

Weed and disease control without pesticides

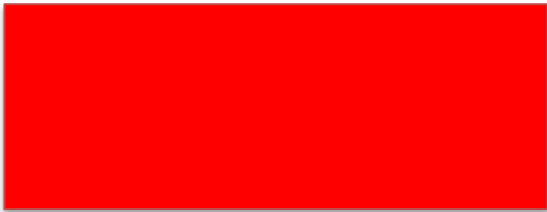
Steve Fennimore



Assumptions

- **There are viable engineering solutions to improve the efficacy of steam and make it an economic solution for control of soil borne diseases and weeds in strawberry and vegetable crops.**

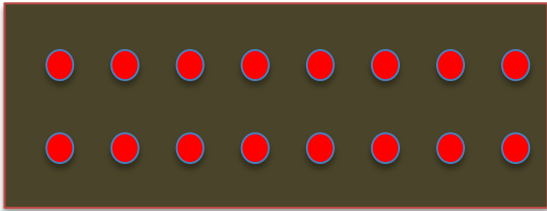
Steam patterns



Broadcast



Band



Spot

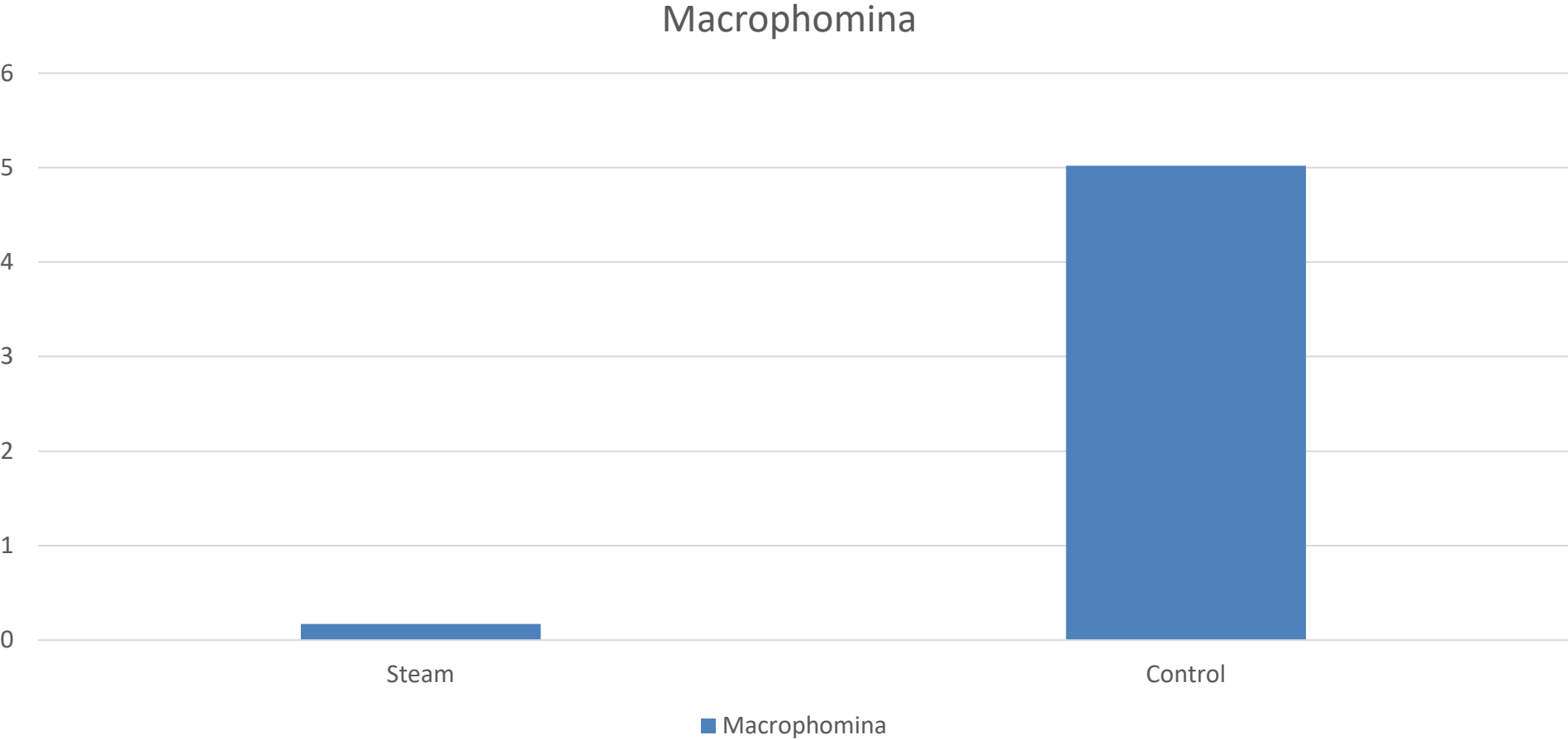




Strawberry trial in Saticoy

- **Organic site initiated September 2023.**
- **Replicated trial, evaluations for Macrophomina (Peter Henry) and for weed control and fruit yield (Oleg Daugovish).**

