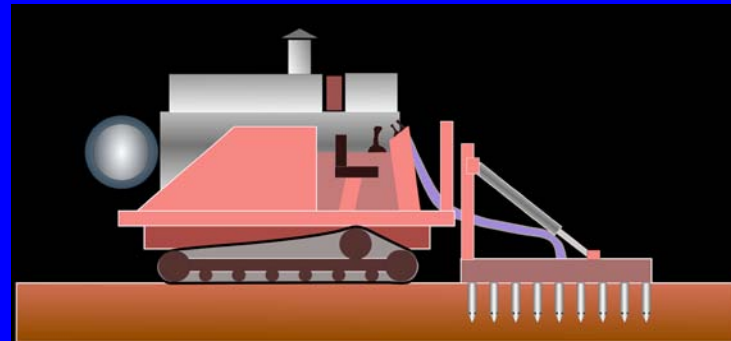


Soil Disinfestation with steam

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



Basics of pest management

- ◆ Prevention:

- keep new pests out of clean fields

- ◆ Eradication:

- Requires years of persistent effort

- ◆ Control:

- Fumigants?
 - Steam?
 - Anerobic soil disinfestation?

Basics of pest management

- ◆ Prevention:

- keep new pests out of clean fields

- ◆ Eradication:

- Requires years of persistent effort

- ◆ Control:

- ~~Fumigants?~~

- Steam?

- Anerobic soil disinfestation?

Steam is a “device” not a pesticide

- ◆ A product is a *pest control device* (or "device") if it uses only physical or mechanical means to trap, destroy, repel, or mitigate any pest and does not include any pesticidal substance or mixture of substances.
- ◆ <http://www.epa.gov/opp00001/factsheets/devices.htm#5>

Points

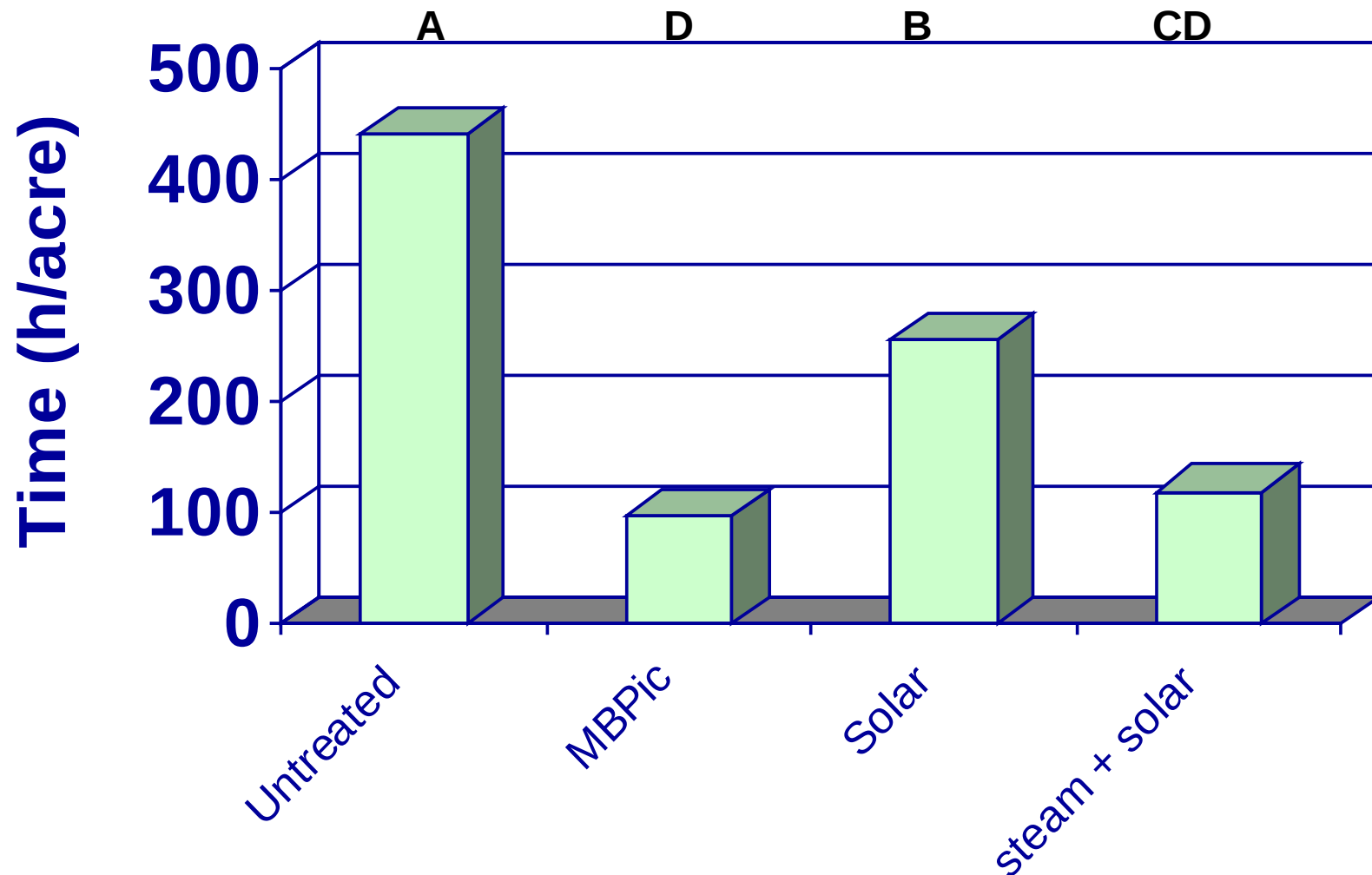
- ◆ Steam is effective for soil disinfestation
- ◆ Costs of operation of the Sterilter steam applicator
- ◆ Future objectives target a 27% reduction in labor and fuel costs

