EFFECT OF ANAEROBIC SOIL DISINFESTATION ON WEED SEED GERMINATION

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The project goal is to optimize anaerobic soil disinfestation (ASD) as an alternative to methyl bromide fumigation using strawberry on coastal California and pepper/eggplant double crop in southeast Florida as model systems (Shennan et al., 2007). Prior to initiating field experiments, a series of pot experiments were conducted to examine the effect of ASD with varying plastic tarps, soil types, carbon sources, and temperature conditions on weed seed germination and survival of the soil-borne pathogen, *Verticillium dahliae*. Here we only present results on weed seed germination.

Effect of varying plastic tarps under simulated coastal California conditions
A split plot experiment with temperature as the main plot (15 or 25 ˚C), type of tarp (no tarp, green, white/black (both 1.25 mil standard polyethylene films), VIF (1.25 mil embossed black tarp), or pit tarp (8 mil black/white tarp)), and soils (Watsonville sandy clay loam or Moss Landing sandy loam) as split plots, was performed with two replicates. Soil was mixed with 10 ton/ha equivalent of wheat bran and packed into a PVC pot (15 x 20 cm). Two nylon mesh packets, each containing 50 weed seeds of common California weeds, annual bluegrass (*Poa annua*; PA), or common purslane (*Portulaca olerace*; PO), were placed at 15 cm depth in each pot. Water was applied to saturate the soil, then allowed to drain through the bottom holes of the pots. After covering the soil surface with a plastic tarp, pots were placed in incubators for three weeks. Soil Eh and temperature at 15 cm depth in each pot were monitored continuously. After three weeks, buried weed seeds were retrieved and germination visually assessed at 24 hours, three days, and seven days after retrieval and placement on wet filter paper at 25 ˚C.

A strong to moderate anaerobic condition (Eh -200 to 100 mV) was developed within one week in all treatments except for the no tarp treatment. Cumulative Eh values below 200 mV during the entire incubation period were similar among all tarp types, indicating that regular plastic film for strawberry mulch may be sufficient for ASD. Germination rates of retrieved seeds were also similar across varying tarp types; 32 to 36% for PA and 62 to 69% for PO, as opposed to 57% for PA and 53% for PO in no tarp treatment. No significant effects of temperature and soil type on germination were detected. This suggests that the potential of

ASD in controlling common weeds in California strawberry fields may be low, but further repetitions of the experiment are needed to draw robust conclusions.

Effect of ASD on nutsedge germination under simulated southeast Florida conditions

Using locally-available carbon sources from FL and a sandy soil from Fort Pierce, FL, an experiment with four replicates was performed to test the effectiveness of 10 carbon sources (none, wheat bran 10 tons/ha, molasses 10 tons/ha, molasses 20 tons/ha, 1% ethanol 100 mm, broiler litter 20 tons/ha, broiler litter 20 tons/ha + molasses 10 tons/ha, broiler litter 20 tons/ha + molasses 20 tons/ha, broiler litter 20 tons/ha + 1% ethanol 100 mm, and broiler litter 20 tons/ha + molasses 20 tons/ha + 1% ethanol 100 mm) on nutsedge germination. An ABS pot (7.7 x 20 cm) was packed with the soil mixed with each carbon source, and a mesh bag containing four tubers of yellow nutsedge (*Cyperus esculentus*) buried 15 cm deep. Water was added to saturate the soil and allowed to drain through the mesh-bottom of the pot. The soil surface was covered with a rubber cap and pots were incubated in a growth chamber for three weeks. Temperature of the chamber was set to simulate a diurnal change of soil temperature under plastic in the summer of southeast Florida (32 to 41 $^{\circ}$C). Soil Eh at 15 cm depth was monitored during the incubation. After three weeks, nutsedge tubers were retrieved and germination visually examined immediately as well as three weeks later. A strong to mild anaerobic condition (Eh -250 to 100 mV) was observed within one week in most treatments including the no carbon source control. None of the tubers germinated regardless of treatment.

To determine why all the tubers were killed, a factorial experiment (four replicates) was performed to test the effects of burial depths (2 cm or 15 cm deep) and presence or absence of the mesh bags. The same methods as for the previous experiment were used but without the addition of any carbon sources. Soil Eh at 15 cm deep indicated the development of a strong anaerobic condition from the 5th day of incubation in all pots (Eh -200 mV). None of the retrieved nutsedge tubers buried at 15 cm deep germinated, whereas 66% of tubers buried at 2 cm depth germinated (P<0.0001). The higher germination rate at the shallow depth, where the soil is slightly drier, indicates that the lack of oxygen at the greater depth probably led to tuber death. The retrieved tubers were rotten and not considered viable. Use of the mesh bag increased the average nutsedge germination rate from 50% to 60% (P=0.04), probably by providing slightly more void spaces around tubers. The C/N ratio of the sandy soil is around 17 yet the soil appears to contain sufficient available carbon sources to create anaerobic conditions when temperatures are high, oxygen supplies are limited, and soil water content remains above the field capacity.

Reference

Shennan, C., Muramoto, J., Bolda, M., Koike, S. T., Daugovish, O., Rosskopf, E., Kokalis-Burelle, N., and Klonsky, K. 2007. Optimizing anaerobic soil

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