

Spot Steam Application in Strawberry

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- Oddbjørn Bergem, Peter Henry, John Rachuy



Definition of soil disinfestation

- Reduction of the pest community in the soil to a level that will permit profitable crop production.
- A “kill step” used to control soil pests



Methods of soil disinfestation

- Soil fumigants
- Heat
 - Solarization
 - Steam – 158°F for 20 min
- ASD



How soil steaming works

1. Inject steam into the soil to raise soil temperature to 158°F for 20 minutes. Objective is pasteurization not sterilization.
2. Steam transfers heat from heat source to target soil particles
3. When steam contacts cold soil particles, steam molecules condense releasing heat to the soil particles
4. Steam kills the pathogens in an around the soil particles
5. Steam also kills weed seeds and nutsedge tubers



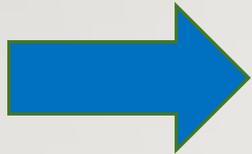
Why choose steam for soil disinfestation?

1. It kills soil pests
 2. No one owns it
 3. Not a pesticide – is a device
 4. Is a sanitation treatment – organic compliant
 5. Is flexible and safe
 6. No buffer zones, township caps, or notifications
 7. Unlike fumigants, no plastic mulch needed after treatment
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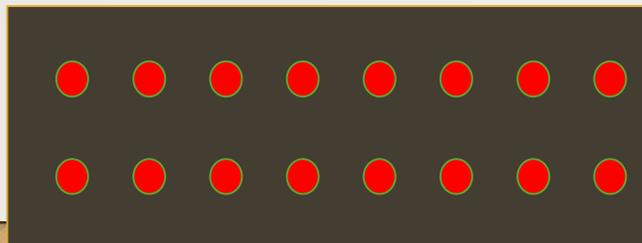
Steam patterns