Drain steaming – Nipomo, CA



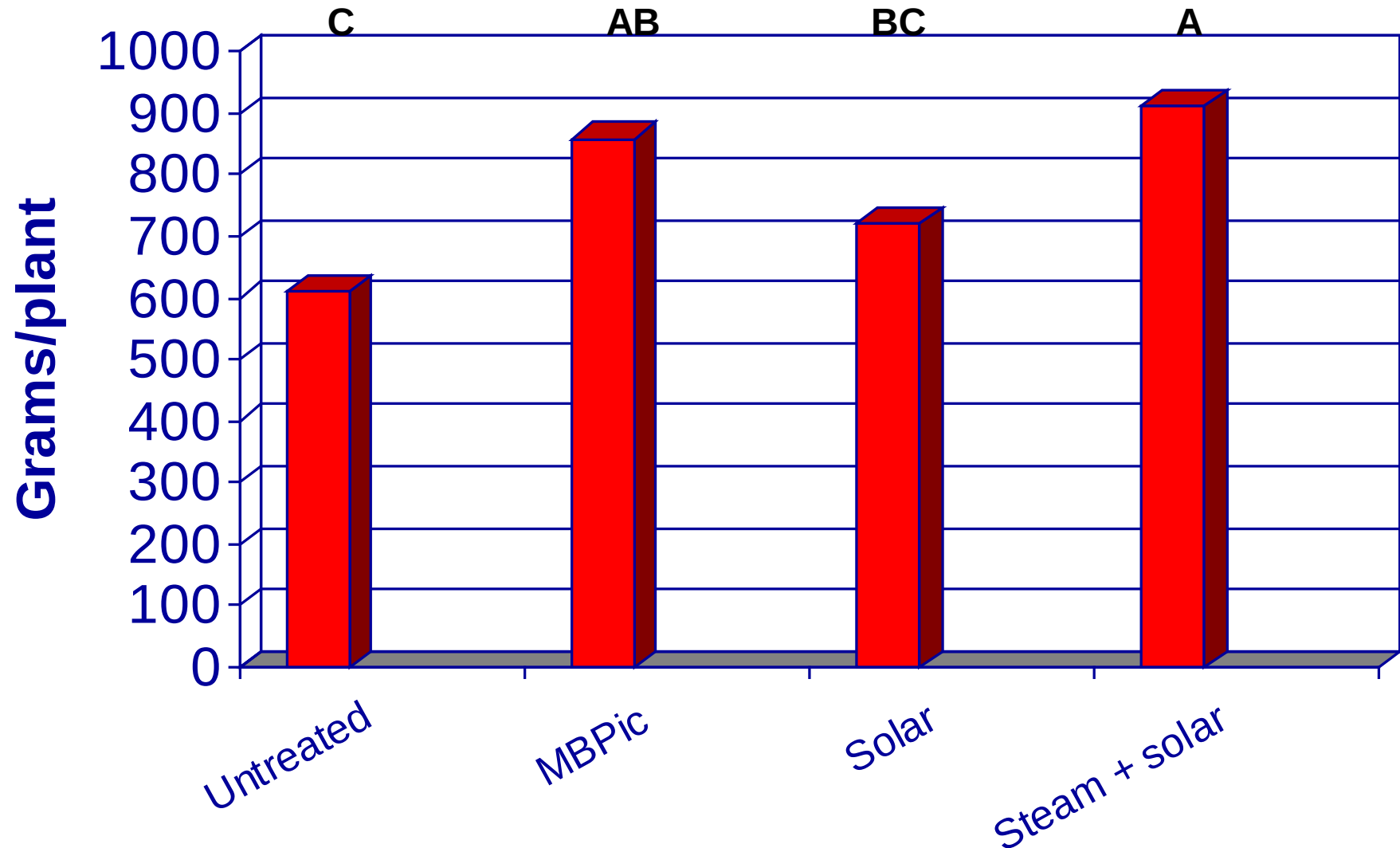
B. Hanson

Hand weeding time in strawberry (Salinas), 2008-09



LSD = 0.05

