

Physical & Chemical Weed Control in Lettuce, Onion & Spinach

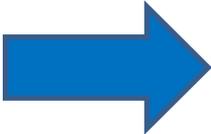
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Assumptions

- **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 vegetable crops.**

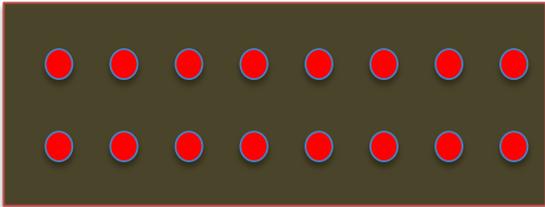
Steam patterns



Broadcast



Band



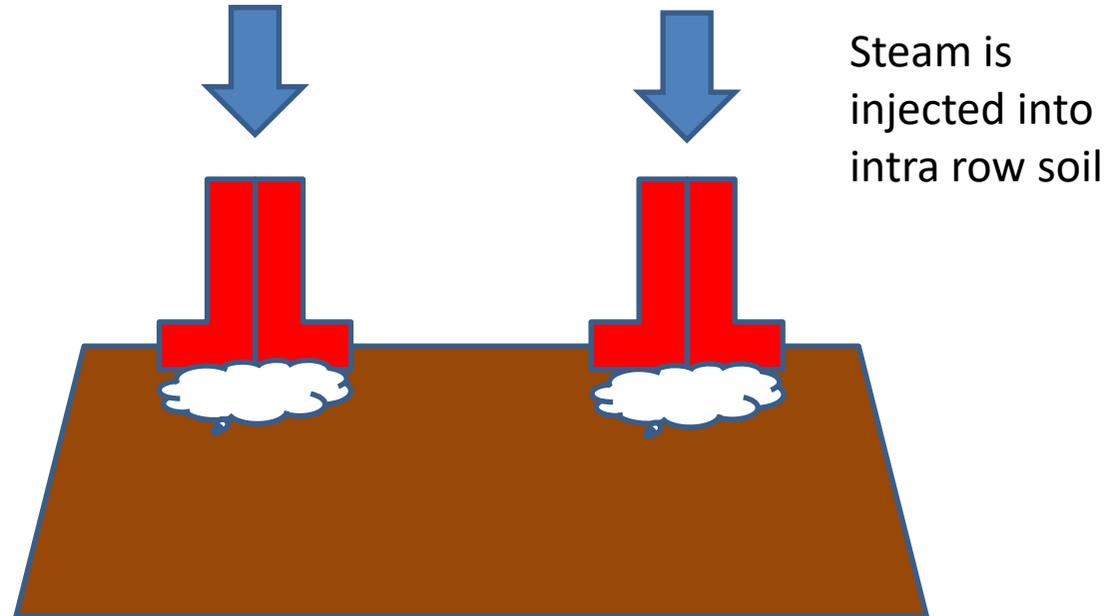
Spot



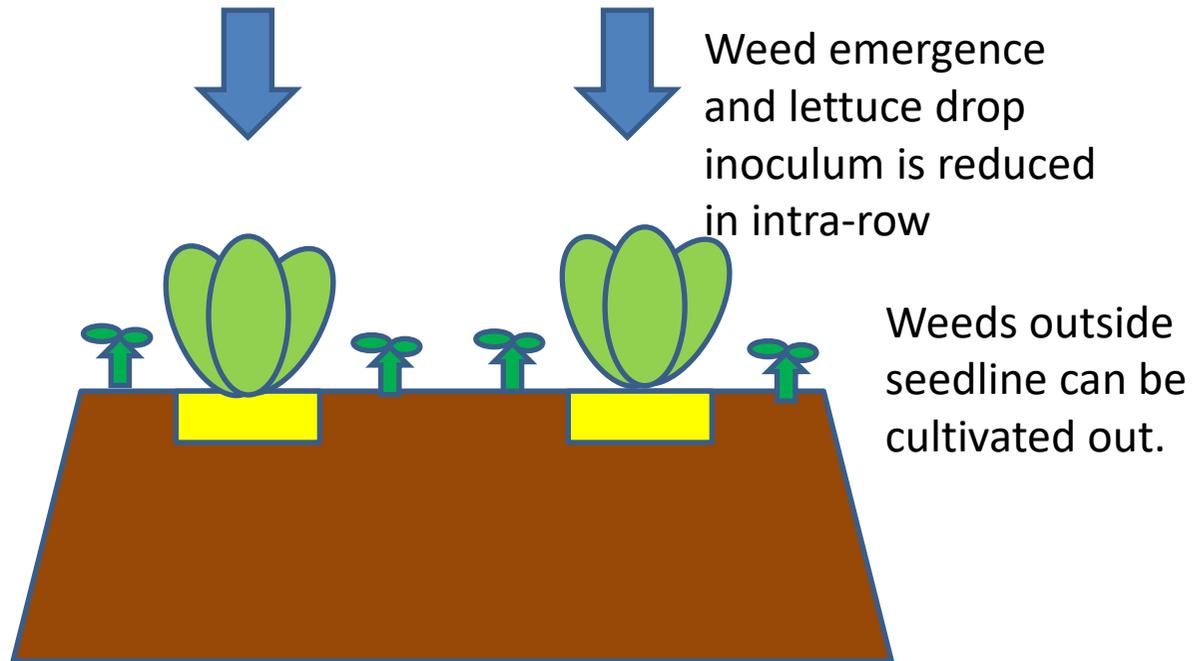
Objective: Evaluate soil disinfestation with steam in lettuce for control of soilborne diseases and weeds.



1. Seed lines disinfested with steam



2. Seed lettuce into the disinfested band



2023 activities

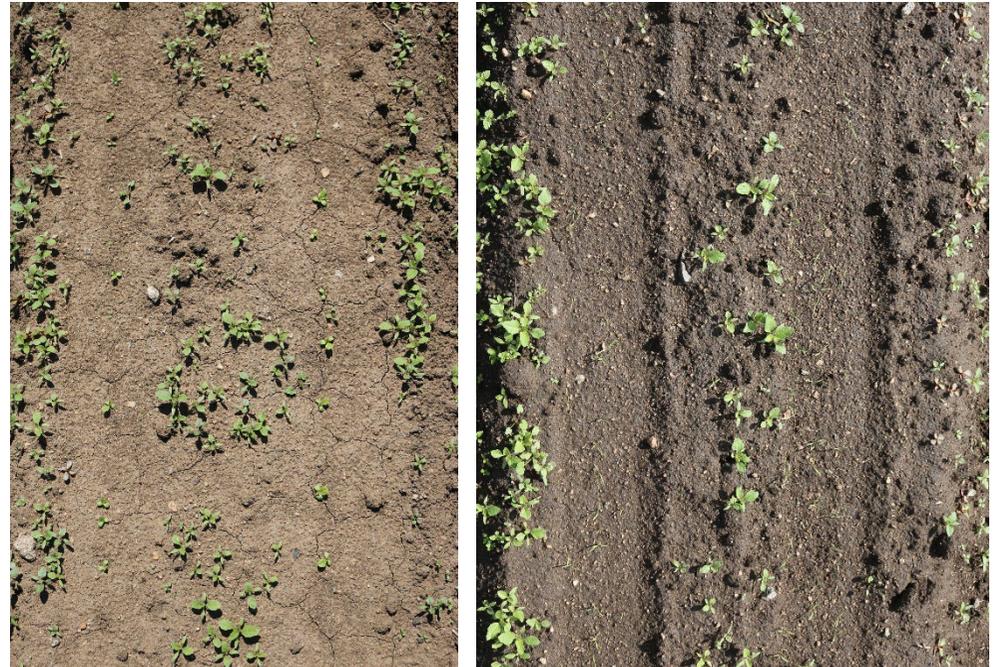
- **Conducted four lettuce demonstration trials in the Soledad area and one at Spreckels**
- **One onion and one lettuce trial on the field station.**

