

Soil Disinfestation With Steam in California Strawberry

Steve Fennimore, Extension Specialist U.C. Davis, at Salinas, CA



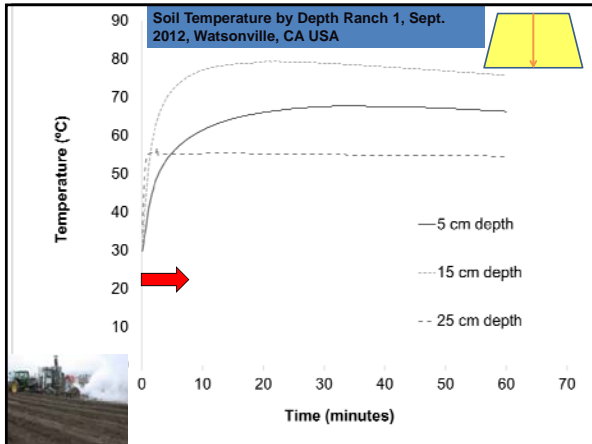
CDPR March 21, 2017

Timeline

- ❖ 2007 evaluated stationary steam application
- ❖ 2009 Ferrari mobile applicator
- ❖ 2011 Built custom mobile steam applicator
 - ❖ Treated 52 inch raised bed
- ❖ 2015 Built custom mobile steam applicator
 - ❖ Treated 14 ft swath flat soil

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Why Steam?

1. Steam kills soil pests
2. It is an alternative to fumigants
3. It is compatible with biofumigants AITC
4. Many nonfumigant methods are needed
 - a) Steam kills macrophomina & weeds
 - b) Uses 0.3 acre inches water
 - c) Steam is consistent

AUTOMATIC STEAM APPLICATION THE ALPHA MACHINE BUILT IN 2011

San Juan Rd.
Watsonville, CA
9/10/12

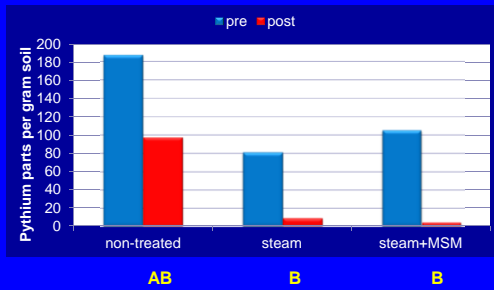


Weed Densities & Hand Weeding Times 2012-13

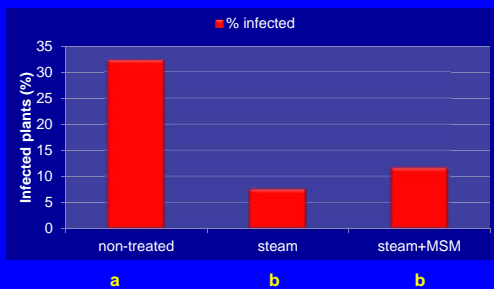
Treatment	Watsonville-Ranch 1	
	Weeds (no./Acre)	Time (hr. /Acre)
Steam + mustard	6,071 b	21 b
Steam	2,024 b	12 b
Non-treated	101,175 a	167 a

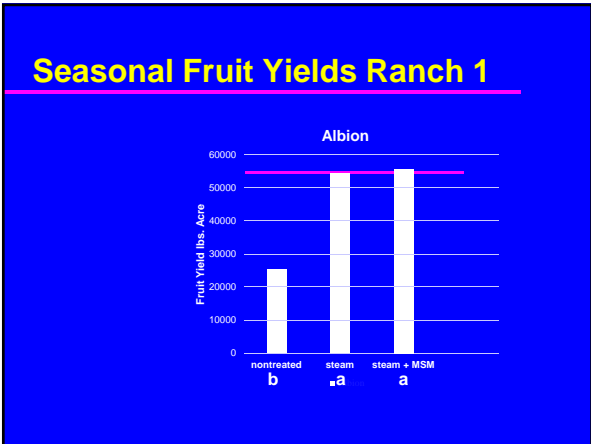
Mean separation using Fisher's Protected LSD P =0.05

Pythium Control Ranch 1 2012



Albion: % Plants With *Macrophomina p.* at Season End





A business role for steam

- ❖ An 80 acre farm with 72 acres cropped
- ❖ 65 acres can be fumigated, 7 acres cannot
- ❖ Combined total treatment cost of \$158,006.
- ❖ Net returns above operating costs for 7 acres \$129,745 based on Albion yields compared to no steam

Fennimore & Goodhue 2015

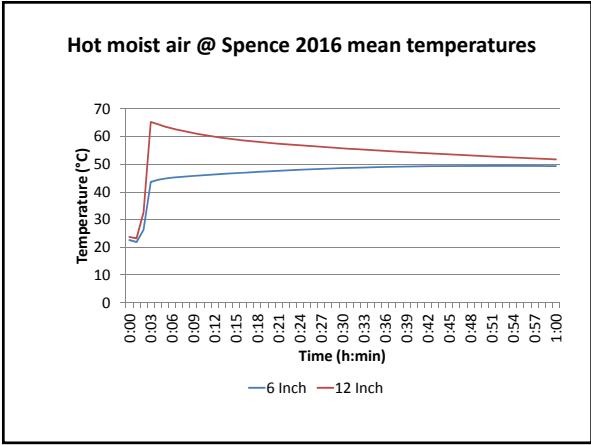
Direct-fire hot moist air generators

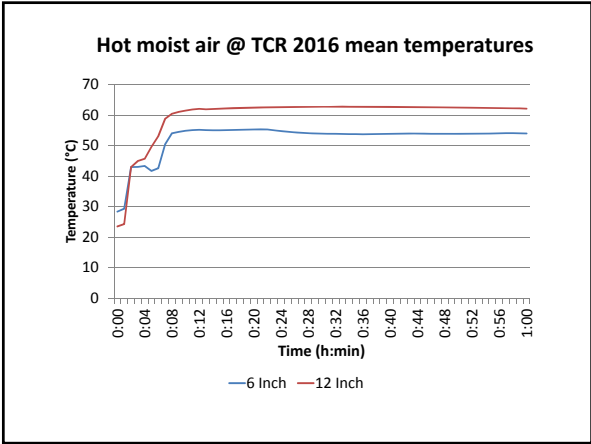
- ❖ Advantages
 - ❖ No steam boiler
 - ❖ Very efficient
 - ❖ Water hardness