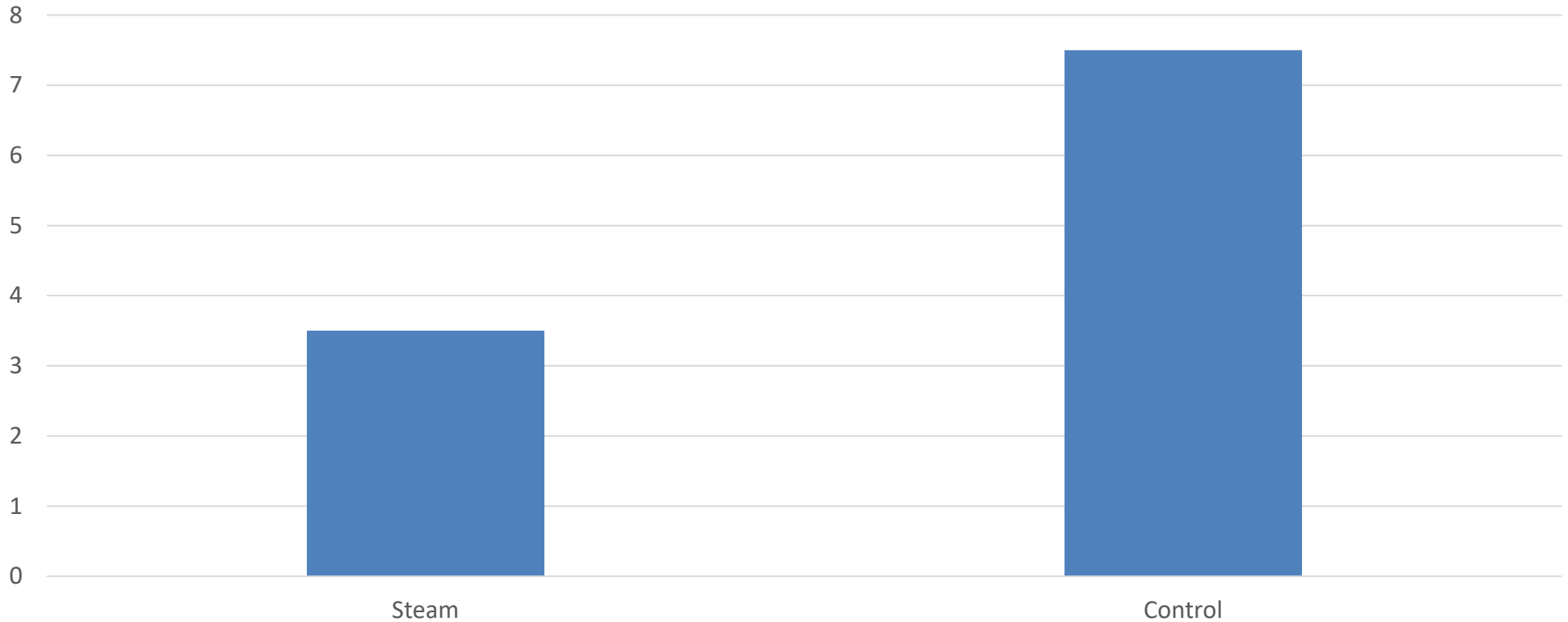
Macrophomina control with steam



Peter Henry

Weed control with steam

Weeds/20 ft bed



Steam

Control