Field station lettuce trial

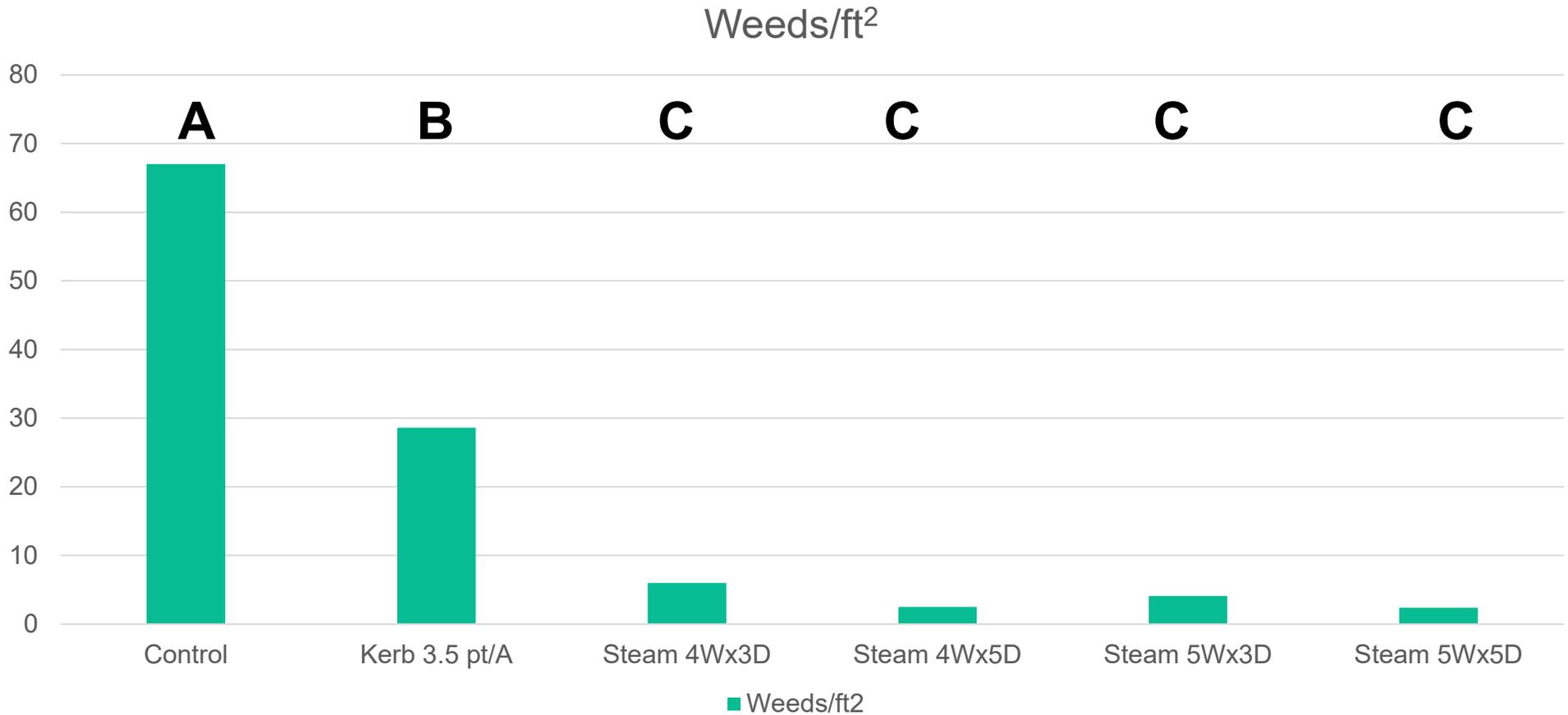
- **Steam applied in bands 4 & 5 inches wide, steam injected 3 & 5 inches deep August 29 & 30, 2023**
- **Lettuce planted August 31, 2023**
- **Replicated 4 times**

Weed control by species

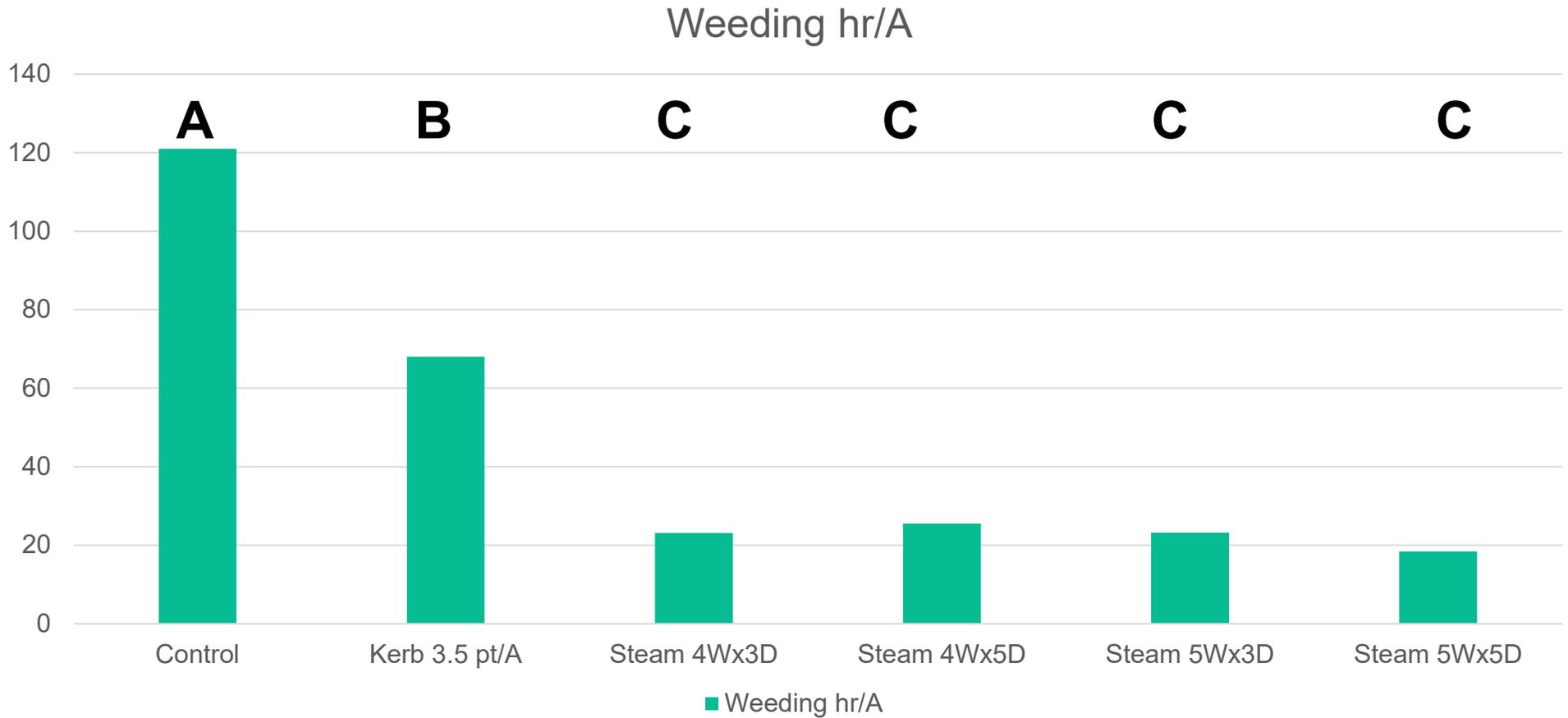
- Purslane 99%
- Shepherd's-purse, nettleleaf goosefoot 88%
- Burning nettle, henbit, pigweed 100%
- Little mallow 42%