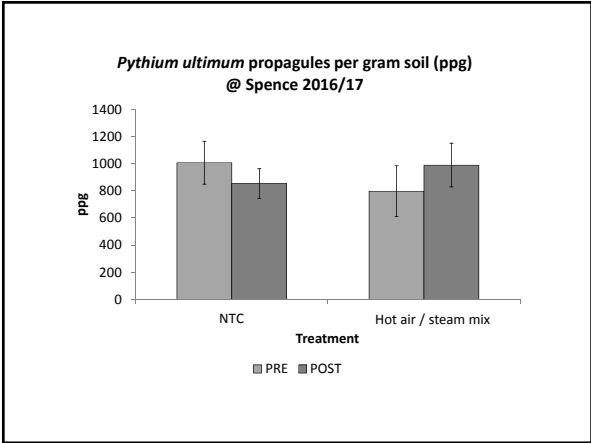
Johnson Gas Appliance, Cedar Rapids, IA

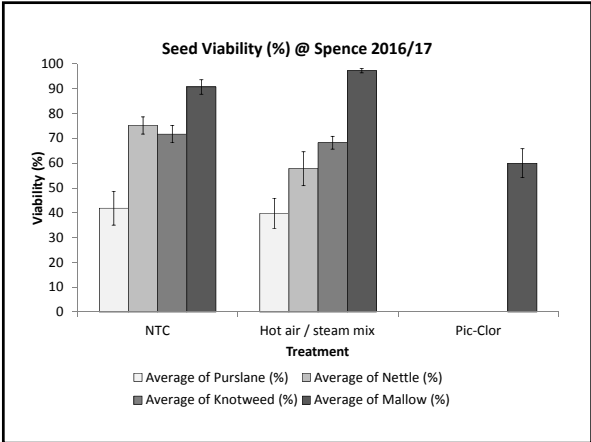
Temperature curves Spence and TCR 2016
Adding of a 6 Inch injection point
Using heat trapping, moving

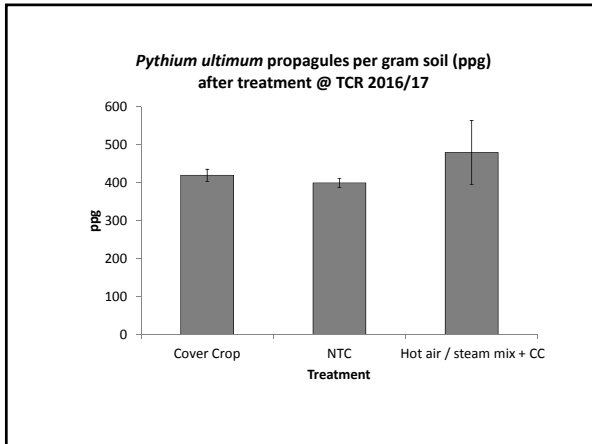


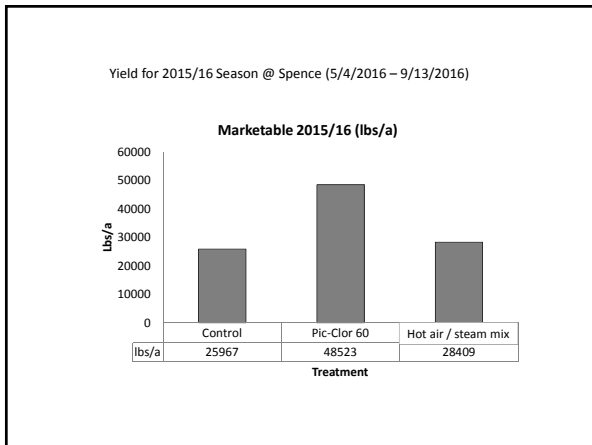


Control efficacy at Spence and TCR 2016





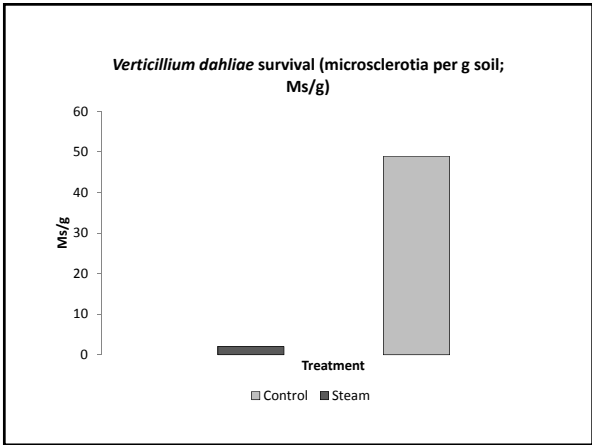




What went wrong

1. Direct fire steam is about 35% steam + 65% flue gas (hot air)
2. The steam + hot air mix is hard to trap in soil
3. Not enough energy was captured by the soil and pests were not controlled
4. We need pure steam

Examples of control efficacy with pure steam (Microplots at USDA, Salinas)
(samples were in 7 cm distance to injection point)



Pictures