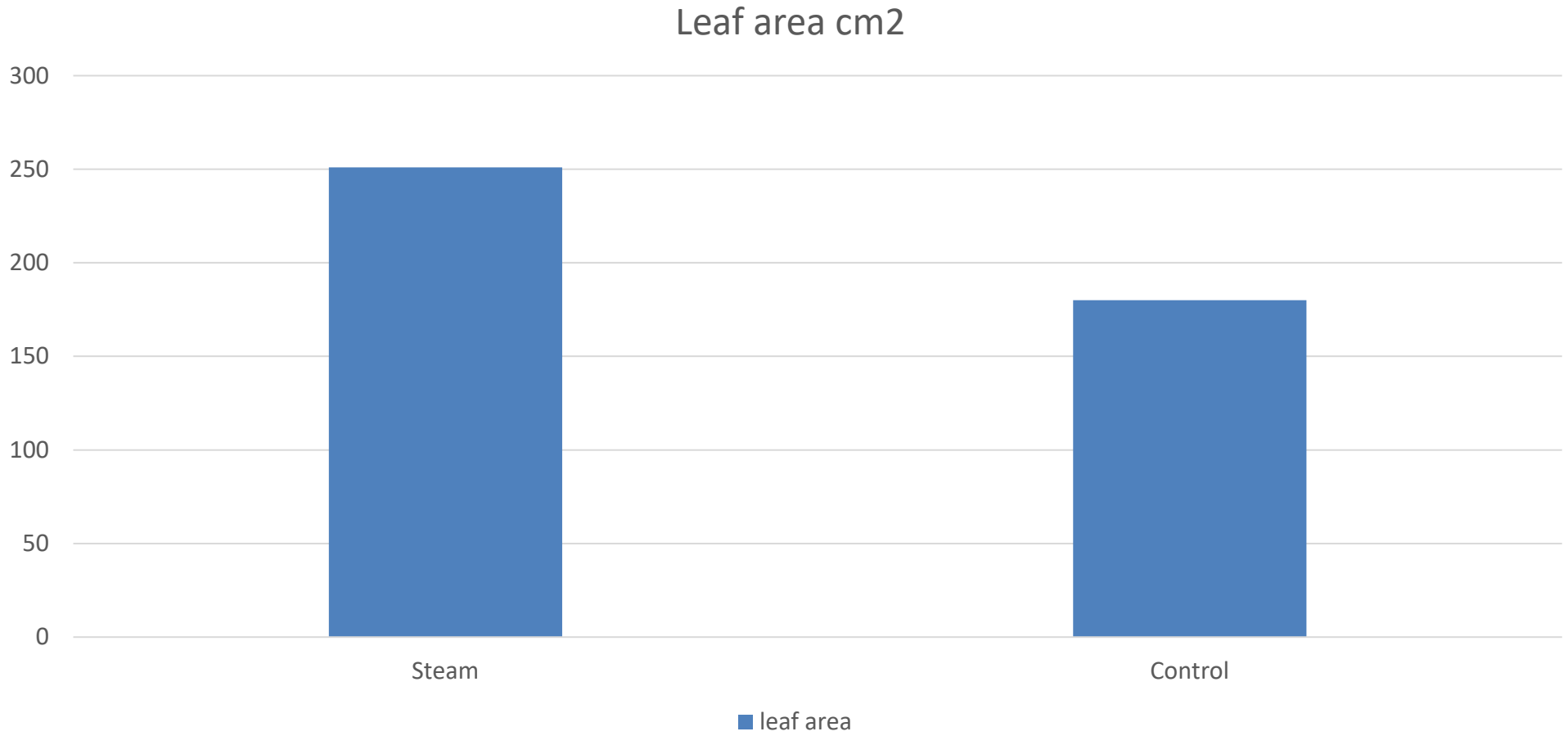
■ Weeds

B

A

Oleg
Daugovich

Plant leaf surface area 1.3.24



Steam

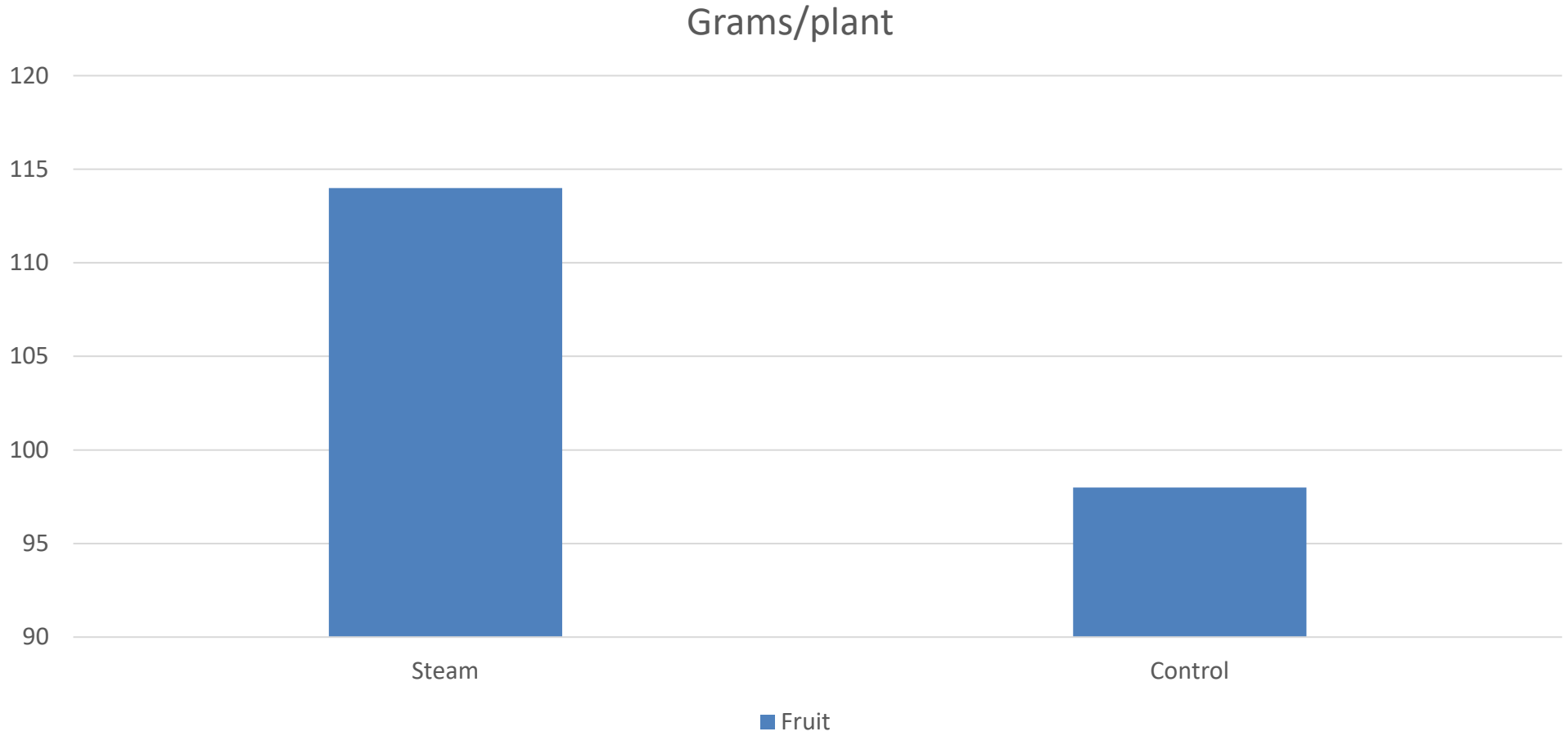
Control

■ leaf area

A

B