Broadcast



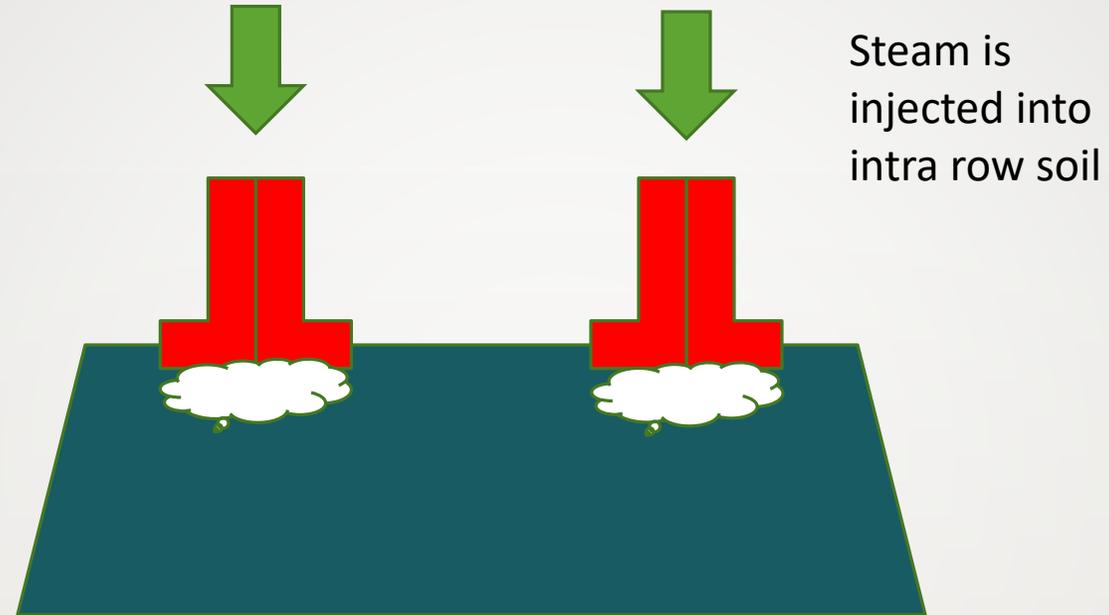
Band



Spot



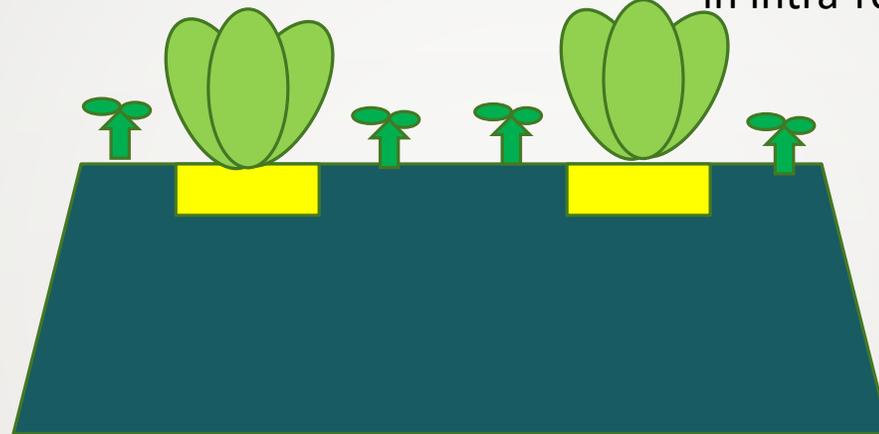
Seed lines disinfested with steam



Seed lettuce into the disinfested band



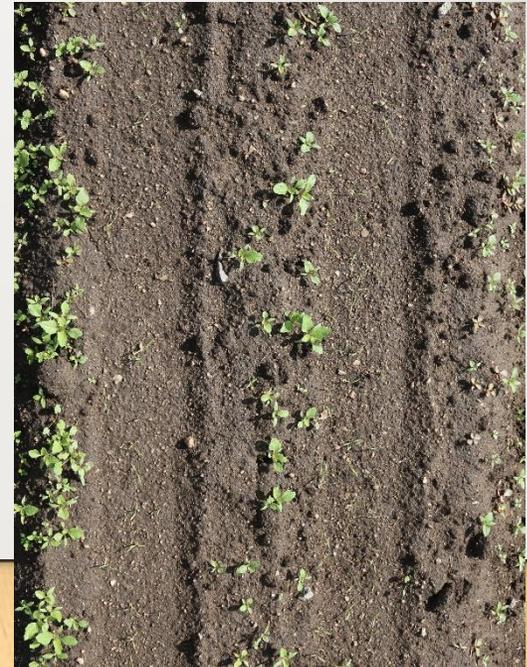
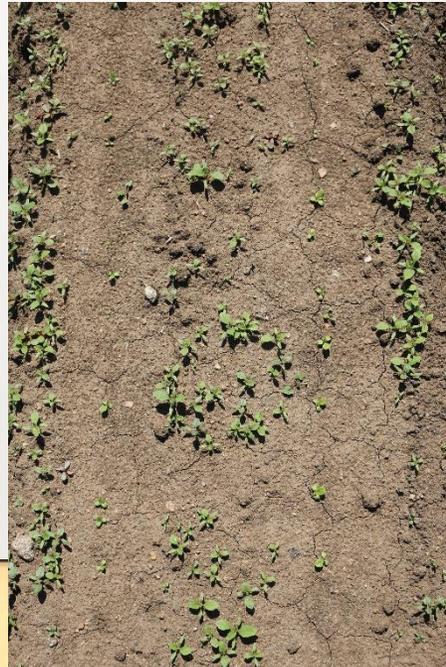
Weed emergence
and lettuce drop
inoculum is reduced
in intra-row



Weeds outside
seedline can be
cultivated out.

Weed control by species

- Purslane 99%
- Shepherd's-purse, nettleleaf goosefoot 88%
- Burning nettle, henbit, pigweed 100%
- Little mallow 42%