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

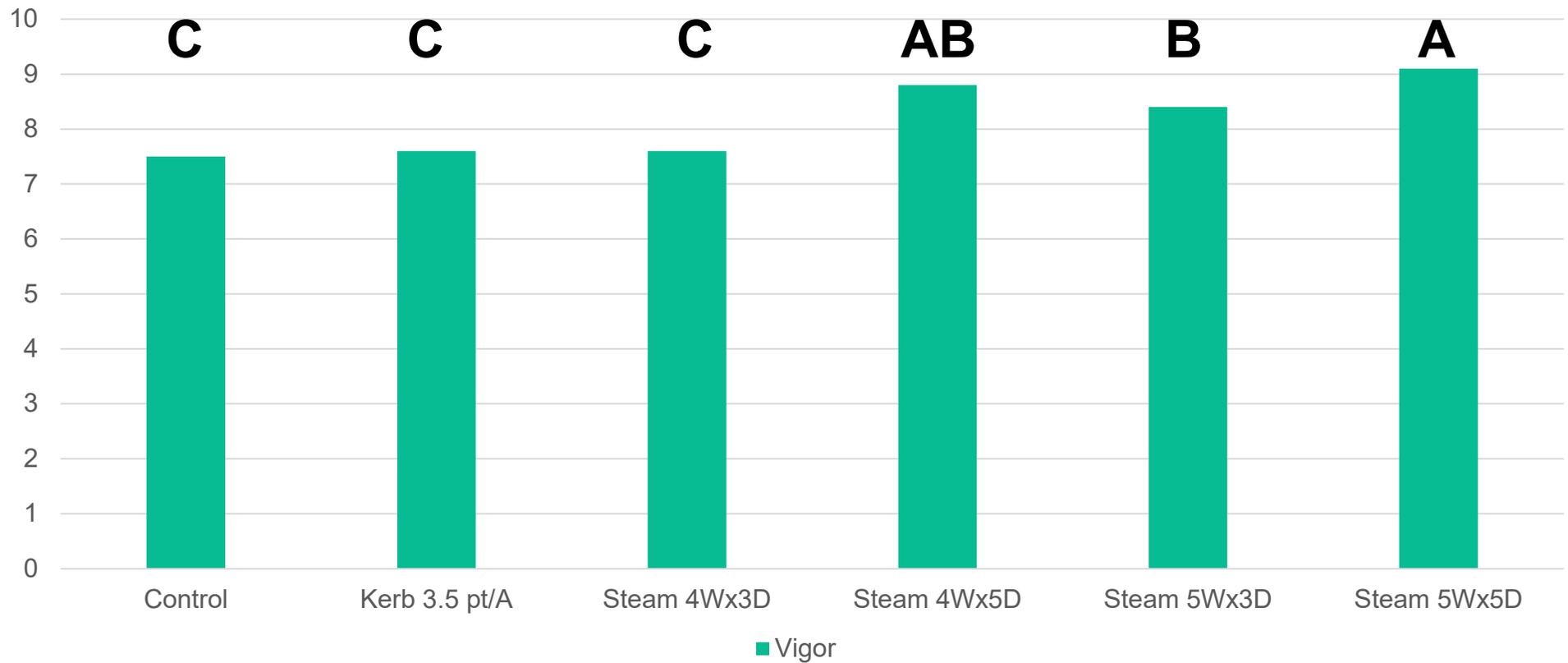


Hand weeding times



Lettuce vigor 0-10

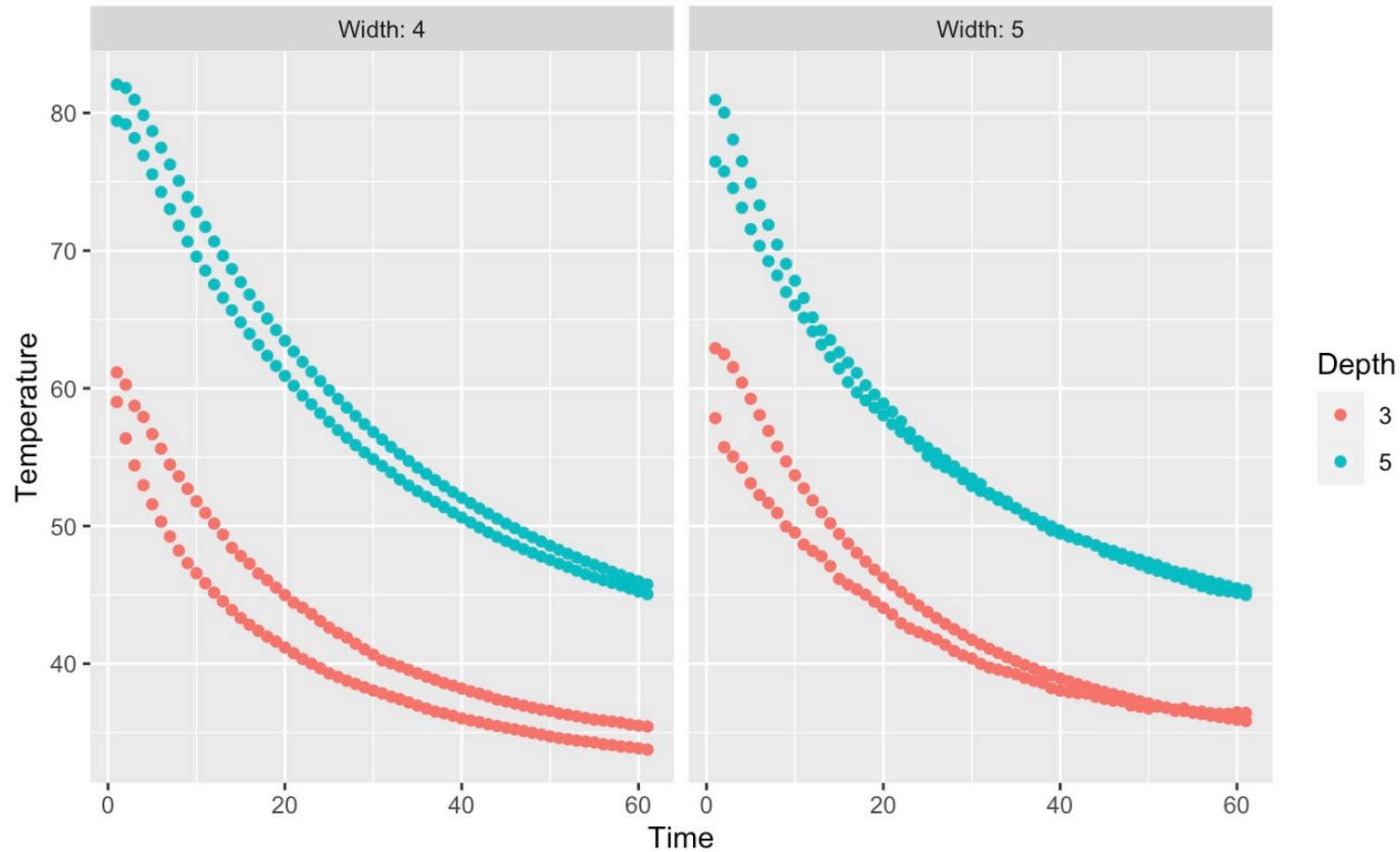
10=largest; 0 = no plants



***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 |

Soil temperatures °C by band width & depth



4 inches wide by 5 inches deep



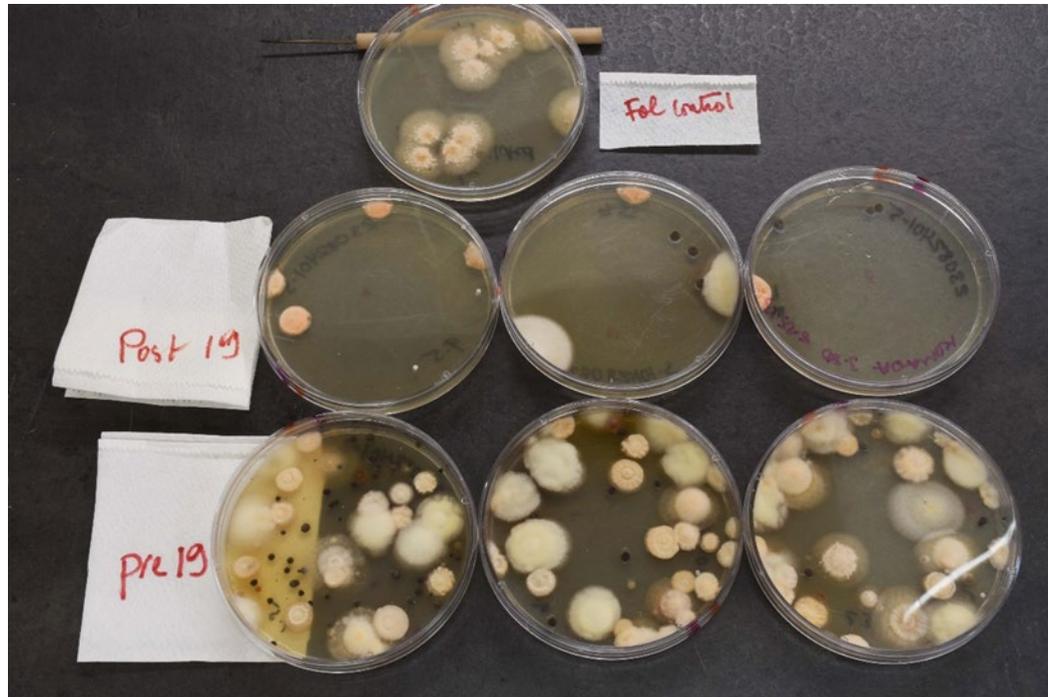
Results of width by depth study

- **Little difference in weed control among the steam treatments**
- **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**

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 is being assessed by plate & qPCR assays**
- **Weed control & yield were assessed**