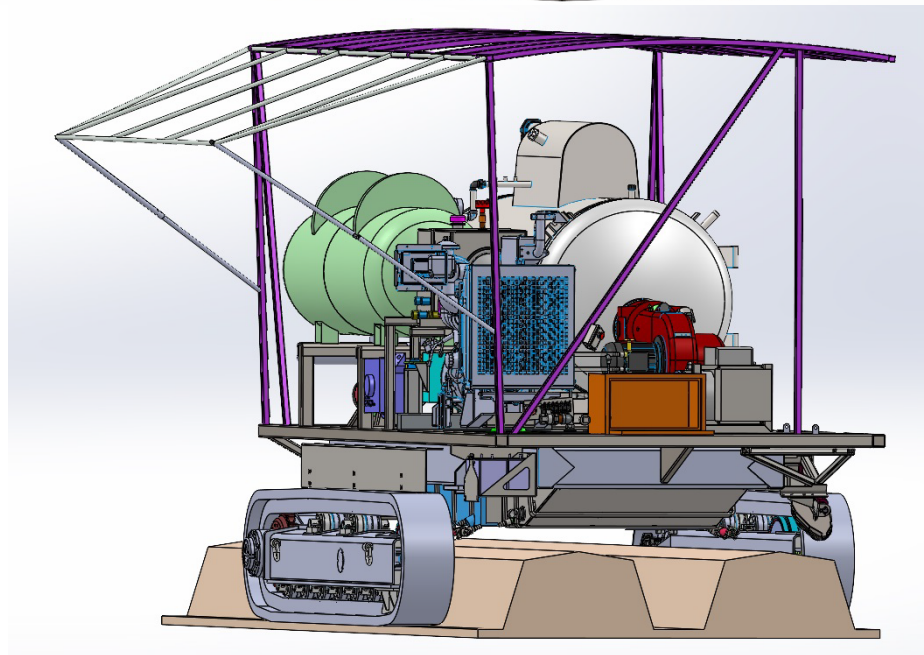
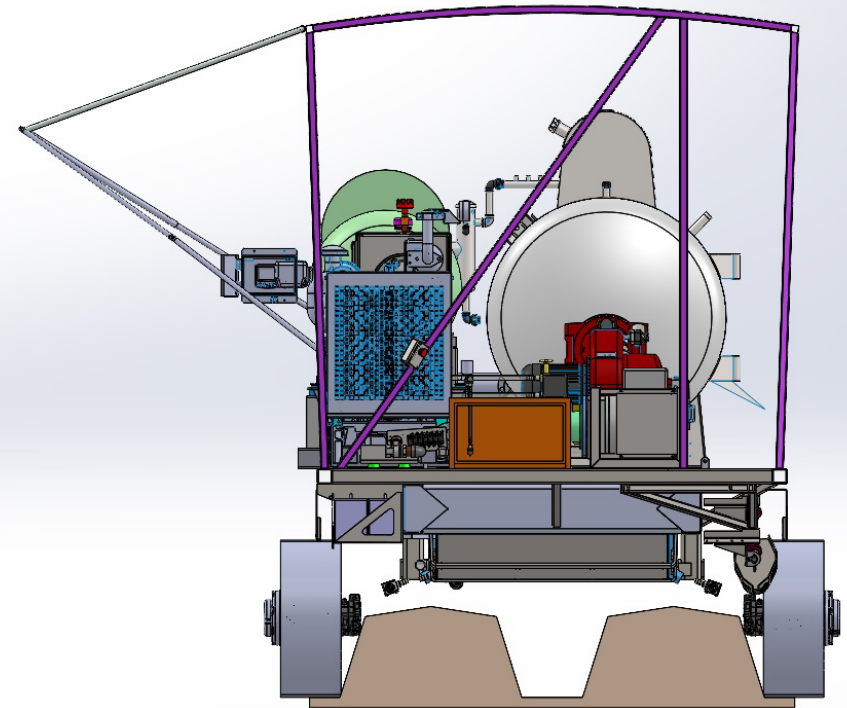
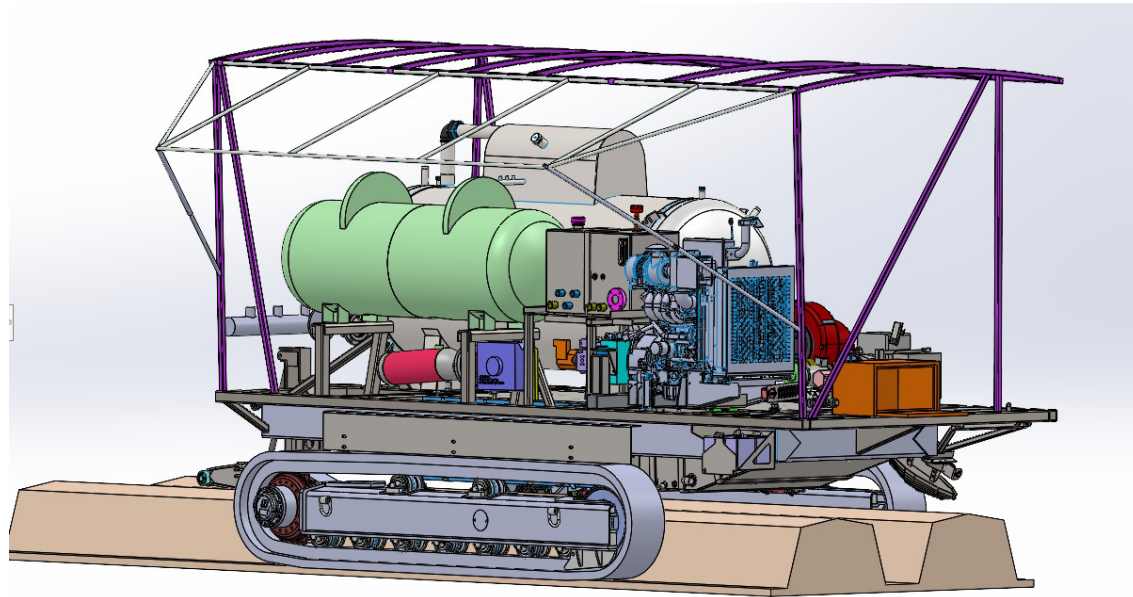
Fruit yield grams/plant through May 2024