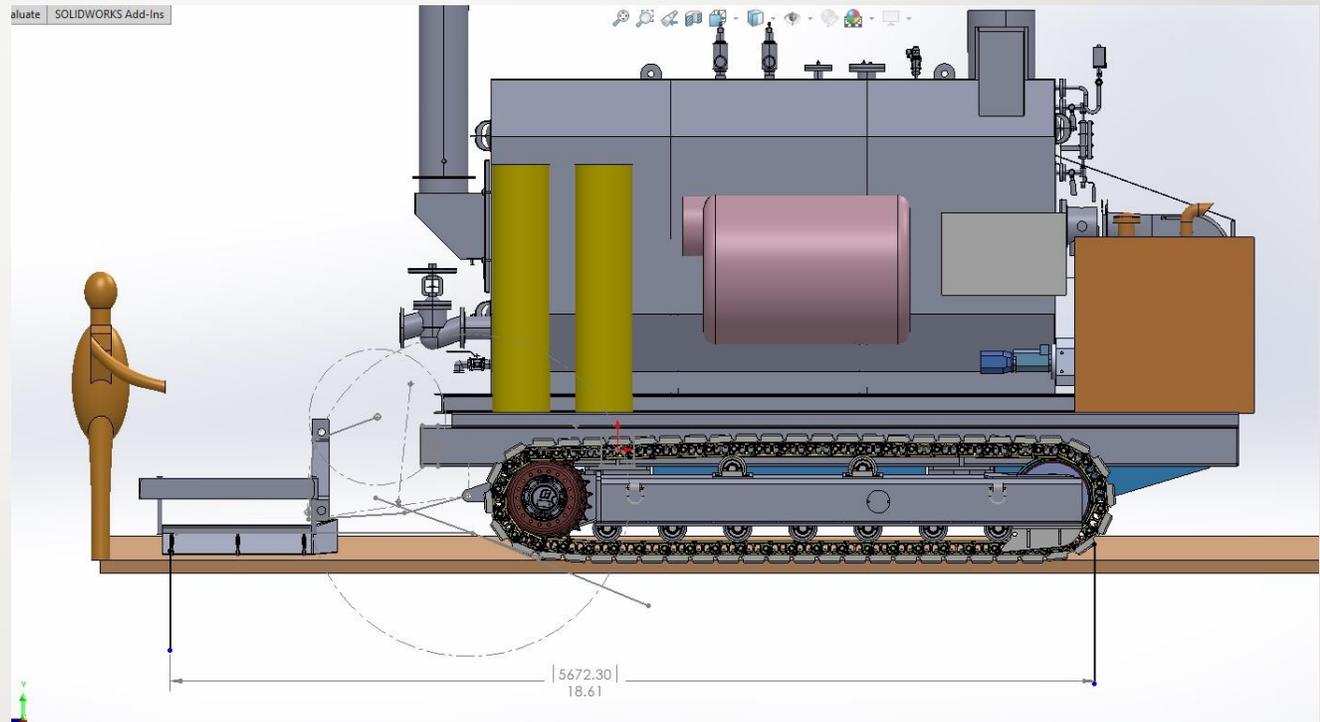
Weed densities & hand weeding times in lettuce with band steam

Treatment	Weed densities	Weed time
	1,000/A	Hr/A
Steam	103 b	22 b
No steam	1080 a	39 a

***Pythium ultimum* control before & after steaming**

Treatment	Before	After
	CFU/g soil	
Steam	563	77 b
No steam	528	320 a
P-value	0.447	0.0198

New
concept for
a steam
applicator



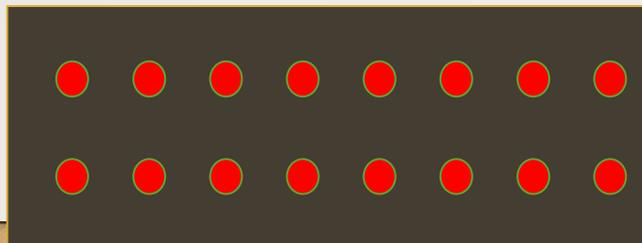
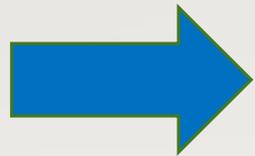
Steam patterns



Broadcast



Band



Spot



The device



Application



Soil Steam International – “Field Saver”



Objective of the prototype

- Determine if treating the plant hole with steam is adequate
- Test a design for an autonomous spot steam applicator for strawberry beds
- Being developed by Soil Steam International, Sandefjord, Norway

<https://soilsteam.com/>



Fruit field evaluation



Steam disinfestation in a fruiting field

- Treatments included steam, and a control
- Treatments were replicated 4 times and arranged in a RCBD
- Data collected were soilborne pest control, weed control and fruit yield
- Trials in Oxnard, Salinas and Watsonville