Pre & Post Plate Assays for FOL Fusarium

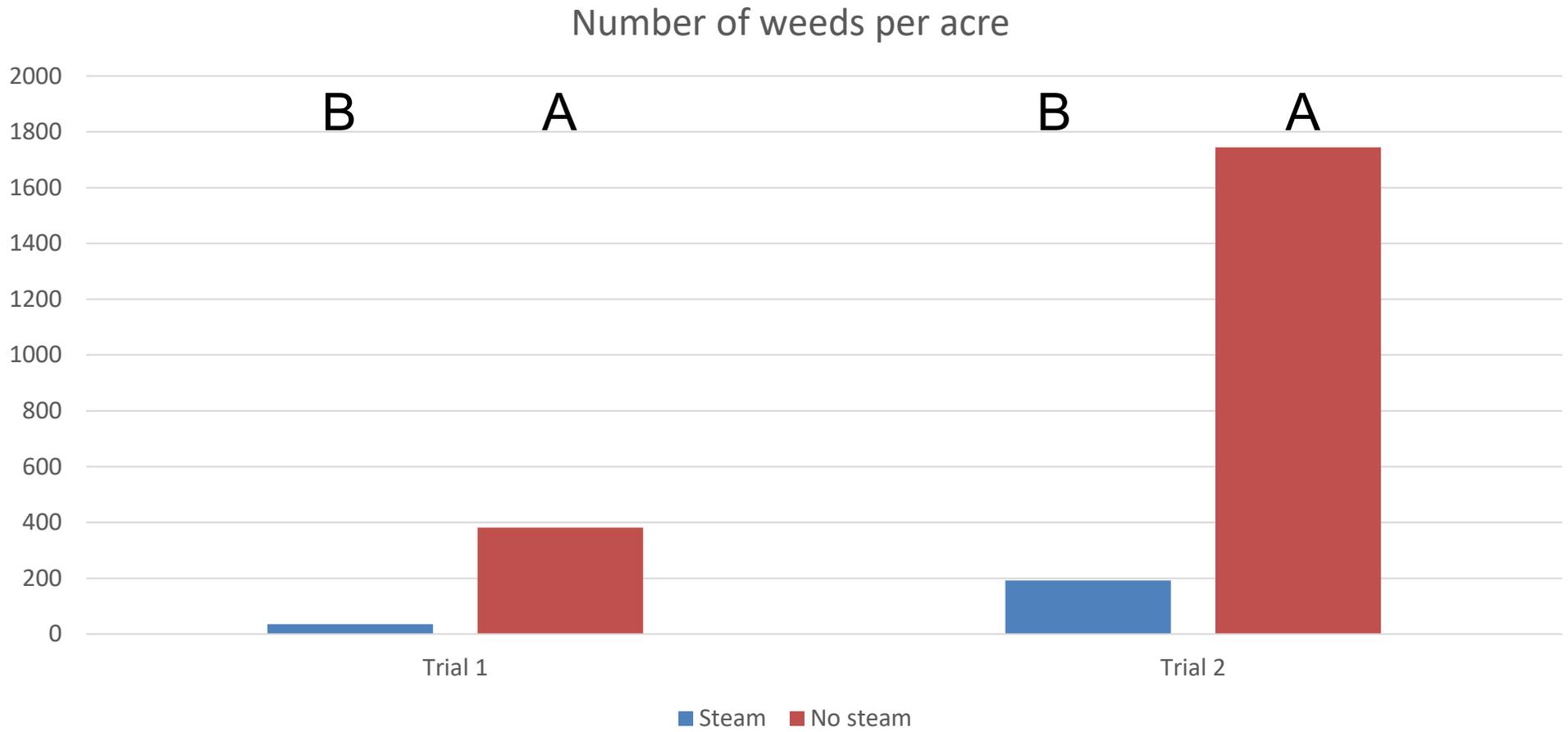


POST 0 CFU/gram soil

PRE 360 CFU/gram soil

Assays by Koike/TriCal Diagnostics

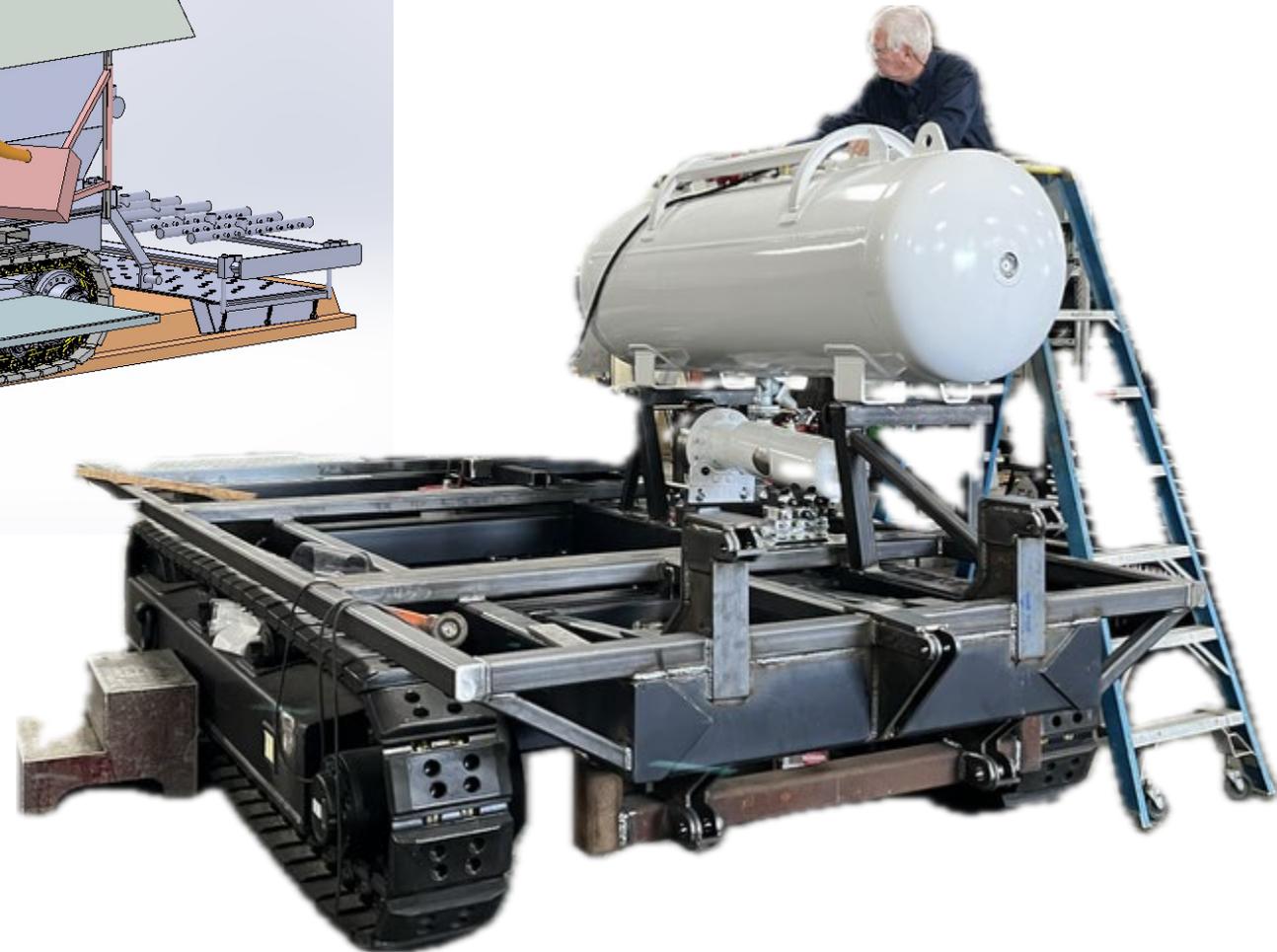
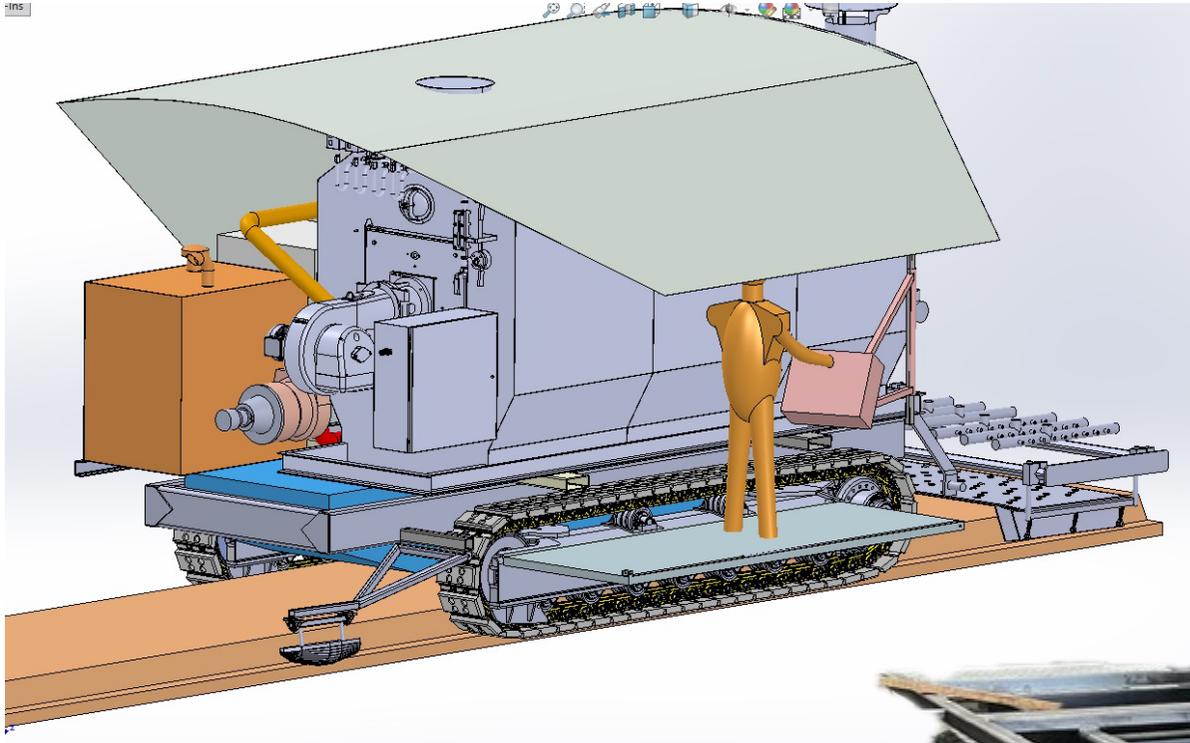
Soledad weeds



Soledad studies

- **Steam suppresses weeds & fusarium**
- **We are running plate & qPCR assays for Fusarium**
- **We are working with the Genome lab in Davis to evaluate the effect on beneficials**