Strawberry yield at Salinas 2008-09



LSD = 0.05

2008-09 Steam evaluation in strawberry



Control

Methyl bromide

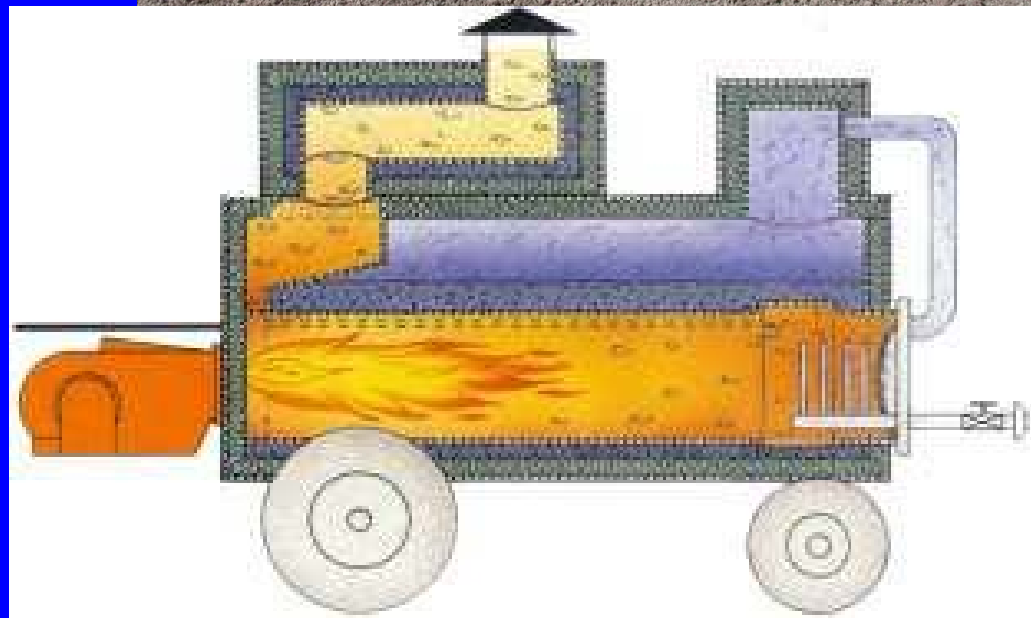