Saticoy Summary

- **Steam improved pest control and yield**
- **As always – we know that steam works well for control of soil pests.**
- **However, what we lack is an effective applicator.**

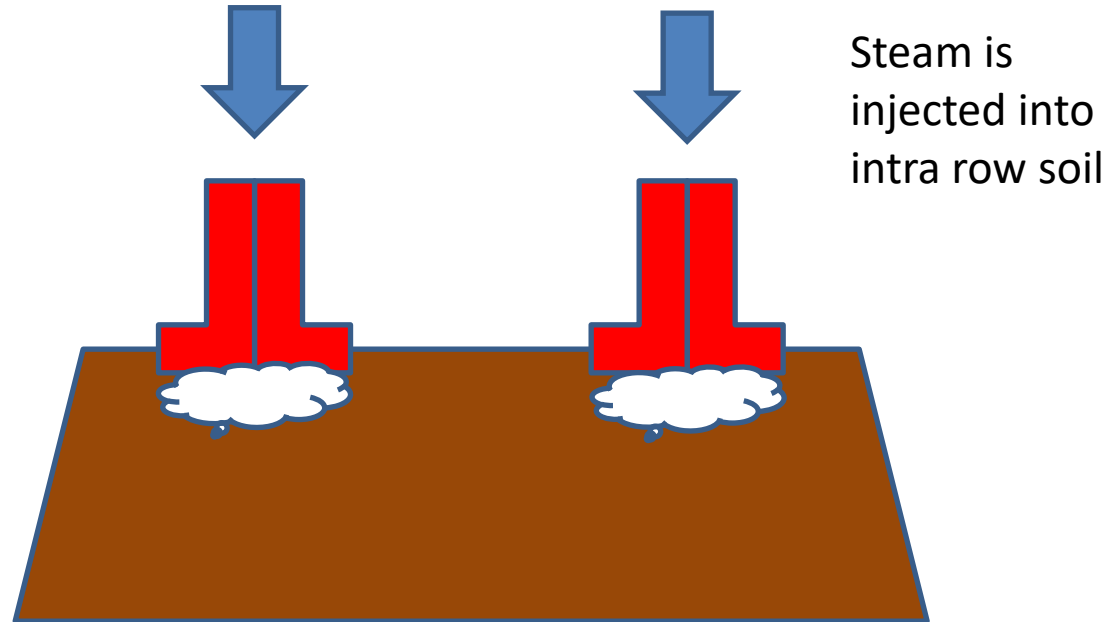
STRAWBERRY STEAMER



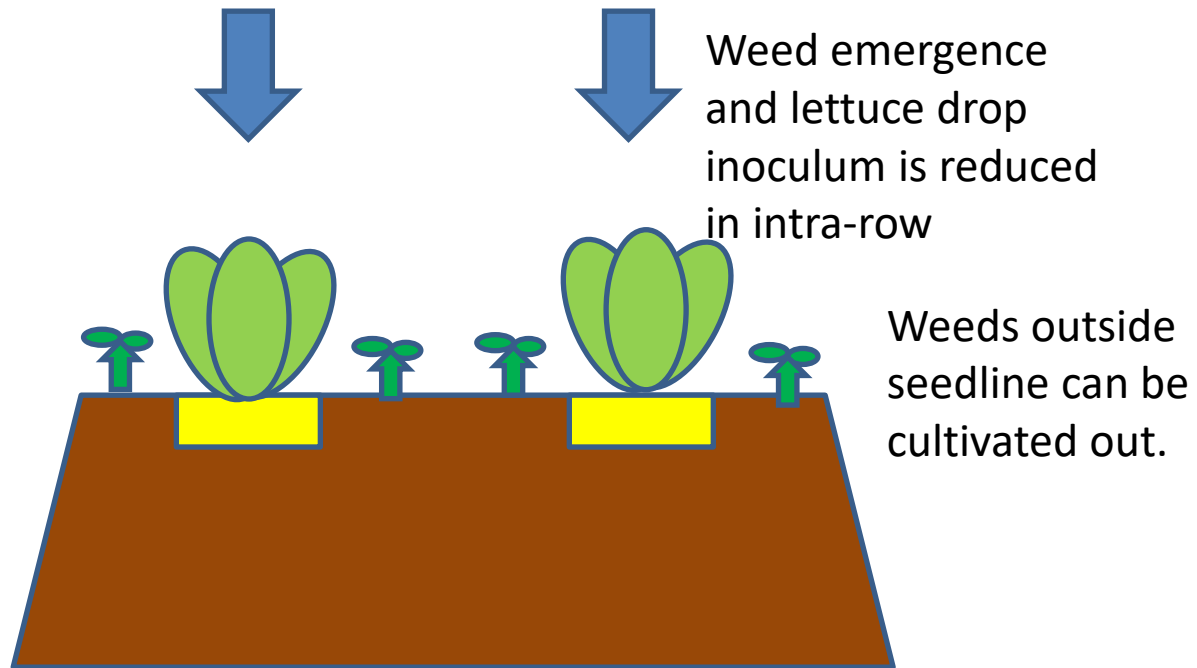
Objective: Evaluate precision applied band steam in vegetables for control of soilborne diseases and weeds.



