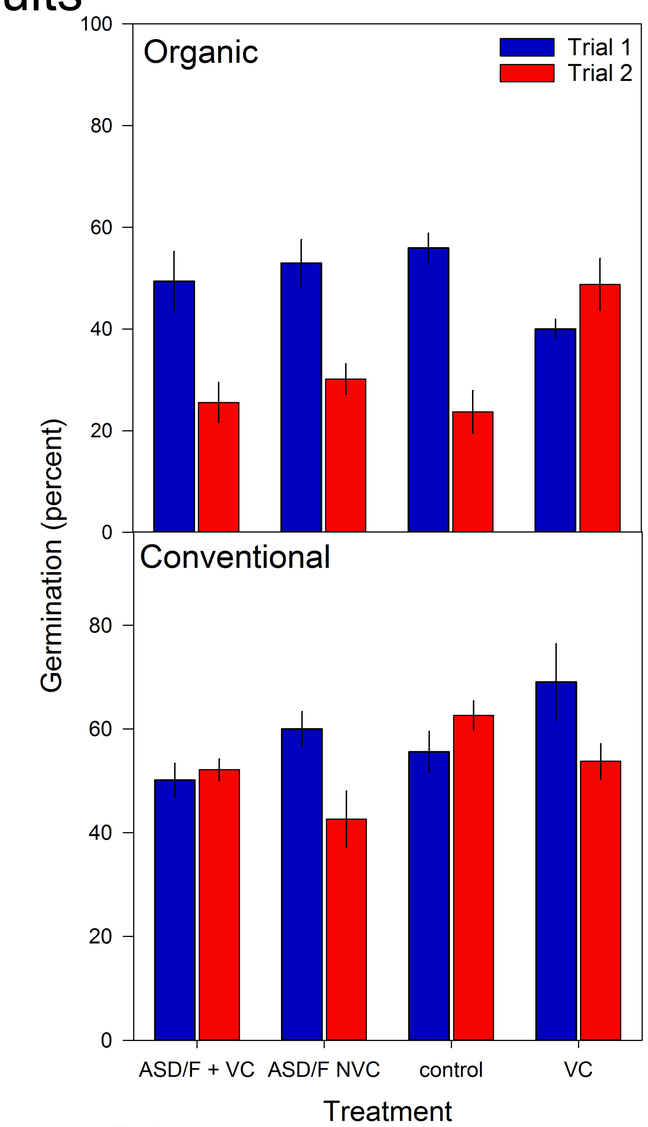

Fig. 3 Germination rates of Paradox walnut seeds 20 weeks after planting. Values are mean ± 95% confidence intervals (n = 5). Means without overlapping intervals were considered significantly different ($P < 0.05$).

Treatments: ASD or fumigated (conventional) soils amended with vermicompost (ASD/F + VC), ASD or fumigated soils not amended with vermicompost (ASD/F NVC), no-treatment controls (control), or soil only amended with vermicompost (VC).

Conclusions

- Seeds planted in soils pre-treated with ASD or Telone C-35 and amended with vermicompost had significantly lower populations of *A. tumefaciens* 12 weeks post-planting compared to soils not amended with vermicompost, except for the ASD-treated and vermicompost-amended soil in Trial 2 (Fig 2). However, all trees, regardless of treatment, were significantly smaller in Trial 2.
- In lab trials (Strauss et al. 2015), fumigated soils amended with vermicompost had significantly greater bacterial diversity compared to non-amended soils, which correlated to decreases in *A. tumefaciens* survival/abundance. The decrease in *A. tumefaciens* populations on seeds planted in pre-plant treated soils amended with vermicompost indicates a similar mode of action may occur in the field.
- Germination rates were significantly greater for seeds planted in fumigated soils amended with vermicompost compared to ASD soils amended with vermicompost (Fig 3). Since ASD does not reduce the soil microbial diversity as dramatically as chemical fumigation (Strauss et al. *in press*), the enhanced soil microbial diversity resulting from vermicompost amendments may be more influential in fumigated soils compared to those treated with ASD.

Acknowledgements We thank Tri-Cal for performing soil fumigation, and Chuck Boldwyn, Dale Pattigan, and Rodolfo Cisneros at the University of Kearney Agricultural Research and Education Center for field use, support, and management. We also thank Rachel Greenhut, Dara Russell, and Sebastian Albu for field support. This work was funded by the CDFA Fruit Tree, Nut Tree, and Grapevine Improvement Advisory Board and USDA-ARS CRIS 2032-22000-015-00D.

References Strauss SL, Stover JK, Kluepfel DA (2015) Impact of biological amendments on Agrobacterium tumefaciens survival in soil. Applied Soil Ecology 87: 39-48.