Steam + Solar

Solar alone

Sandwich steaming



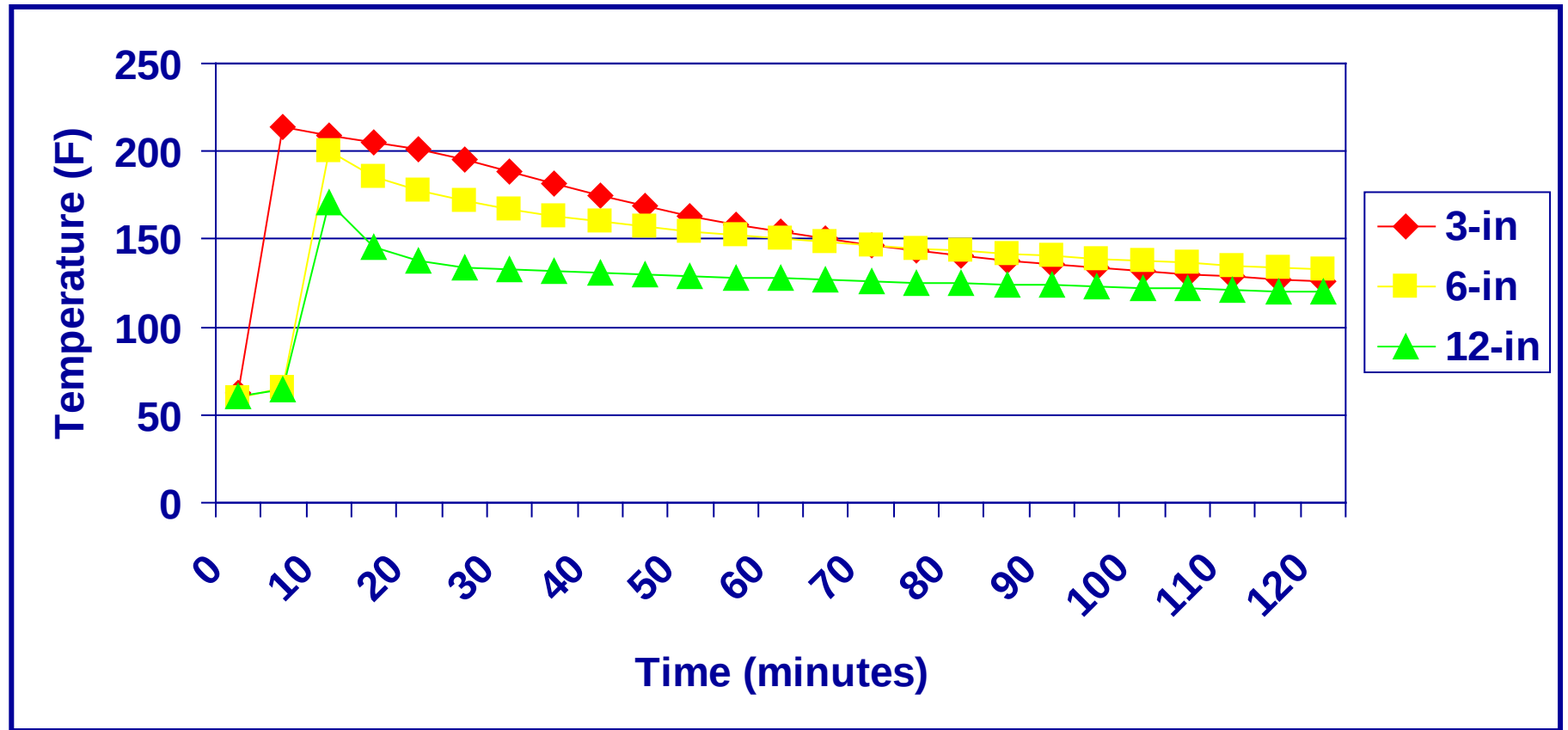
Hood 100-in x 74-in
99 spikes 10-in
4 outlets/spike