1. Seed lines disinfested with steam



2. Seed lettuce into the disinfested band



Lettuce grown in steam treated bands



Field station lettuce trial

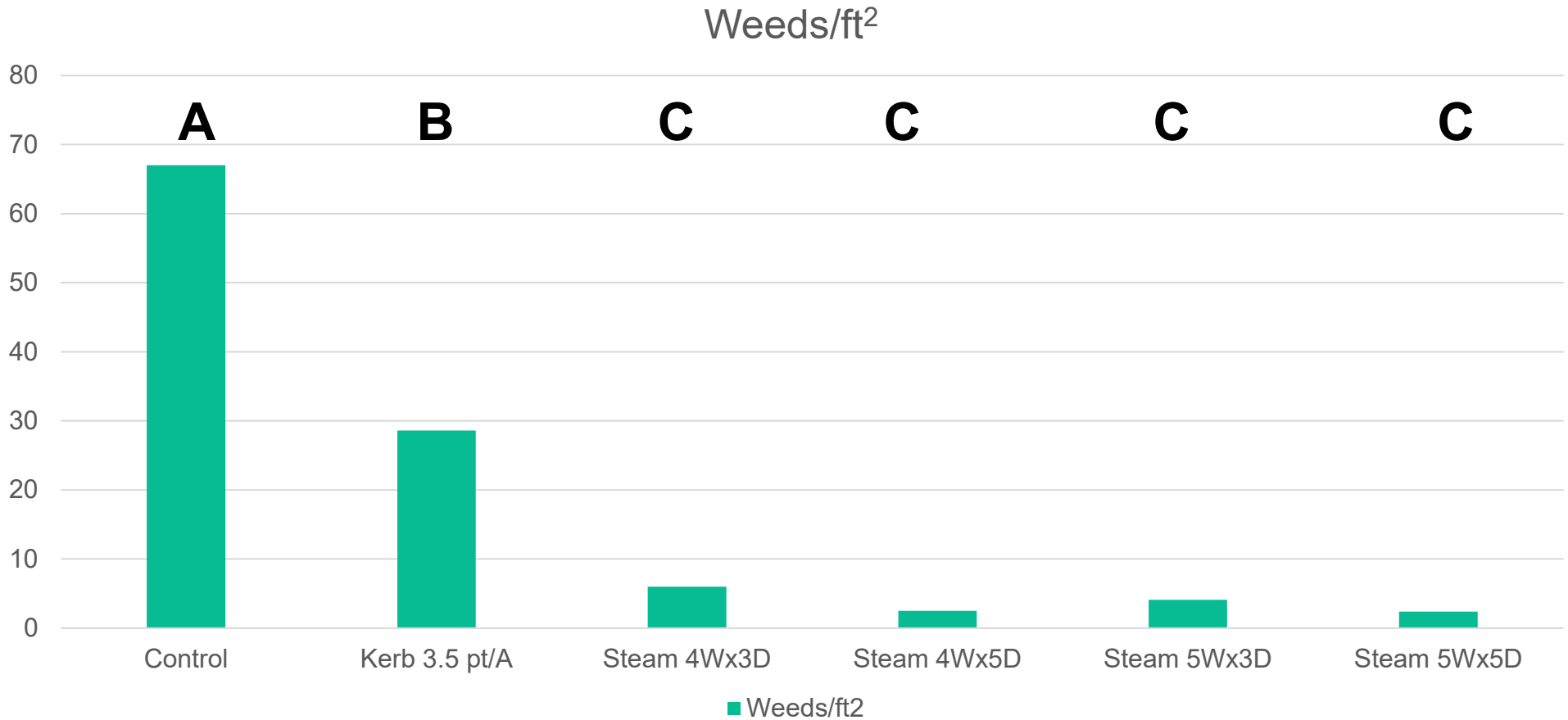
- **Steam applied in bands 4 & 5 inches wide, steam injected 3 & 5 inches deep August 29 & 30, 2023**
- **Lettuce planted August 31, 2023**
- **Replicated 4 times**