Commercial scale steam applicator



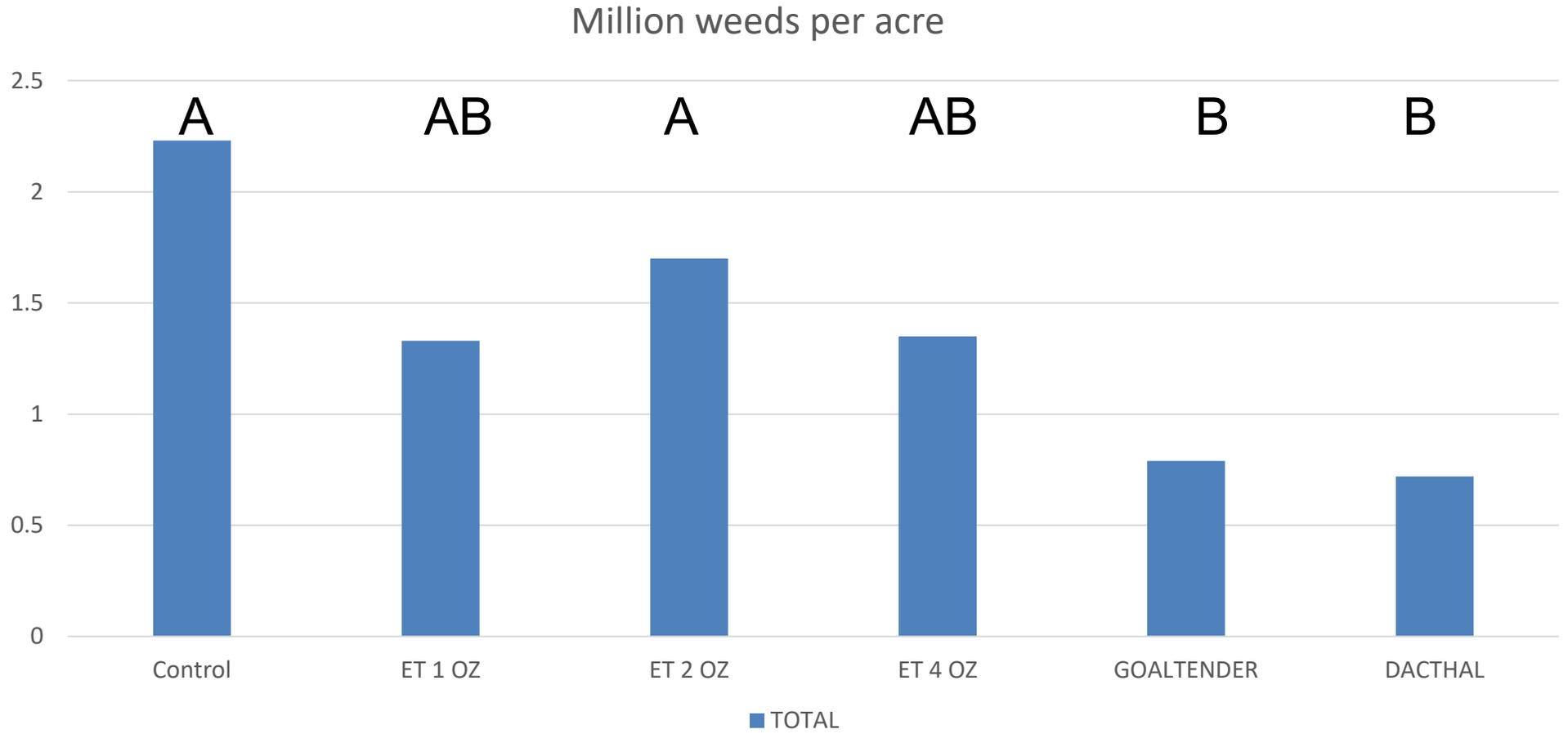
2024 plans

- **Finish the self-propelled steam applicator and test in Yuma during the winter**
- **Return it back to Salinas after Yuma SW Ag expo & run demonstration tests in the Salinas Valley**
- **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**
- **300 gallons of onboard water**
- **50% larger steam generator should allow faster speeds.**

ET evaluation in onion

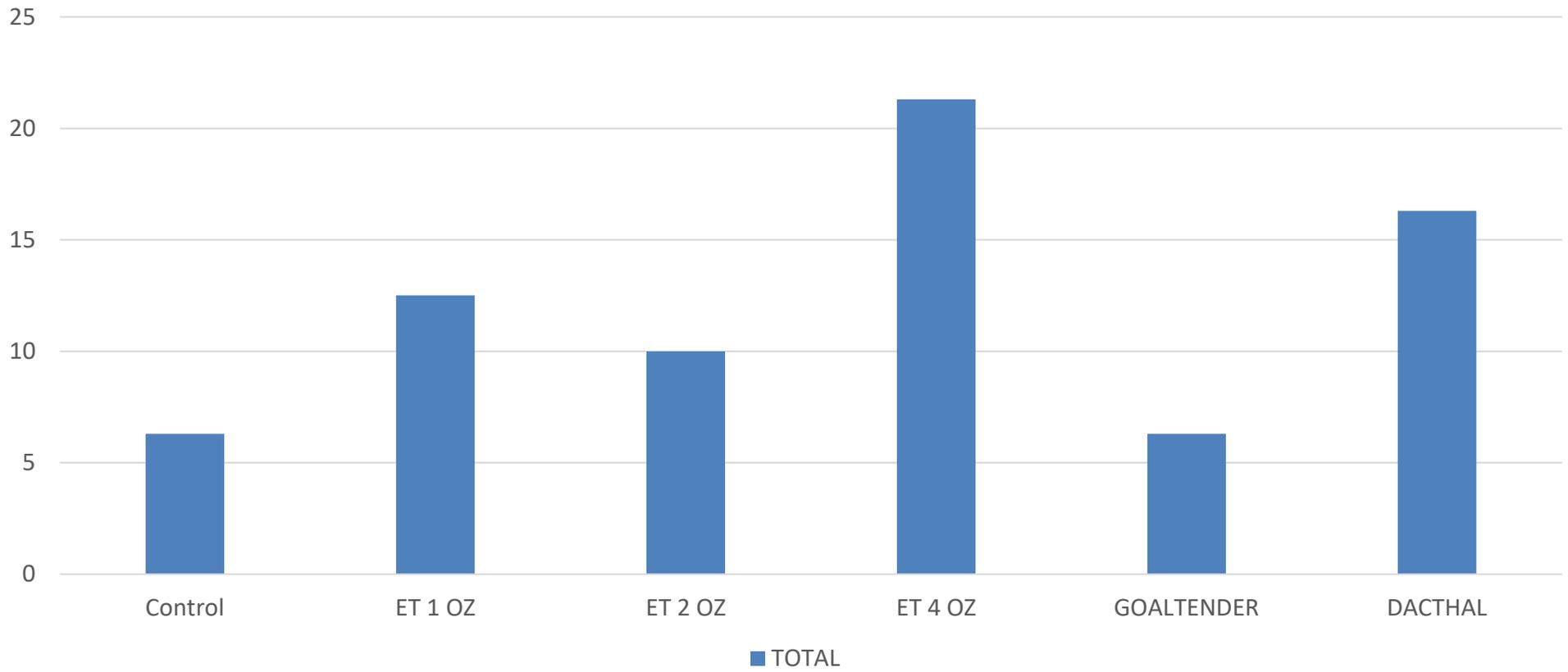
- **ET (pyraflufen-ethyl) was evaluated in onion at Salinas, CA**
- **ET was applied at 1, 2 & 4 fl oz/A to 2 leaf yellow bulb onion 'Great Western'**
- **Standards GoalTender 8 fl oz/A, Dacthal 8 pt/A**
- **Small plot trials single 40 inch bed by 24 ft.**
- **Evaluations were crop injury, weed control and yield**