Why the Sterilter is different

- ◆ Super heated steam – heats soil fast 5-7 minutes.
- ◆ Short distance from boiler to soil (6 ft).
- ◆ Injects steam 9 inches in the soil effectively treating the top 12 inches.
- ◆ Operates automatically – low labor input.
- ◆ However, the unit we have is slow. There are larger models and we are discussing several modifications such as bed steaming.

Sterilizer soil temperatures

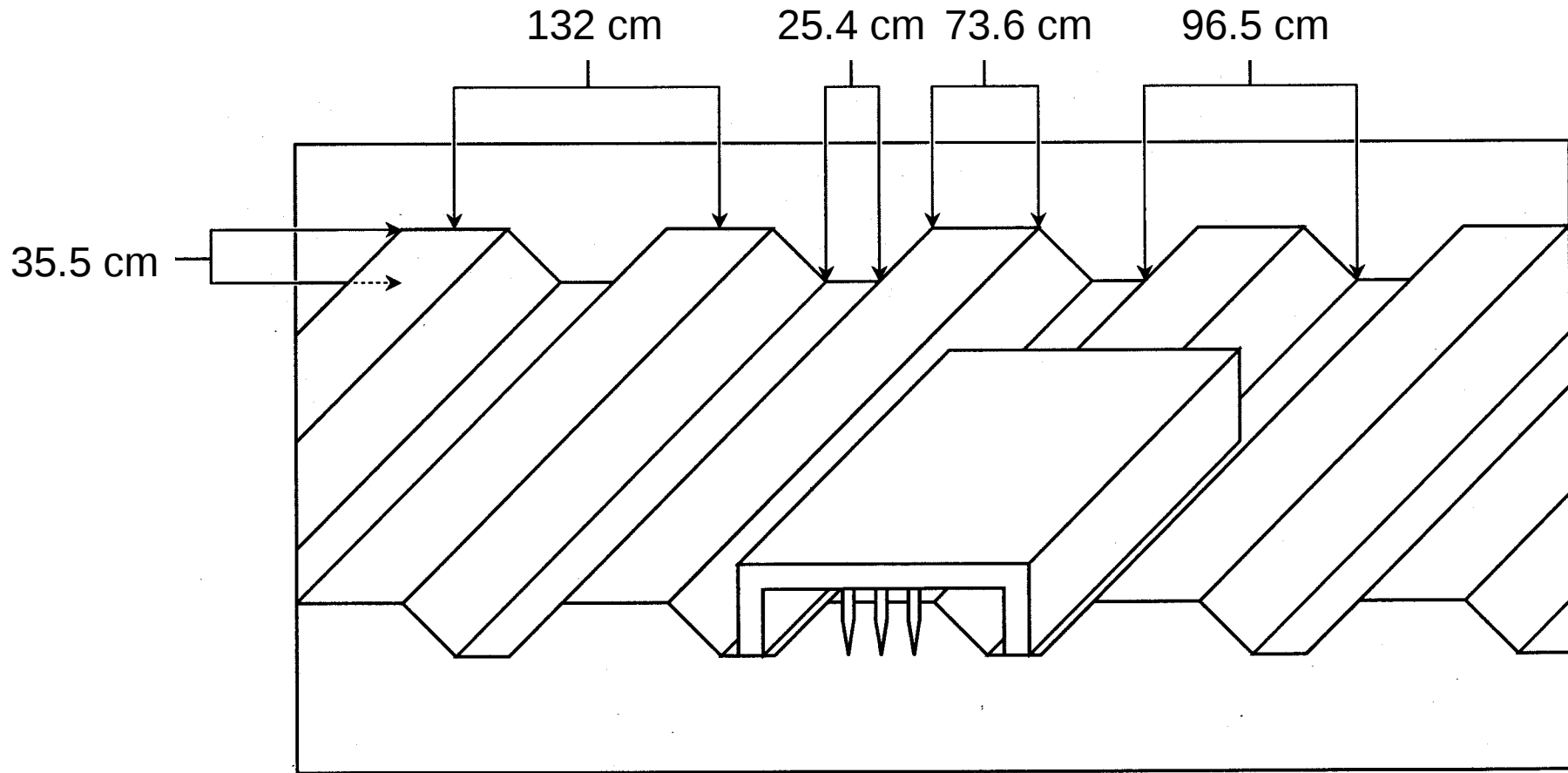


Nov. 2, 2009

Operation costs for Sterilter

Item	Cost \$/A
Diesel (\$2.28/gal)	2,303
Labor (\$17.35/hr)	1,488
Machine (3 yr dep.)	\$478
Total	\$4,269

Design for a steam hood for 52-in beds



Reconfiguration: 33 spikes per bed X 74-in long X 3 beds = 54 hr/A with the S500

With the S950 unit it should be possible to do 1 acre/day

Bed steaming – future objective

- ◆ Our objective is to increase steaming time and fuel efficiency by 27% per acre. Insulation of the steam hood will also increase fuel efficiency.
- ◆ Bed steaming can also increase labor use efficiency and decrease machine costs per acre.
- ◆ A larger machine can also increase labor use efficiency.
- ◆ Switch to propane to reduce impacts on air quality.

Almonds

- ◆ Almond tree replant – fumigants are used to protect young trees from diseases such as *Armillaria*, *Phytophthora* ect.
- ◆ Greg Browne (2008) found that spot applications of chloropicrin in the tree site protected the newly planted tree.

Almonds- hypothesis

- ◆ Steam treatment of a tree site 3 ft wide by 2 ft deep will protect a young almond tree.
- ◆ Almonds are planted at densities of 90 or more trees per acre.

B.C. Canada

Apples- replant protection

- ◆ We are using an auger design to inject steam that was developed in Canada by Moyls and Hocking (1994).
- ◆ They designed a system to inject steam into a rotating auger that agitates soil as it is steamed – but the soil is not removed from the hole.
- ◆ Moyls and Hocking were able to steam treat a tree site in 1 or 2 minutes per site.
- ◆ The Moyls and Hocking estimated the costs at \$1.05 US per tree site.