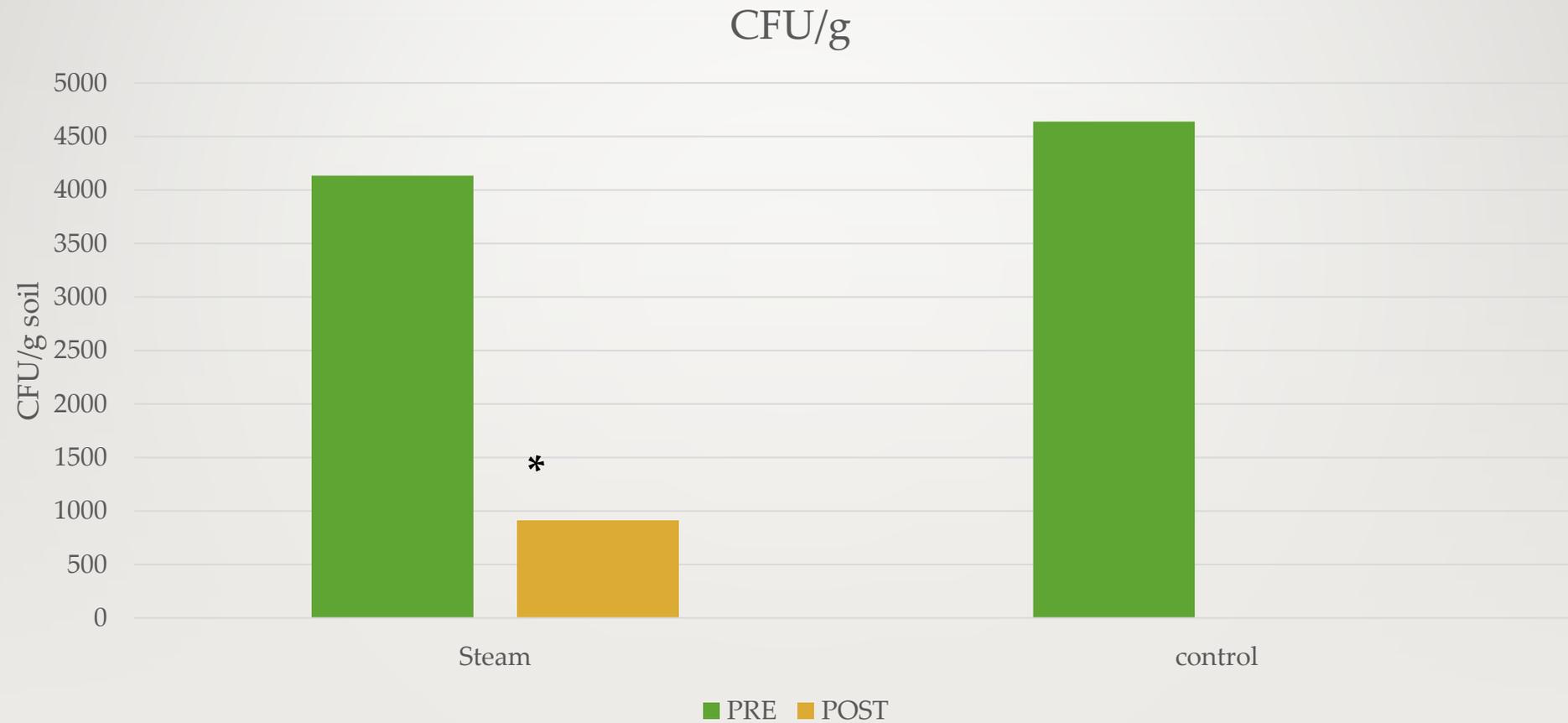
Steam



Control



Oxnard – *Fusarium oxysporum*



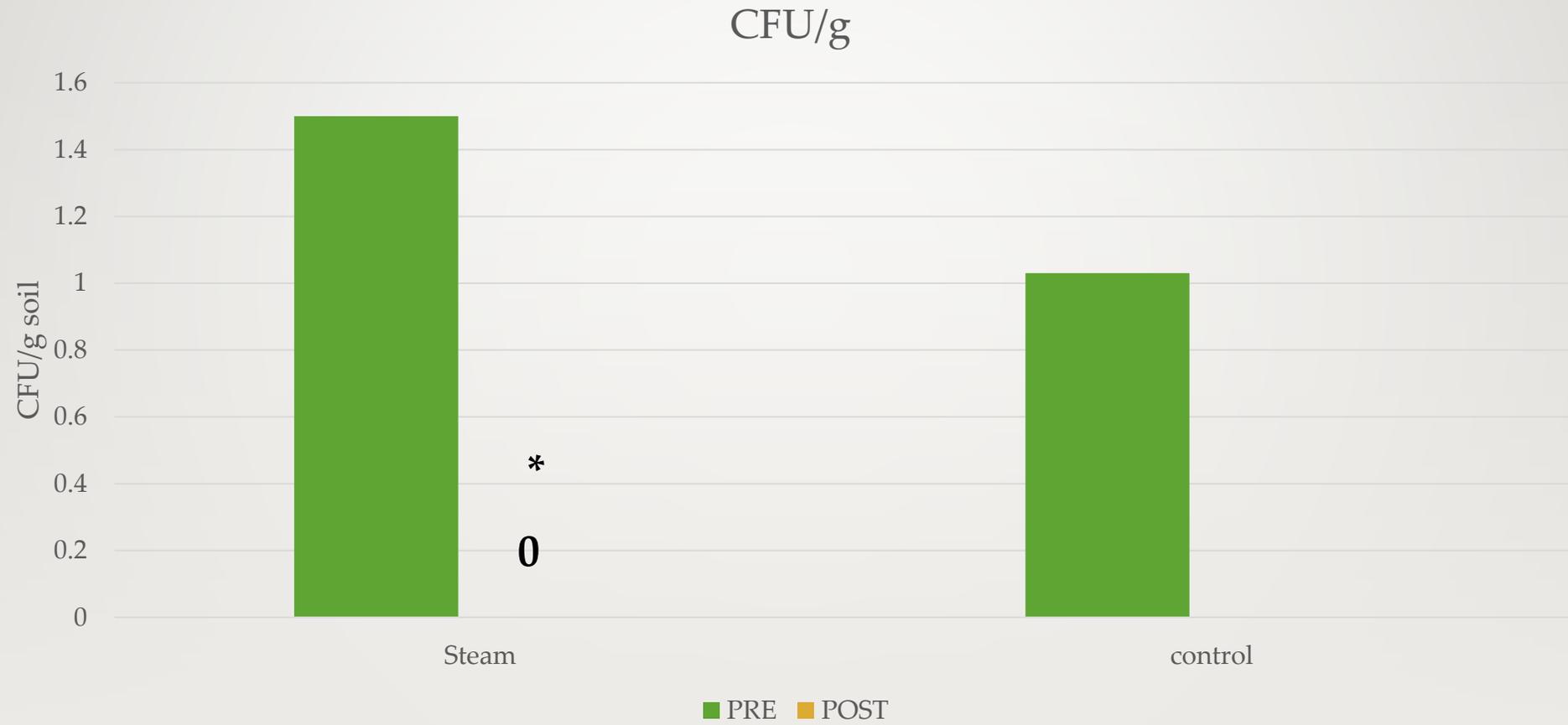