Weed control by species

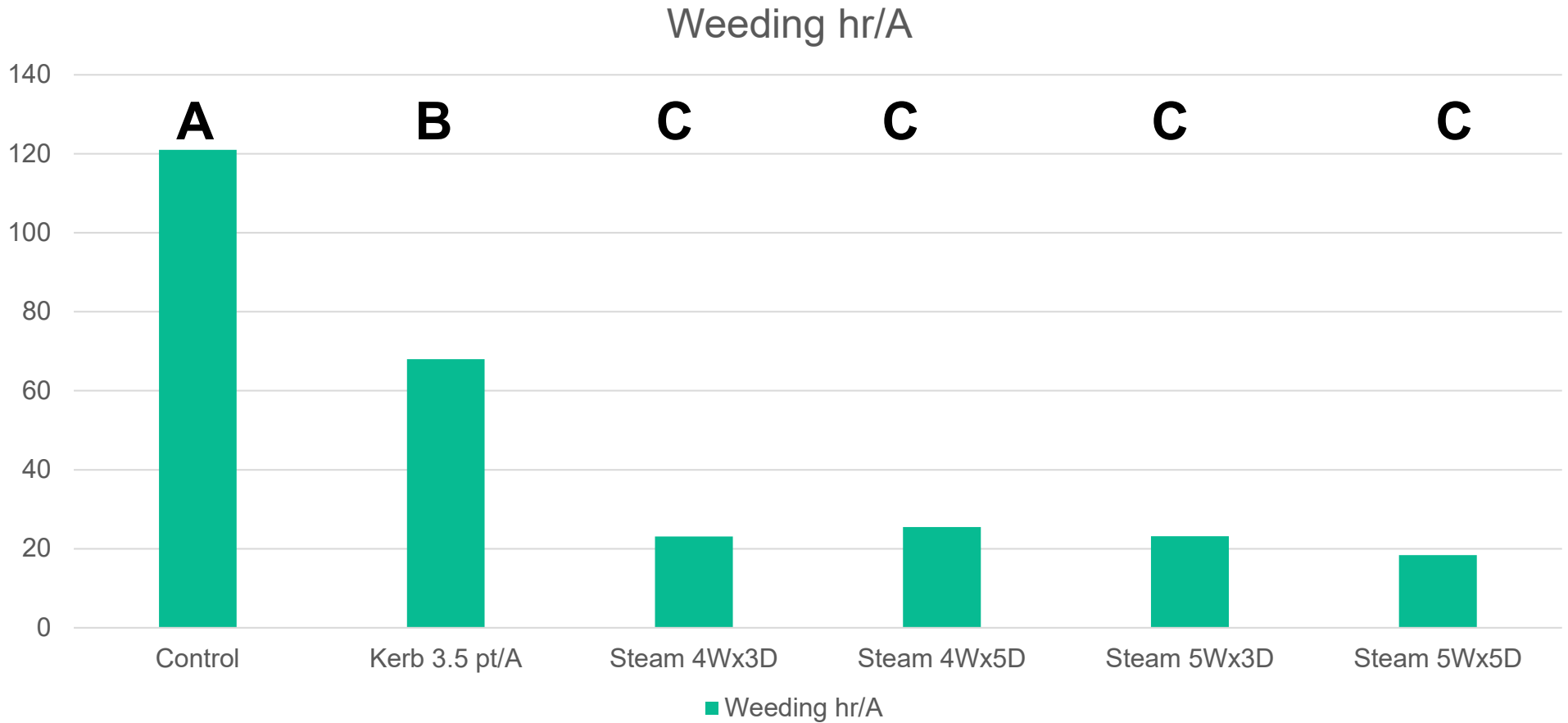
- Purslane 99%
- Shepherd's-purse, nettleleaf goosefoot 88%
- Burning nettle, henbit, pigweed 100%
- Little mallow 42%



Total number of weeds in the seedline band – the “expensive” weeds

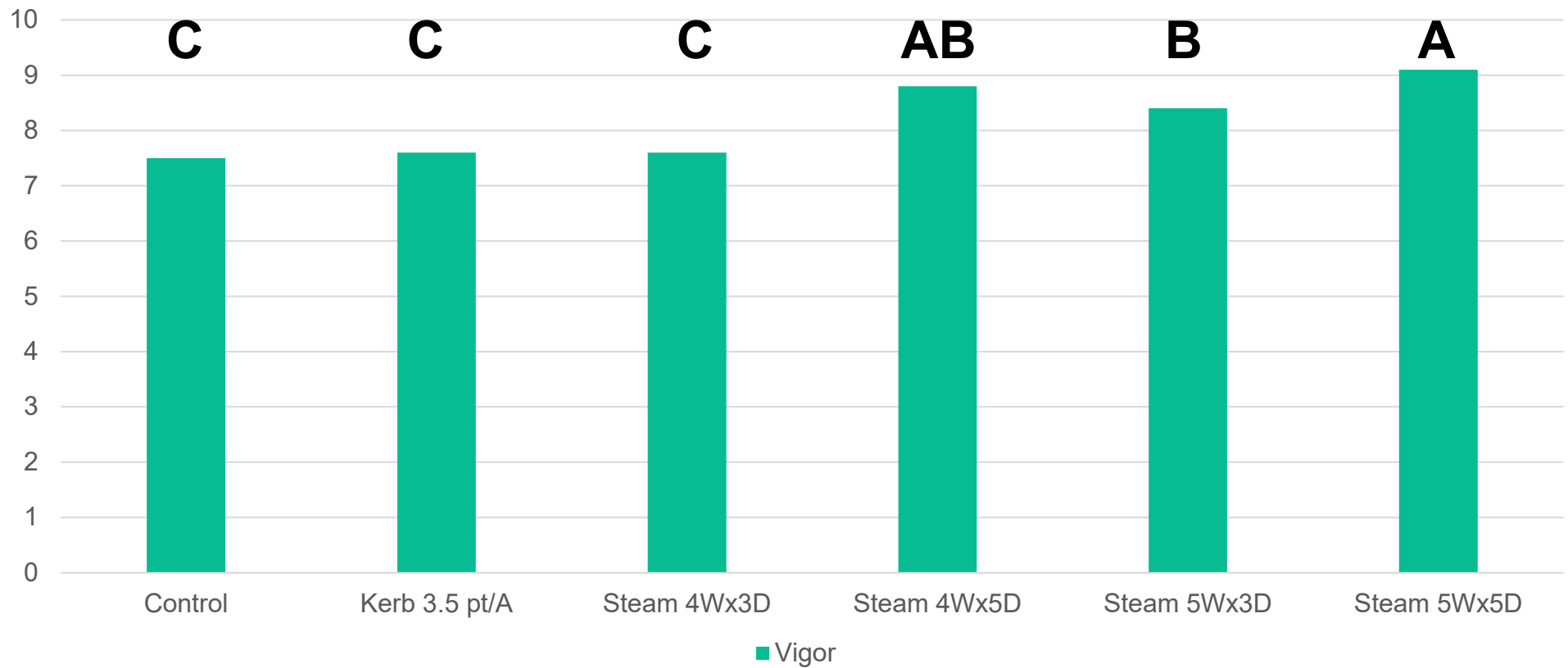


Hand weeding times



Lettuce vigor 0-10

10=largest; 0 = no plants



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

Treatment	Before	After
	CFU/g soil	
4w 3d	8.5	1.4
5w 3d	6.7	1.3
4w 5d	10.2	0
5w 5d	12.8	0
control	8.2	5.7

