Anaerobic Soil Disinfestation To Manage Weeds In Organic Watermelon Production

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Introduction

- Anaerobic soil disinfestation (ASD) is a preplant alternative to preplant chemical dependent fumigation for controlling soilborne pathogens and weeds (Momma et al. 2013).
- Yellow nutsedge (*Cyperus esculentus*) and Palmer amaranth (*Amaranthus palmeri*) are the most troublesome weeds in the vegetable production (WSSA, 2017).
- Yellow nutsedge control efforts aimed at the soil weed seed/tuber bank with ASD; we hypothesized that ASD could inhibit emergence of Yellow nutsedge and impact watermelon plant vigor.

Objectives

Objective 1: Identify if ASD impacts watermelon plant vigor.
Objective 2: Discover if ASD influences weed seed emergence.
Objective 3: Determine if ASD influences Yellow nutsedge emergence.

Methods (Experiment 1 & 2)

Location: Two high tunnel and greenhouse experiments at Clemson University, Coastal Research and Education Center, Charleston, SC.
Data Analysis: ANOVA utilizing RStudio, and means were separated at P≤0.05 with Tukey's HSD test.

Methods: Experiment 1

Design: Randomized complete block design (RCBD) with 3 replications.
Factor 1: Cultivars.
Factor 2: Carbon source.
Treatments: 2 carbon sources (No carbon-Control) & (Chicken manure + molasses-CM+M) with plastic mulch.
Carbon Source Rate: Control=0, CM=133.8 g/microcosm, M=87.06 ml/microcosm.

Fig 1: (a) Carbon source applied, (b) Weeds seeded, (c) Watering to super saturation, (d) Covered with plastic mulch and ASD run for 4 weeks, (e) Punched holes, kept it aerated for 1 week, and transplanted watermelons out for 4 weeks.

Methods: Experiment 2

Design: Randomized complete block design (RCBD) with 3 replications.
Factor 1: Cultivars + grafted rootstock.
Factor 2: Carbon source.
Treatments: 3 carbon sources (No carbon-CT) & (Chicken manure + molasses as uncovered-CU) & (Chicken manure + molasses as covered-CC).
Carbon Source Rate: Control=0, CM=60.70 g/microcosm, M=46.98 ml/microcosm.

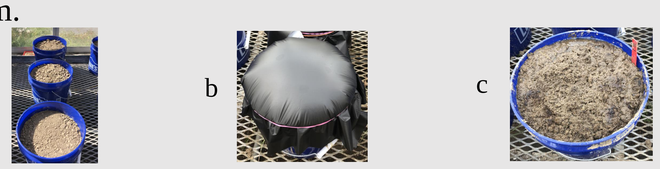
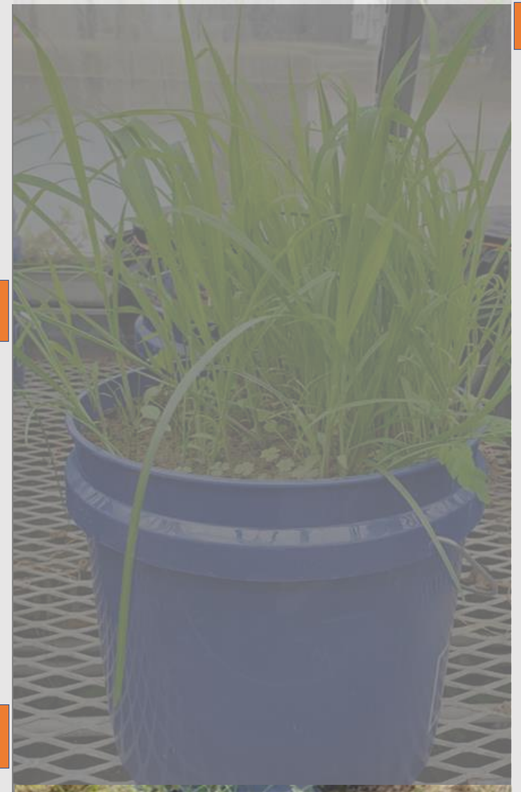


Fig 2: (a) Control, (b) Soil after 48 hours of ASD initiation with plastic mulch (Note: volatile acids production), (c) Soil after 48 hours of ASD initiation without plastic mulch.



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Results & Discussion: Experiment 1