Oxnard – strawberry plant mortality



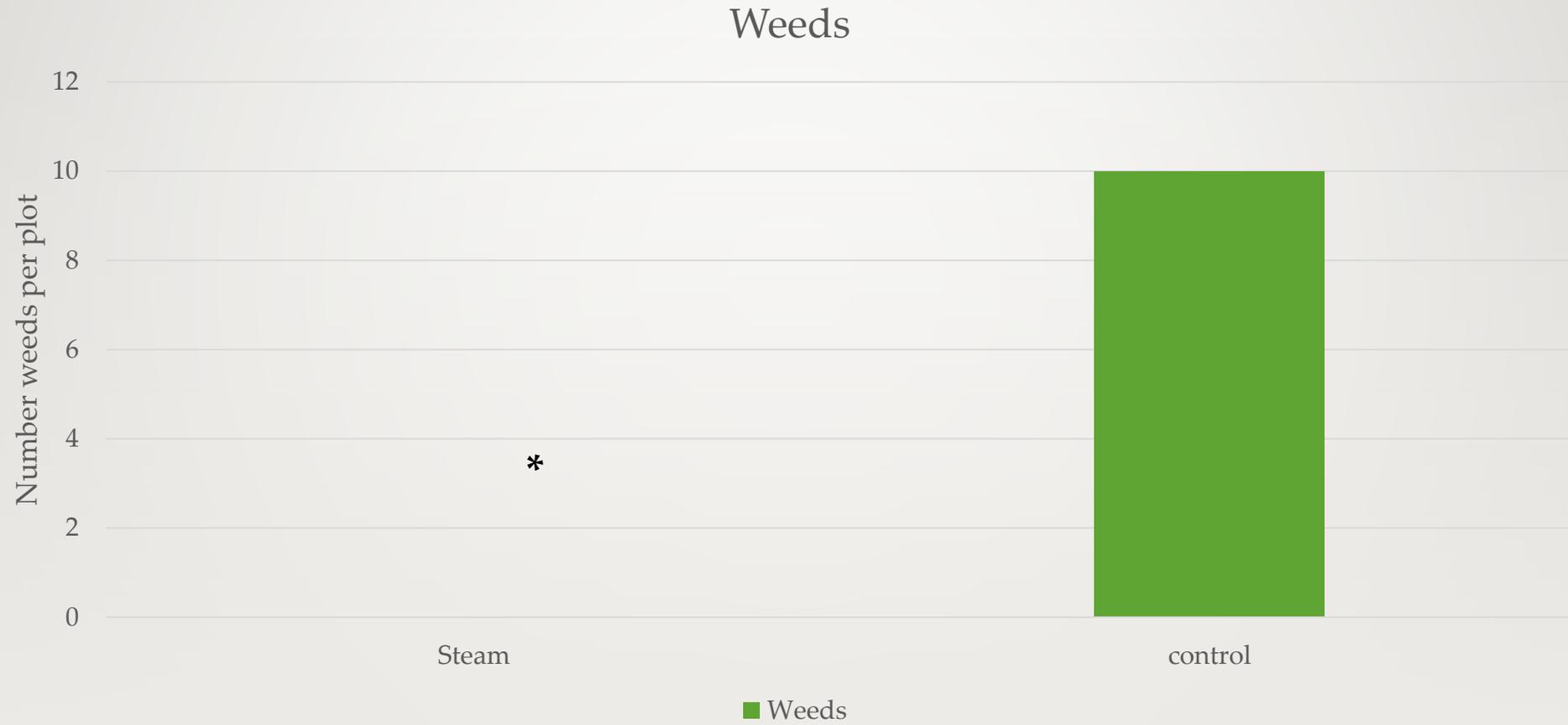
Oxnard – Cumulative fruit yield through 12.12.22



