

2021 Final Report: *Hoffmann, M.; Samtani, J.; Brannen, P., Jennings, K. and Volk, E.:*
Weed and Pathogen Control Efficacy of Allyl-Isothiocyanate (AITC) and heat-releasing substances (CaO) Co-Applied with Steam as potential Soil Fumigant Alternative

Objective 1: Evaluate weed and pathogen control efficacy of steam co-applied with allyl-isothiocyanate (AITC) for the purpose of soil disinfestation in strawberry systems.

Hypothesis 1: combined activity of steam and Allyl-Isothiocyanate (AITC) will increase weed and soilborne pathogen control efficacy, compared to either of the components on their own. To investigate this, two strawberry field were conducted between Sept. 2020 and May 2021. Each trial was a completely randomize block design with 9 pre-plant treatments (replicated 4 times): 1) NTC; 2) Pichlor-60 shank applied (170 lb/ac) 3) Steam (60 min, 5 psi); 4) Steam (30 min, 5 psi); 5) Steam (10 min, 5 psi); 6) AITC shank applied (130 lb/acre); 7) AITC (130 lb/acre) + Steam (60 min, 5 psi); 8) AITC (130 lb/acre) + Steam (30 min, 5 psi); 9) AITC (130 lb/acre) + Steam (10 min, 5 psi). Steam was applied through 7 Inch injectors every foot at both sides of the bed, using a SIOUX Propane Powered steam generator (Figure 1). After treatment, soil samples from each replicate were taken at the time of planting and used to assess the presence of fungal pathogens (*Pythium spp.*) and weed pressure (weed germination). AITC + Steam controlled *Pythium spp.* better than steam alone (Figure 2) and led to higher yields (Figure 3).



Figure 1. Application of steam treatments at the Central Crops Research Station in Clayton, NC.

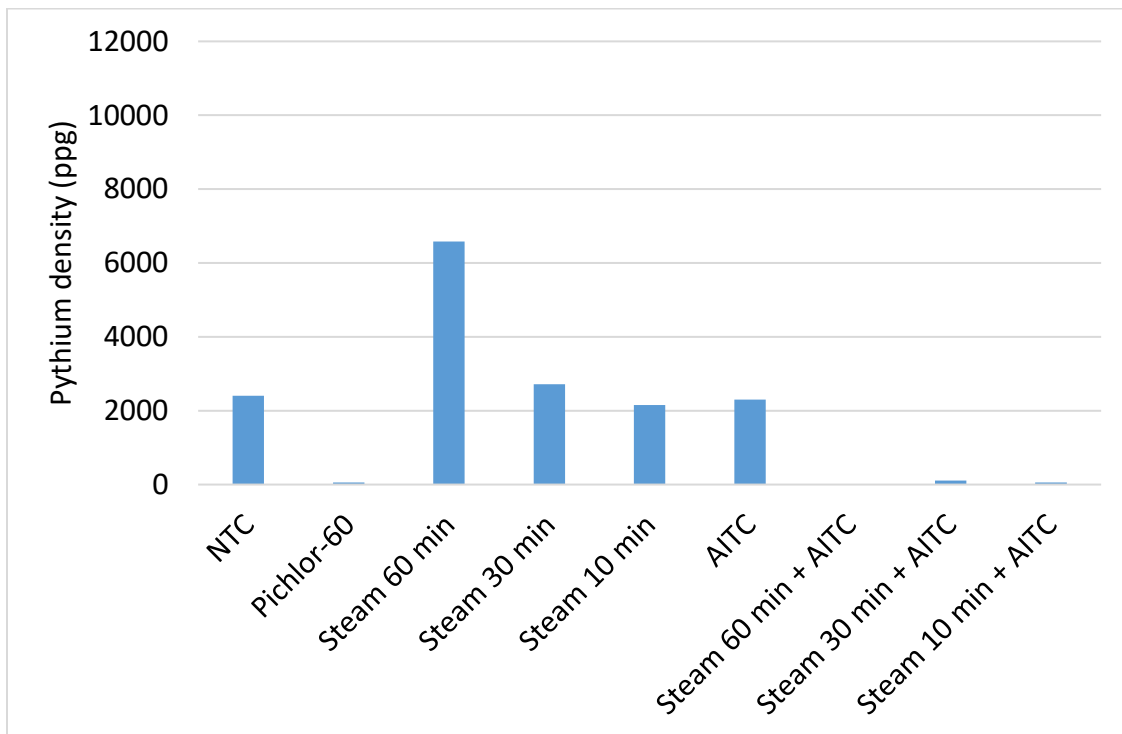


Figure 2: Pythium density (propagules per gram soil (ppg)) after treatment at the Central Crops Research Station in Clayton, NC.

