PROGRESS REPORT ON
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Project Title: Integrated systems for managing soil-borne diseases in strawberry production in North Carolina

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Public Abstract

.Black root rot (BRR) caused by a complex of soil-borne pathogens: *Pythium irregulare* and *Rhizoctonia fragariae* is a widespread disease of strawberry in North Carolina (Abad et al., 1999). BRR causes the death of feeder roots and the degradation of structural roots resulting in an overall decrease in productivity (Maas, 1998). The main objective of this project is to implement a non-fumigant methodology to control soilborne pathogens of strawberry. Specific objectives are to: 1) evaluate the effect of anaerobic soil disinfestation (ASD) to limit colonization of strawberry roots by endemic populations of soilborne pathogens, and 2) examine the capacity of cover crops + compost to suppress the fungal pathogens inciting BRR of strawberry. A field trail was established and implemented in fall 2018; however, a hurricane brought 32 inches of rain and the trial was terminated. Subsequently, the trial was reinitiated in the fall of 2019. All treatments were implemented and the crop was planted. Baseline data was secured on soil health parameters and soil conditions immediately before and after planting. Reputable data has not been analyzed to date and data will be secured into the spring of 2020.

Introduction:

Traditionally, methyl bromide (MeBr), a soil fumigant, has been used in strawberry production systems and relied on the single application of a broad-spectrum biocide to disinfest soils prior to planting. Due to health and environmental concerns, this soil fumigant was phased out for commercial use. Biologically-based techniques including organic amendments, crop rotation, cover crops, soil solarization, cultural practices, ASD and host resistance have been used to manage soil-borne pests in strawberry production systems. Although non-chemical methods are promising alternatives to fumigation in strawberry, their efficacy is dependent on environmental and biological variables. Improved understanding of management/environment/ pathogen interactions is needed to develop site and pathogen specific management strategies. Any single biological technique is unlikely to provide efficacy in all situations; however, combining multiple strategies should increase the reliability of pathogen control.

Our group and others (for examples, Izzo and Mazzola, 2007; Noble and Coventry 2005) have conducted extensive work on the identification, detection, biology and biologically mediated soilborne disease management. The most important problem our growers face is Black Root Rot (BRR) caused by a complex of pathogens. Sixty different taxa among 1300 fungi and stramenopiles isolated from strawberry roots documented that *Pythium irregulare* and *Rhizoctonia fragariae* AG-A, AG-G predominated (Abad et al., 1999; Torres-Barragan et al. unpublished). BRR causes the death of feeder roots and the degradation of structural roots resulting in an overall decrease in productivity (Maas, 1998). The main objective of this project is to implement a non-fumigant methodology to control soilborne pathogens of strawberry. Specific objectives are:

1.) Evaluate the effect of anaerobic soil disinfestation (ASD) to limit colonization of strawberry roots by endemic populations of soilborne pathogens, and

2.) Examine the capacity of cover crops + compost to suppress the fungal pathogens inciting BRR of strawberry.

Our working hypotheses are ASD-generated temperature and anaerobicity for disease control are pathogen specific and cover crop + compost systems can enhance soil antifungal metabolites and microbiome communities to function in disease control.

Materials and Methods:
Treatments were established at the Catle Hayne Research Station, Castle Hayne, NC. The first main treatment was Cover crop/compost system: Summer legume/grass (Cowpea:Pearl Millet, 100:10 lb/A) were field-sown June 20. Compost (12 Tons/A), produced using the Controlled Microbial Compost (CMC) system, was amended to these plots when the cover crop was seeded. The summer cover was managed for optimum growth until 18 September and then flail mowed to allow cut residue distribution evenly on the cover crop plots. The cover crop and compost were soil incorporated 8 to12 inches deep using a rototiller or rotary spade. Beds were formed and covered with plastic with a double drip tape buried 2 to 4 in deep. Plots were flooded to saturation within 24 hours.

The second main series of treatments were those amended with carbon sources to induce Anaerobic soil disinfestation (ASD). The ASD beds were established 18-19 September. We incorporated molasses or mustard meal (see table below for treatments and rates). After this, beds will were covered with plastic mulch and drip irrigation was applied (via the buried lines) to until the beds were saturated to induce anaerobic conditions in the topsoil. We used TIF (totally impermeable film) to ensure emerging gases are optimally trapped. A clear plastic was also used in two treatments. We installed redox electrodes hooked up to data loggers to assess real-time changes in the redox potential (anaerobic state) of the soil and soil temperature probes to monitor temperature.

A third series of treatments included the controls; the positive control was PicClor60 applied at 175lbs/A (or 350 lbs/43560 sq ft treated area) and the negative control was non-fumigated and non-amended plots.

Plots were 3-beds wide and 30 feet long with twin rows of strawberry plants on each bed spaced 12x12 inches apart. The experimental design is a randomized black design with four replications. Holes were punched in the plastic 5 days before planting on 21-22 Oct.

Table of treatments applied				
1		PicClor-60		175 lbs/A PicClor 60
2		No fumigation/amendments		None
3		Cover crop + compost		see text
4		ASD carbon source 1	Molasses full rate	5000 lbs/A
5		ASD carbon source 2	Molasses half rate	2500 lbs/A
6		ASD Carbon source 3	Mustard meal half rate	1000 lbs/A
7		ASD clear plastic carbon source 1	Molasses full rate	5000 lbs/A
8		Clear plastic only	No fumigation	None
9		Mustard meal	Mustard meal Full Rate	2000 lbs/A
10		Mustard meal + carbon source 1	Mustard meal half rate/Molasses half rate'	As above

Results and Discussion:

All treatments were successfully implemented. Baseline samples were secured at the time of cover crop establishment (20 Jun), prior to soil amendments (18 Sep) and the day of planting (21 Oct) – however no data has been summarized to date. Plant growth parameters, disease incidence and yield parameters will be secured in the coming season.

These carbon treatments were used as proved sources for ASD work. We envision various sources of carbon can be used including on-farm grown cover crops (with low lignification) and various “waste” products.