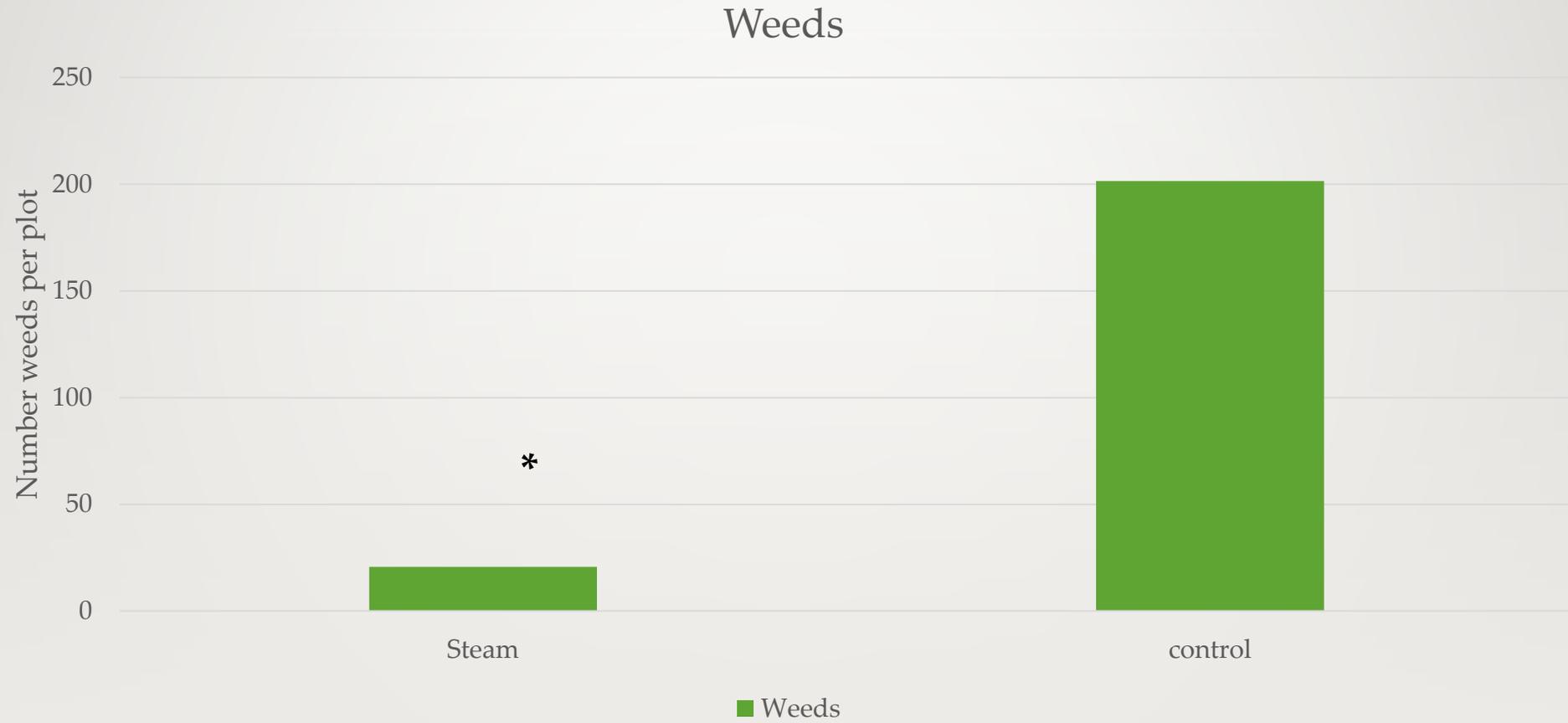
Watsonville – *Macrophomina phaseolina*



Oxnard – Weeds # per 20 plant holes



River Road – Weeds # per 32 plant holes through 4.5.23



Watsonville– Weeds # per 32 plant holes – through 4.4.23



Pythium control- Salinas 2022

Treatment	River Rd	Spence
	% reduction	
No steam control	0 b	0 a
Steam	99 a	98 b

Steam disinfestation in a fruiting field - summary

- Steam was very effective in controlling weeds and *Pythium* spp.
- Steam suppressed *Fusarium* at Oxnard
- Steam suppressed *Macrophomina* at Watsonville
- Fruit yield from steam treatments was vastly higher than the control at Oxnard
- Yields will be collected from the Salinas and Watsonville sites during the upcoming season



Strawberry Herbicide Evaluation



Embed Extra

- Clover control in strawberries is a challenge because fumigants and available herbicides are weak on these weeds
- Embed Extra is a low volatile formulation of 2,4-D. This herbicide has a lot of activity on clovers
- We tested it in 2021-22 as a directed spray in strawberry in collaboration with the IR-4 program
- Work was conducted at the Spence research farm near Salinas