Total weed densities



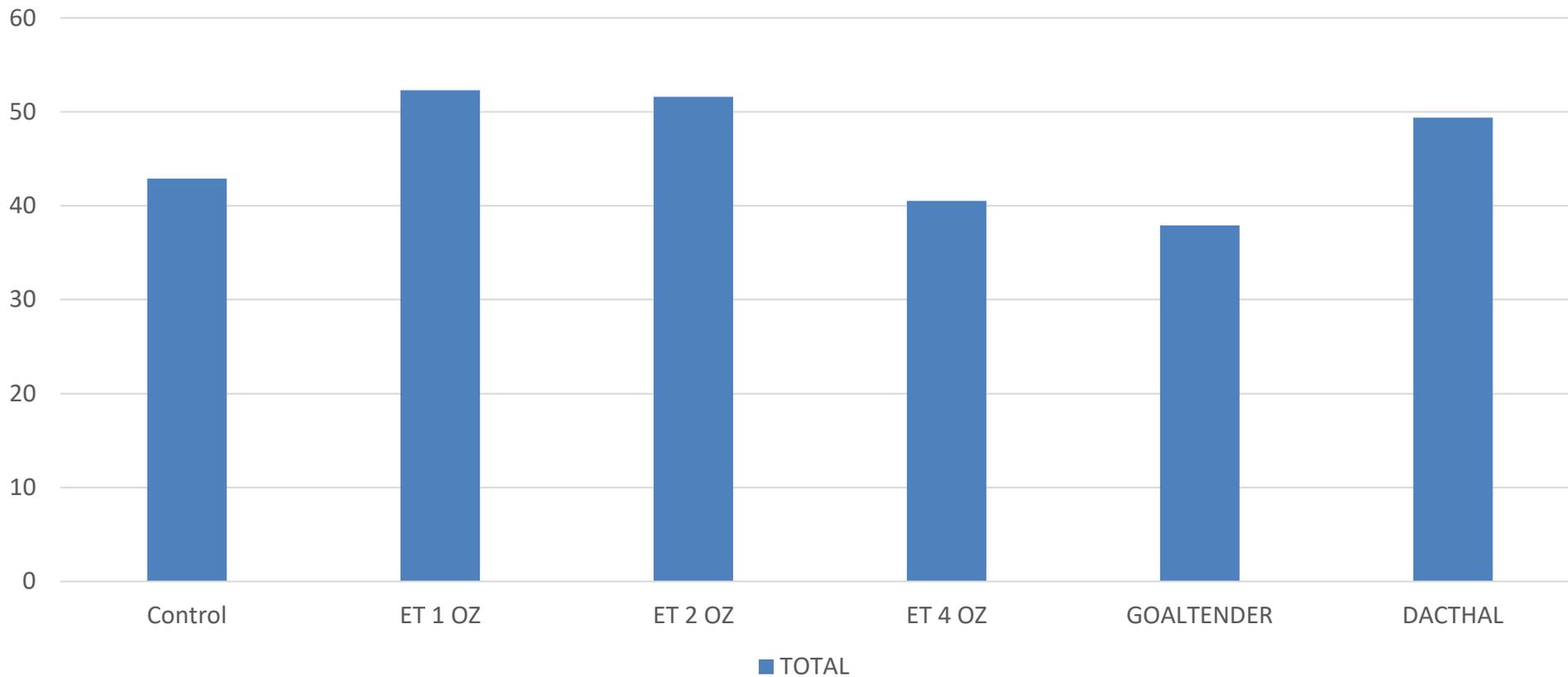
Onion injury 22 DAT

0 = no injury; 100 = dead



Number large 2.5-3" onion 1,000/A

Number bulbs 1,000 Acre



ET compared to Dacthal



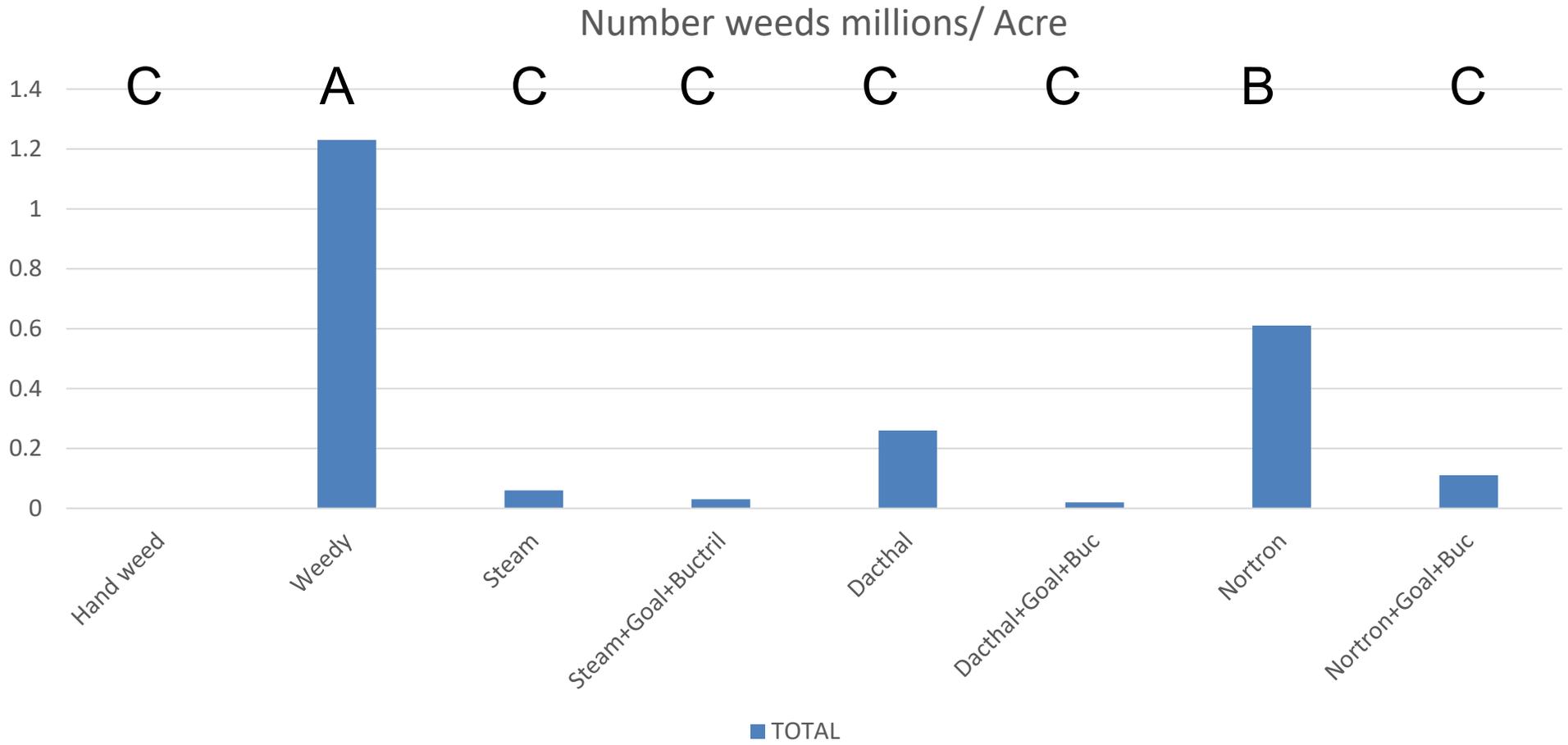
ET conclusion

- **Injury is comparable to GoalTender**
- **ET needs a base treatment of Dacthal or Nortron**
- **Onion yield was not reduced by ET**
- **Recommended for further evaluation and possible registration through IR-4**