Beneficial soil microbes

- **Steam did not kill nitrifiers (Nitrospirota)**
- **Steam enhanced the Firmicutes 3X (beneficials).**

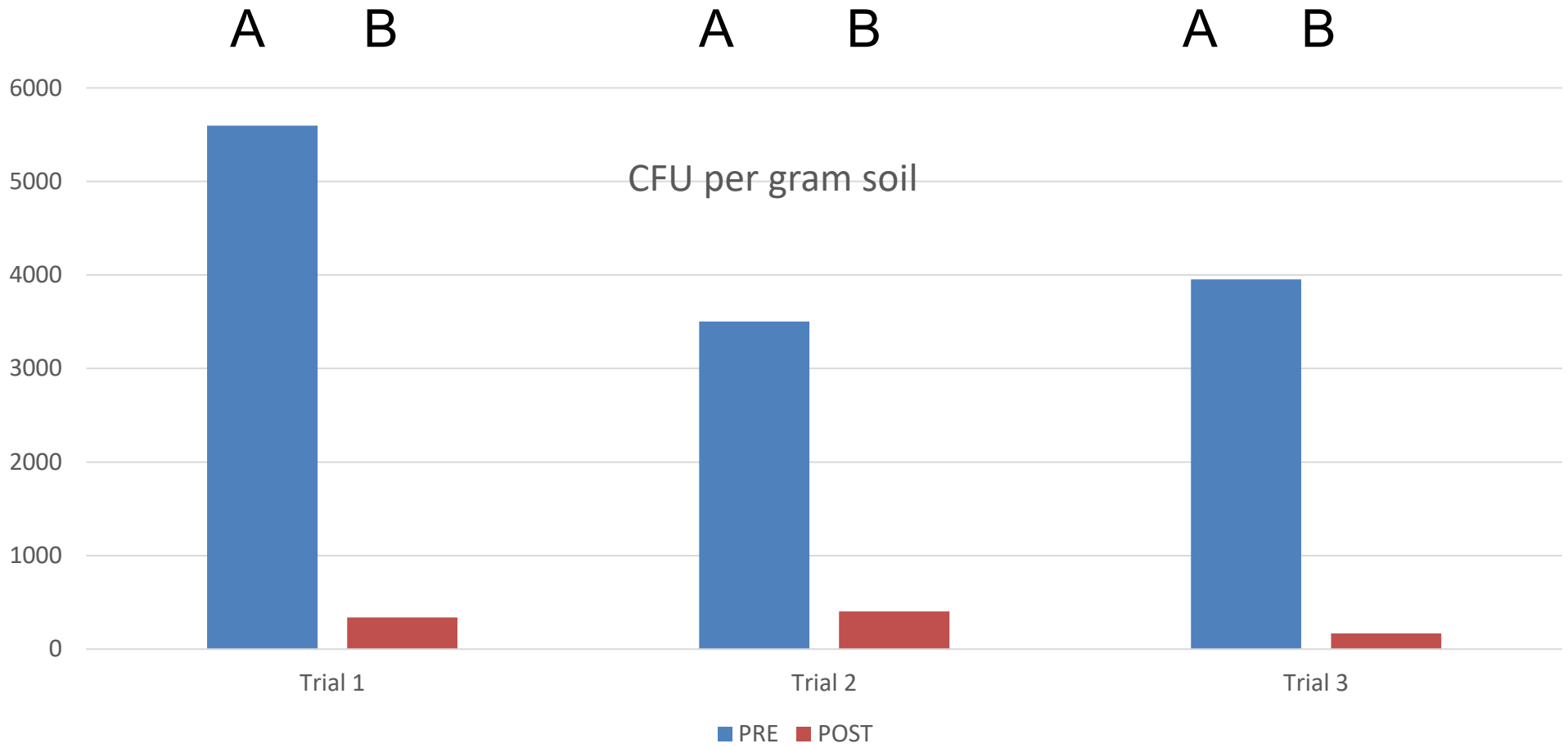
Results of width by depth study

- **Little difference in weed control with steam was excellent**
- **Soil temperatures are higher for longer when injected 5 inches compared to 3 inches**
- **Pythium is controlled better when injected 5 inches than at 3 inches**
- **Did not reduce critical beneficial soil microbes**

Soledad studies

- **Commercial field has history of Fusarium**
- **Steam was applied June 16, 28, & 30, 2023**
- **At each date two 1200 ft 80-inch beds were treated. In each bed two 30 ft sections were not steamed to serve as no steam controls.**
- **Steam was injected in six 4-inch wide bands aligned with the planter spacing**
- **Soil samples were collected before & after steam application**
- **Fusarium control was assessed by plate assays**
- **Weed control & yield were assessed**

Soledad Fusarium spp.



Soledad studies

- **Steam suppresses weeds & Fusarium**
- **We are working with the Genome lab in Davis to evaluate the effects of steam on beneficial soil microbes**



2024 plans

- **The bed shaper is completely new and adjustable for 40, 42, 80 & 84 inch beds**
- **Tracks have telescoping chassis that adjusts from 80 to 84 inches without major down time**
- **400 gallons of onboard water**
- **In Salinas we are currently operating at at about 3 hours per acre in Romaine lettuce.**