Anaerobic Soil Disinfestation: Carbon Rate Effects on Soil pH, Temperature, Redox Potential, and Tomato Plant Growth

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Introduction

Anaerobic soil disinfestation (**ASD**) is a non-chemical soil disinfestation technique proposed for the control of soil-borne pathogens, plant parasitic-nematodes, and weeds in different crops. ASD is applied in three steps:

1) Soil amendment with a labile carbon (C) source
2) Cover the soil with totally impermeable film (TIF) or solarization film
3) Irrigate to saturation

these three steps allow to create anaerobic conditions and stimulate anaerobic decomposition of incorporated organic material through facultative anaerobic microorganisms, producing organic compounds that are toxic or suppressive to soil-borne pathogens, nematodes, and weeds.

Objective

The objective of the experiment was to determine the effect of increasing molasses (C source) rates on soil pH, temperature, redox potential (Eh) and tomato (*Solanum lycopersicum* L.) plant growth.

Materials & Methods

The experiment was conducted in greenhouse at the UF/SWFREC (Immokalee, FL), during the fall-winter season of 2015. Black 10-L plastic pots were filled with sandy soil (Immokalee fine sand), amended with **composted poultry litter** (22 Mg ha^{-1}), and **molasses** (Agricultural Carbon Source, TerraFeed, LLC, Plant City, FL) was applied at the rate of **0** (control), **13,900**, **27,700**, **41,600** and **55,500** L ha^{-1}. Pots were saturated with **5 cm of water** and tarped with a 0.03-mm black/white **TIF** mulch. Treatments were arranged according to a randomized complete block design with four replications and five pots per experimental unit. After three-week treatment, a tomato seedling cv **Ridge Runner** (Syngenta) was transplanted in each pot to evaluate the plant growth response.

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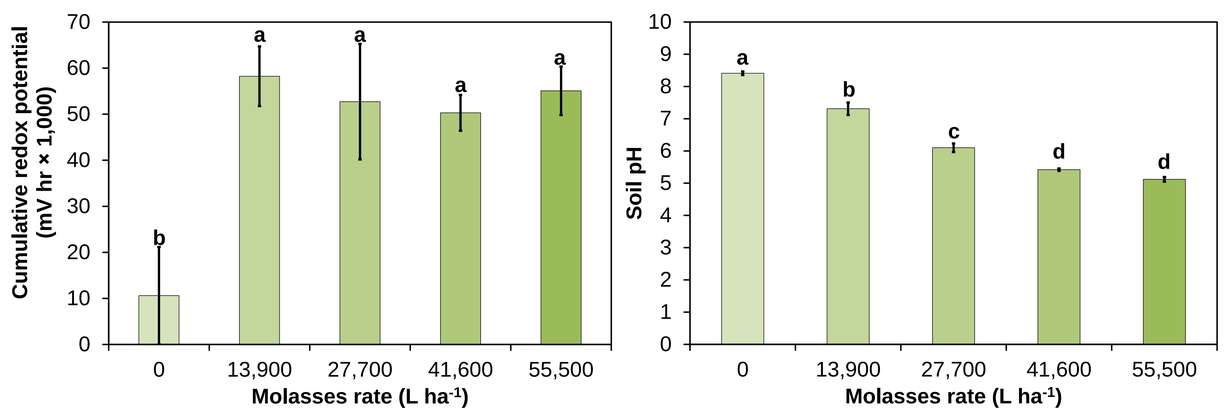
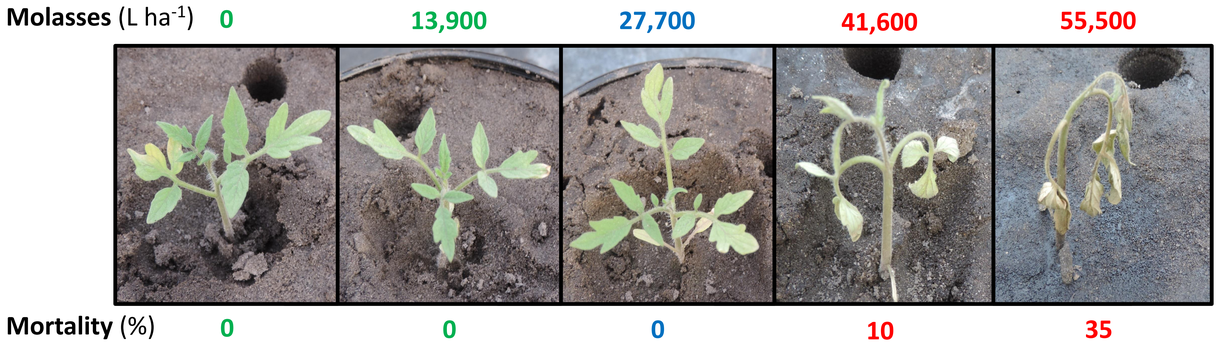
Results

1) During the three-week treatment period, soil temperature was on average 25.8 °C and was not influenced by molasses rate.
2) Cumulative-Eh was not influenced by molasses rates (54,000 mV hr), except for the control that showed significantly lower cumulative-Eh (11,000 mV hr).
3) At the end of the three-week treatment period, soil pH decreased with increasing molasses rate, ranging from 8.4 in the control to 5.1 with the highest molasses rate.



Different letters indicate significant differences at P = 0.05 by Duncan's multiple range test. Mean ± standard error.

4) Plant phytotoxicity, and 10% and 35% of plant mortality was observed with the highest molasses rates, respectively.



5) Total plant dry biomass was similar at 0 and 13,900 L ha^{-1} of molasses, and consistently declined with increasing molasses rate.

Molasses rate (L ha^{-1})	Plant mortality (%)	Plant rating (0 to 5)	Plant height (cm)	No. leaves	Dry weight (g plant^{-1})		
					Leaves	Stem	Total
0	0 b [z]	5.0 a	87.5 a	17.9 a	16.92 a	8.80 a	25.72 a
13,900	0 b	5.0 a	88.1 a	18.2 a	15.96 a	8.44 a	24.39 ab
27,700	0 b	4.3 b	80.5 a	16.1 ab	13.84 a	6.58 b	20.42 b
41,600	10 b	2.5 c	74.9 ab	14.4 bc	9.80 b	4.87 c	14.66 c
55,500	35 a	1.4 d	62.5 b	12.8 c	5.09 c	2.33 d	7.42 d
P-value	*0.0003*	*0.0001*	*0.01*	*0.009*	*0.0001*	*0.0001*	*0.0001*
Regression [y]	-	L	Q	L	L	L	L

[z] Different letters indicate significant differences at P = 0.05 by Duncan's multiple range test. [y] L = Linear regression; Q = Quadratic regression.

Conclusion

Molasses is an effective C source for generating reducing conditions; however, application rates above 13,900 L ha^{-1} resulted in phytotoxicity.