Integrated weed management in onion

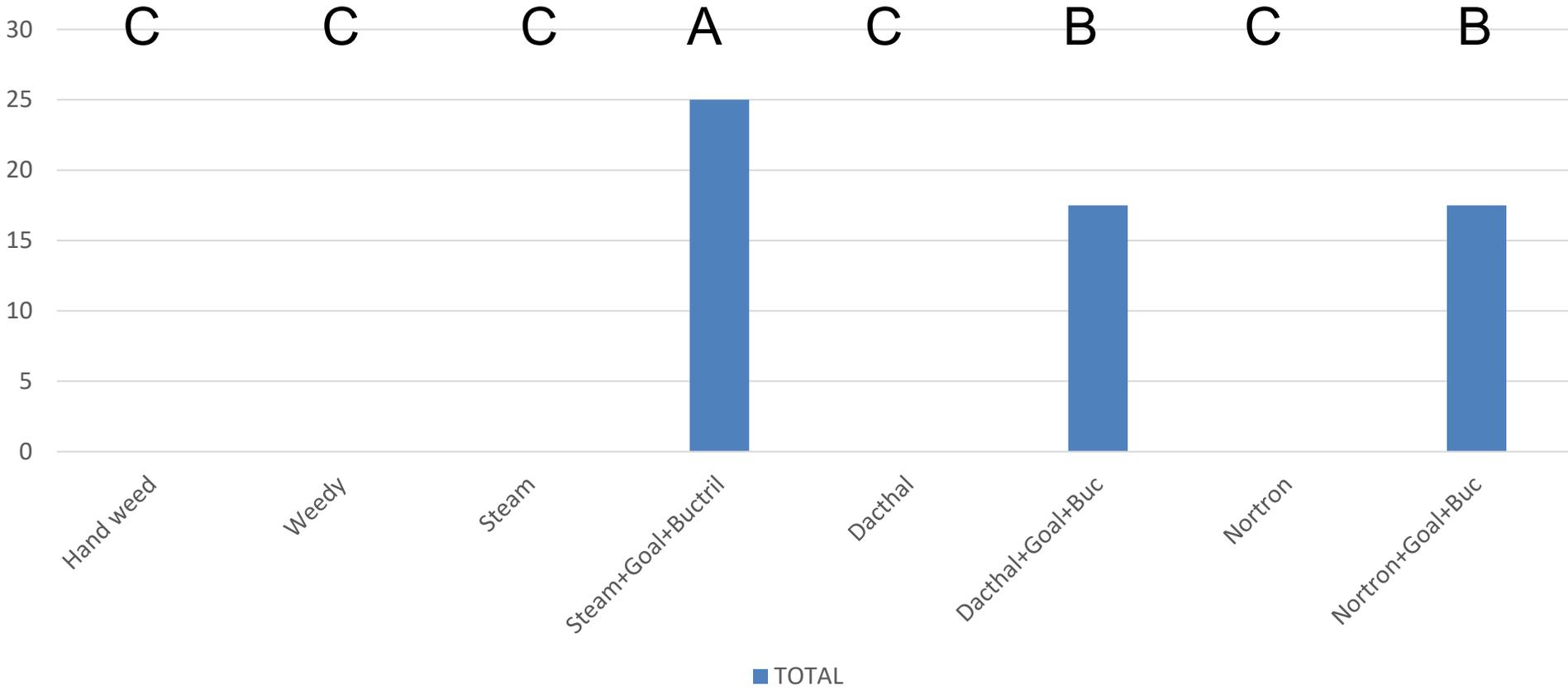
- **Base treatments: Steam, Dacthal 8 pt/A & Nortron 16 oz/A**
- **Sequential treatments of GoalTender 6oz fb Buctril 1 pt/A were made to all base treatments**
- **Yellow bulb onion 'Great Western'**
- **Dacthal & Nortron plots were single 40 inch bed by 30 ft.**
- **Steam plots were 80 inches wide by 60 ft long**
- **Evaluations were crop injury, weed control and yield**

Number weeds millions/A

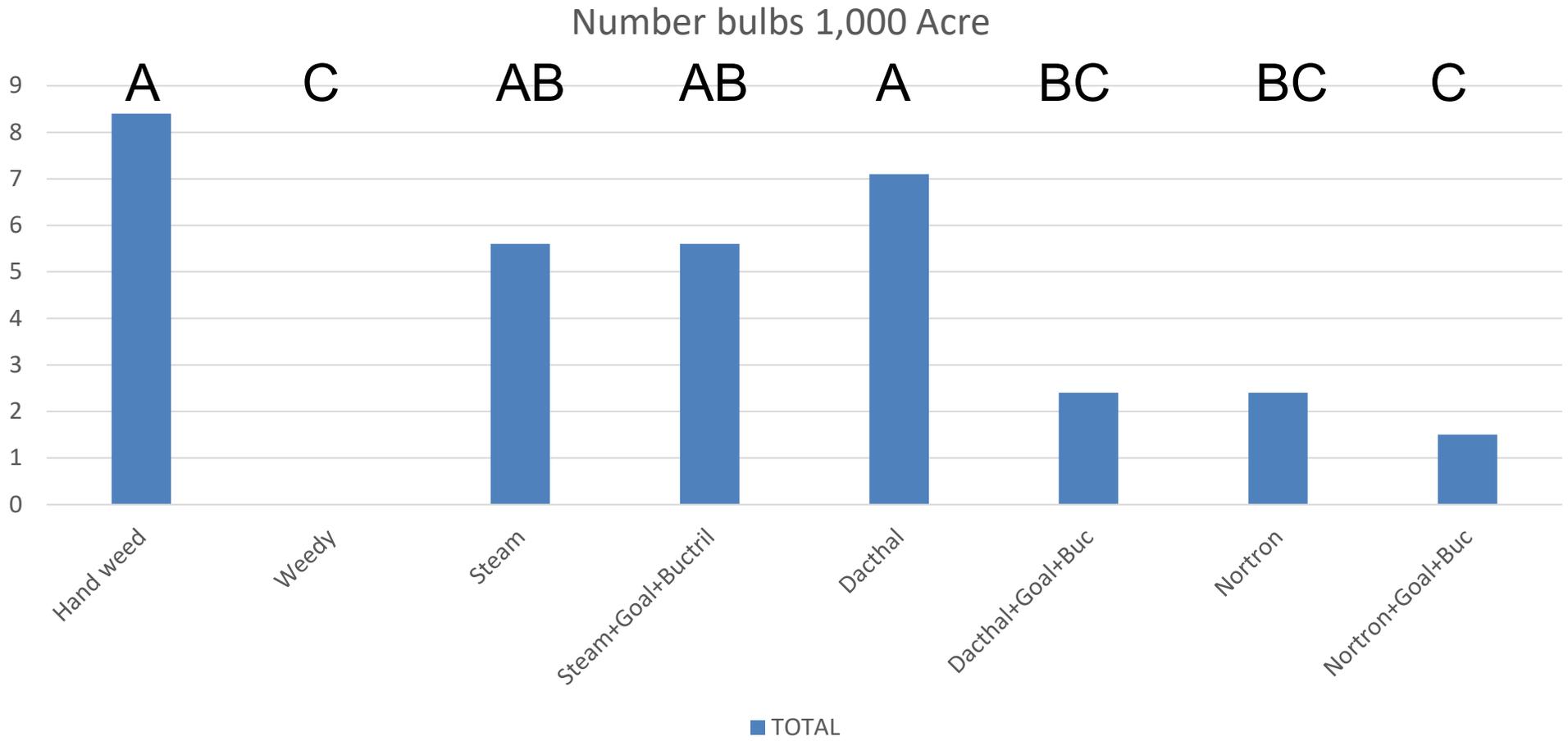


Onion injury % 14 DAT

0 = safe, 100 = dead



Number Jumbo >3" onion 1,000/A





Steam summary

- **Steam is an effective base treatment for onion comparable to Dacthal**
- **Nortron is a possible replacement for Dacthal PRE on onion, but it is not as effective on weeds as Dacthal**

Spinach studies

- **80” bed spinach at field station**
- **Laser weeder with and without Ro-Neet**
- **Ro-Neet alone**
- **Replicated 4 times**

Weed control in Spinach

Weed densities and hand weed time