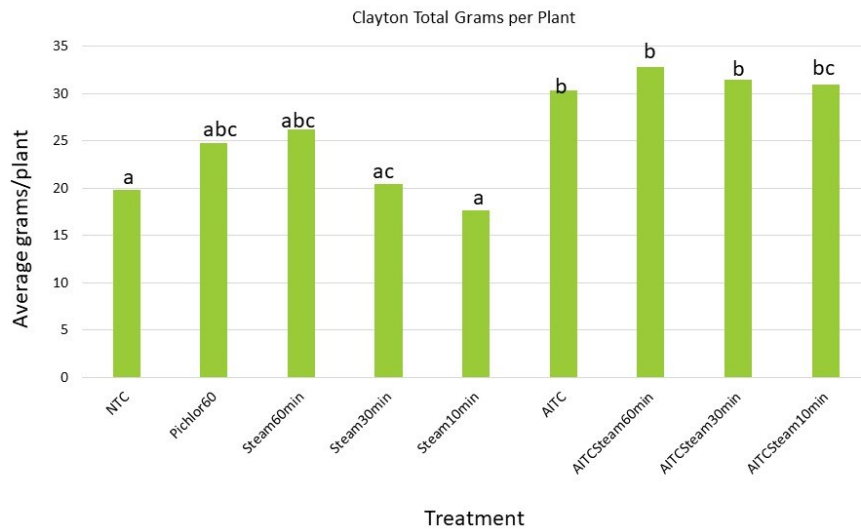


Figure 3. Average grams/plant in the steam + AITC trial over a six-week harvest season at the Central Crops Research Station

Objective 2: Evaluate weed and pathogen control efficacy of steam co-applied with heat-releasing substances in micro-plots

Hypothesis 2: The combined activity of steam and heat-releasing substances (CaO and Na₂O₂) will control soil pathogens and weeds to a greater extent than when the components are used on their own. A microplot trial was conducted in June 2021 to evaluate the weed and pathogen control of steam and steam in combination with exothermic substances in different distances to the injection point. 6 treatments were replicated 4 times each and implemented in 1m x .5m plots: 1) non-treated control; 2) steam (30 min, 5 psi); 3) Na₂O₂ (.1% by soil mass) + water; 4) Na₂O₂ (.1% by soil mass) + steam (30 min, 5 psi); 5) CaO (1% by soil mass) + water; 6) CaO (1% by soil mass) + steam (30 min, 5 psi). At four separate distances from the steam injection point, probes with seeds of 3 different weed species (Hairy Vetch, Rye Grass, Sida) and Yellow Nutsedge tubers were buried in soil probes in 4 inches depth. Temperatures during steam injection was recorded and soil samples were taken from the same 4 distances in each replicate

(Figure 4). After steaming, soil samples were collected for *Pythium* ssp. assessment at similar distances to injection points. The weed assay from the buried probes showed low germination rates at the 2.5 cm and 12.5 cm distances in both the CaO + steam and Na₂O₂ + steam treatments for all assessed weeds and tubers (Figure 5). *Pythium* spp. levels were lowest at the 2.5 cm and 12.5 cm distances in the Na₂O₂ + steam treatment, and levels were low at all 4 distances for both the CaO and CaO + steam treatments (data not shown).



Figure 4. The layout of one microplot (at the Central Crops Research Station in Clayton, NC).

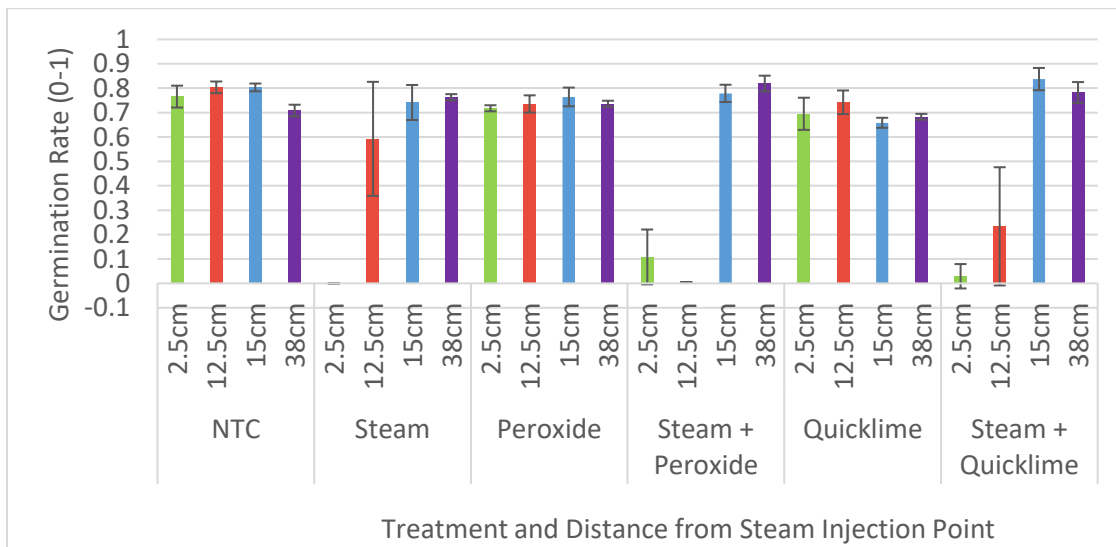


Figure 5: Germination rate averaged across all weed species. 0 = 0 % germination; 1 = 100% germination.

Objective 3. Outreach and information transfer to industry, and development of a multi-state proposal.

Steam and Co-Applied substances will be part of a larger strawberry training at the Southern Fruit and Vegetable Conference in Savannah, GA in January 2022.

Currently, a USDA-NIFA project is funded to continue this research. However, we decided to wait for another year of data before potentially applying for a multi-state project.

Outcomes:

Volk, E., Wahsam, O., Kim, D.S., Fennimore, S. A. and Hoffmann, M. 2020. Steam and Allyl-Isothiocyanate As Potential New Soil Disinfestation Tool. *HortScience* 55(9), S253.