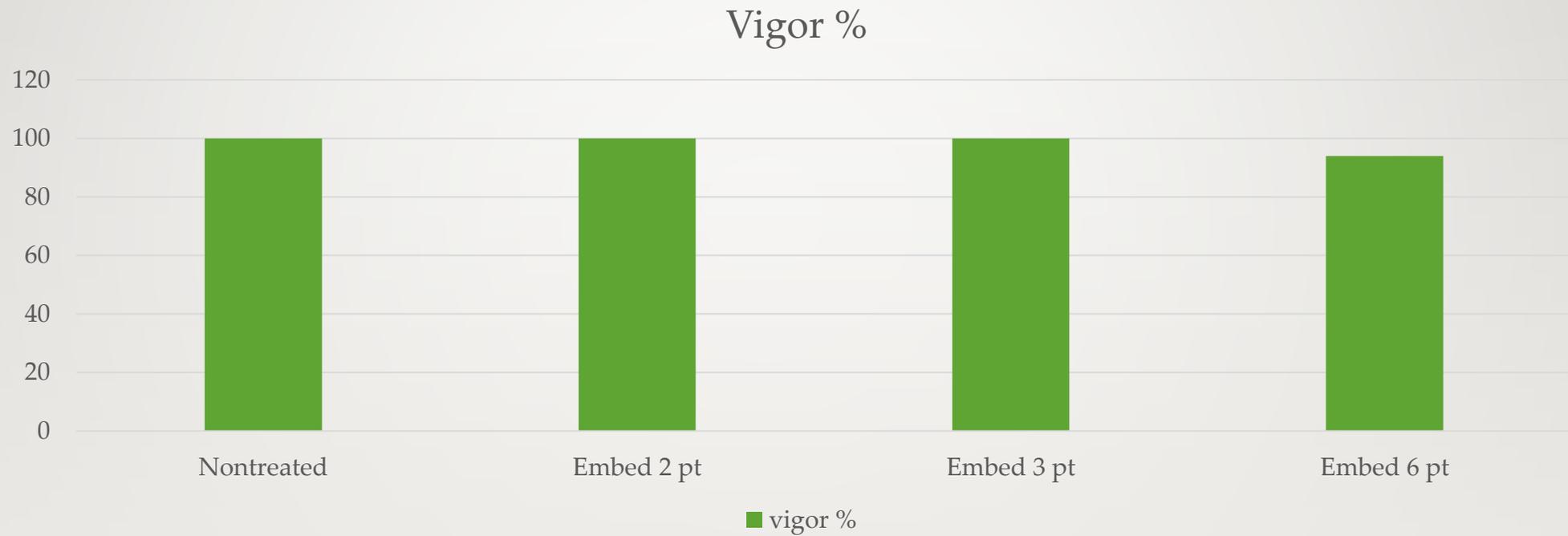
Embed Extra - Details

- Embed Extra 3.8 EC is from Syngenta
- Embed Extra was tested at 2, 3 and 6 pints per acre
- Was applied Feb 23, and March 30, 2022.
- Trials were replicated 4 times
- Data collected were Crop injury, crop vigor, fruit yield and weed control.

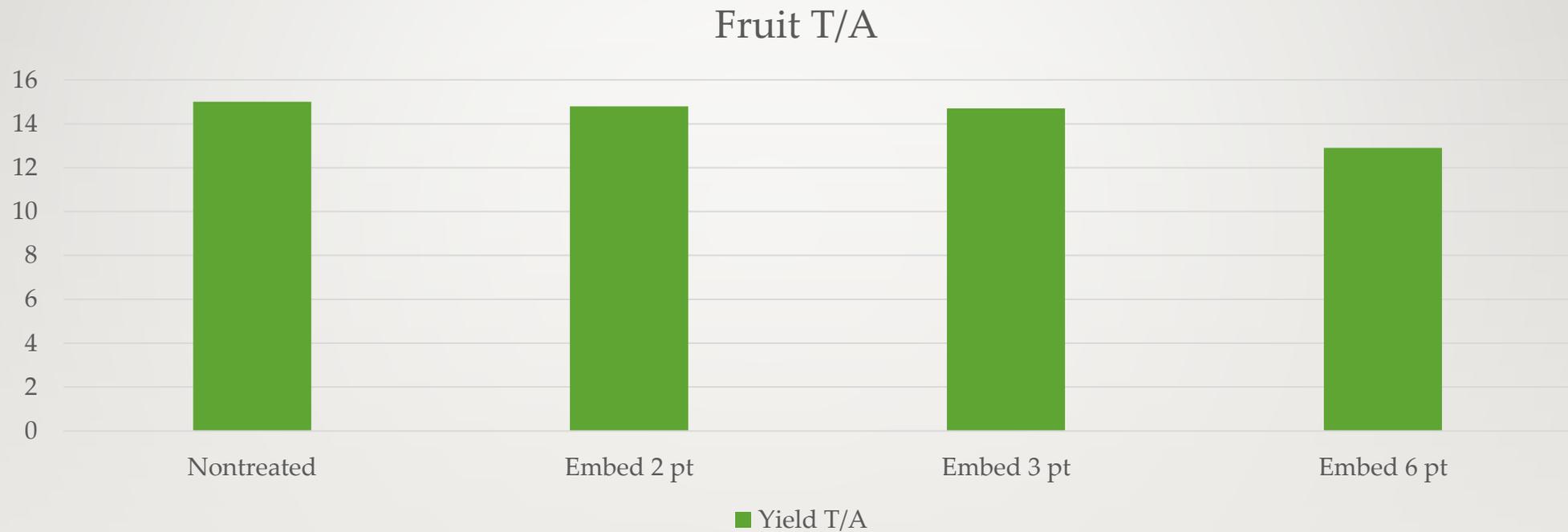
Clover control with Embed Extra



Strawberry vigor with Embed Extra



Strawberry Fruit Yield with Embed Extra





2022.01 - Treatment #1
Embed Extra
Weed-Free Control
X-77 @ 0.25% v/v
Furrow @ 1-2" fb regrowth

2022.01 - Treatment #2
Embed Extra
@ 2.0 pt./Ac
+
X-77 @ 0.25% v/v
Furrow @ 1-2" fb regrowth

2022.01 - Treatment #3
Embed Extra
@ 3.0 pt./Ac
+
X-77 @ 0.25% v/v
Furrow @ 1-3" fb regrowth

2022.01 - Treatment #4
Embed Extra
@ 6.0 pt./Ac
+
X-77 @ 0.25% v/v
Furrow @ 1-3" fb regrowth



Embed Extra – recommendations

- Embed Extra can be safely used to control weeds in strawberry furrows
- Embed Extra at 3 pints per acre was safe to strawberry and provided effective control of clover
- IR-4 is working with Syngenta to possibly register this use for strawberry.