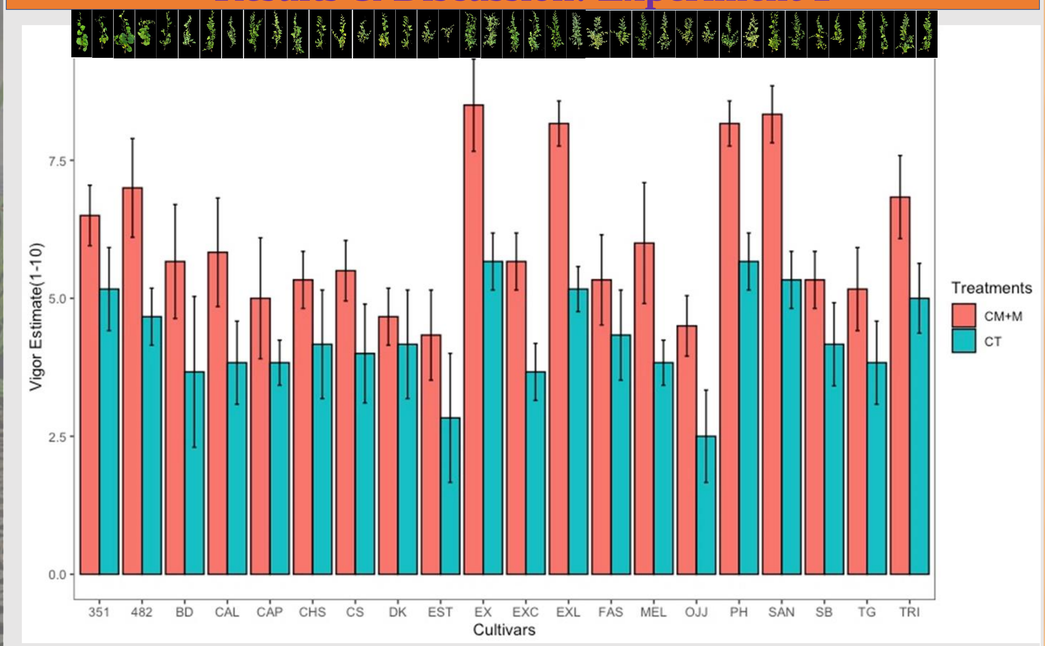

Fig 3: Watermelon plant vigor taken after 4 weeks of Anaerobic Soil Disinfestation (ASD) termination in soil; carbon amendments with no carbon control (CT), and with carbon chicken manure + molasses (CM+M) in microcosms.

- Anaerobic soil disinfestation (ASD) improved watermelon plant vigor compared to control (**Fig. 3**).
- Extazy and Sangria were two top performing cultivars (**Fig. 3**).
- ASD influenced weeds emergence and microcosms treated with carbon source and plastic mulch showed 95% of weed control compared to control treatment (**Fig. 4**).
- Weed emergence was suppressed under ASD treatments; also determined by Singh et al. (2022).

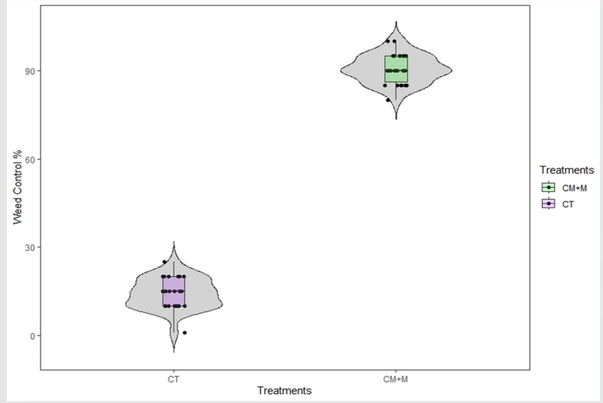

Fig 4: Weed control % rating taken after 4 weeks of Anaerobic Soil Disinfestation (ASD) in soil; carbon amendments with no carbon (CT) and with carbon Chicken manure + molasses (CM+M) in microcosms.

Results & Discussion: Experiment 2

- Yellow nutsedge shoot counts were lowest in microcosms treated with carbon source and plastic mulch followed by microcosms treated with carbon source and no plastic mulch, and control respectively (**Fig. 4**); also observed by Liu et al. (2020).

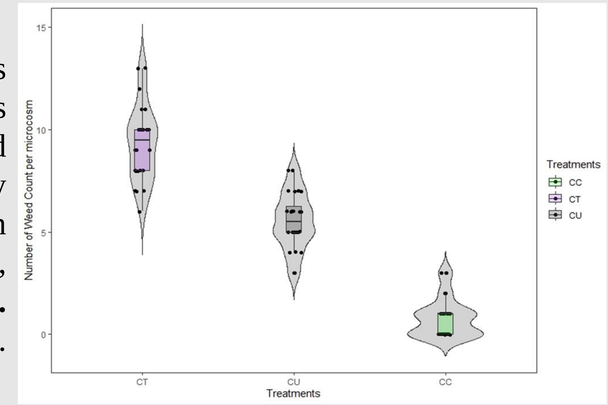

Fig 5: Yellow nutsedge shoot counts taken after 4 weeks of Anaerobic Soil Disinfestation (ASD) in soil; carbon amendments with no carbon (CT), carbon uncovered (CU) and carbon covered (CC) in microcosms.

Conclusions

- ASD improved watermelon plant vigor and reduced emergence of Yellow nutsedge (**Fig. 3, Fig. 5**).
- Overall, ASD suppressed weeds emergence.

Future Research

- Test impact of ASD on weeds control in watermelon under field conditions.

References

Momma, N., Kobara, Y., Uematsu, S., Kita, N., & Shinmura, A. (2013). Development of biological soil disinfestations in Japan. Applied microbiology and biotechnology, 97, 3801-3809.
Liu, D., Samtani, J. B., Johnson, C. S., Butler, D. M., & Derr, J. (2020). Weed control assessment of various carbon sources for anaerobic soil disinfestation. International Journal of Fruit Science, 20(sup1), 1005-1018.
Singh, G., Ward, B. K., Wechter, W. P., Katawczik, M. L., Farmaha, B. S., Suseela, V., & Cutulle, M. A. (2022). Assessment of agro-industrial wastes as a carbon source in anaerobic disinfestation of soil contaminated with weed seeds and phytopathogenic bacterium (Ralstonia solanacearum) in tomato (Solanum lycopersicum). ACS Agricultural Science & Technology, 2(4), 769-779.