Moyls & Hocking auger design

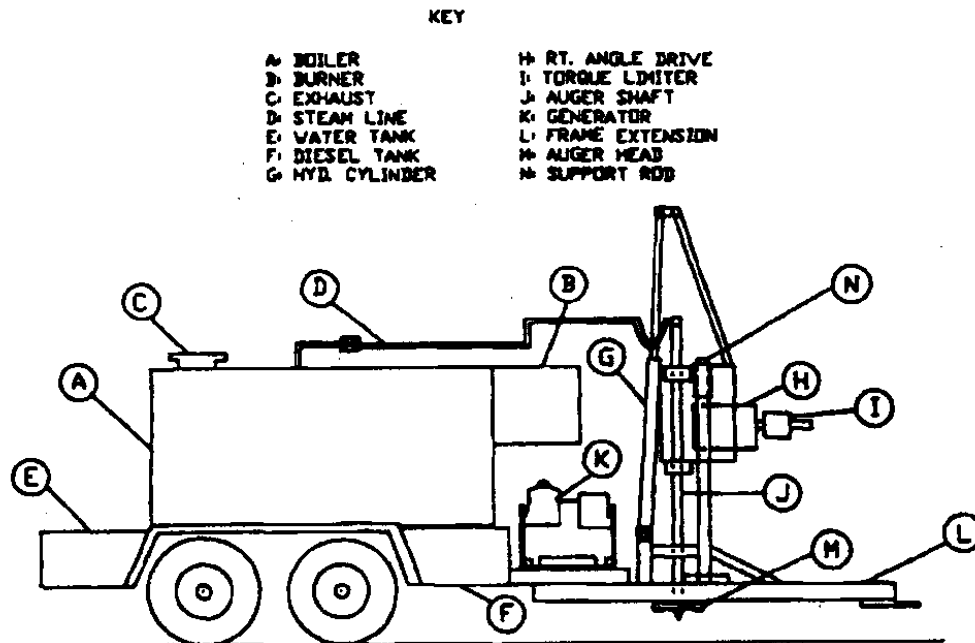


Figure 2—Schematic of steaming unit.

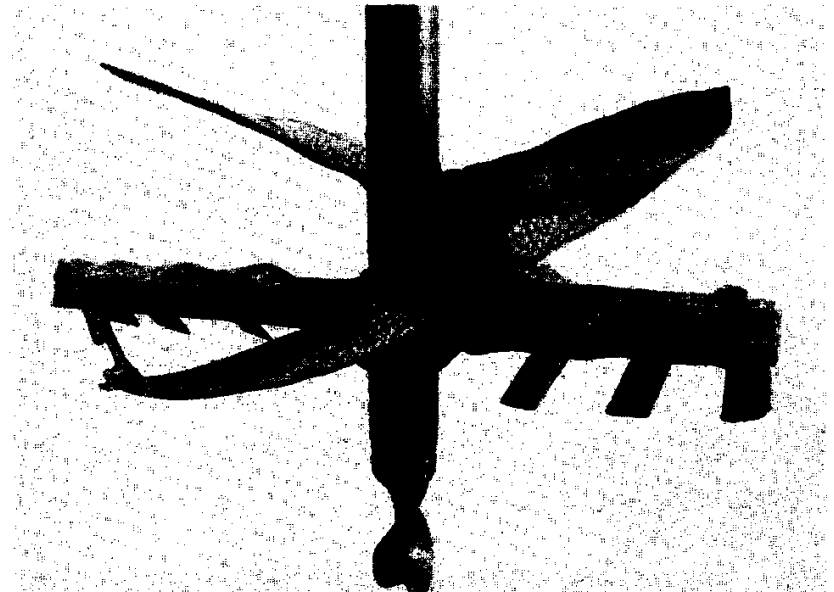
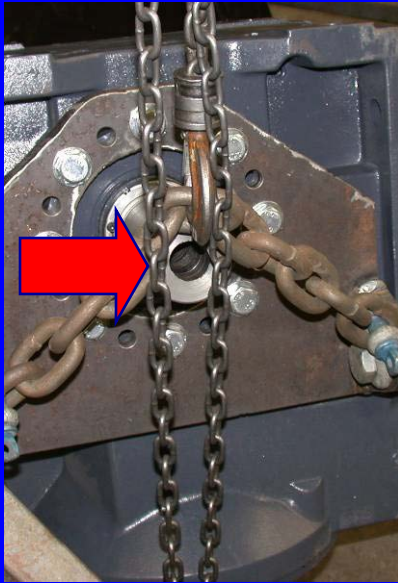


Figure 3—Close-up of steam auger head, showing steam holes.

Our auger design

Hollow shaft



Almonds

- ◆ At 90 trees per acre means we are treating 7.1 ft² per tree site or 636.2 ft² per acre (1.5% coverage).
- ◆ Allowing 5 minutes per tree site treatment of 1 acre would require 7.5 hours.

Estimated costs to steam tree sites

Expense	Cost \$/A	Cost \$/site
Propane	190	2.11
Machine	325	3.61
Labor	132	1.47
Total	646	7.19

Almonds - conclusion

- ◆ The auger steam injection system looks promising. Potential costs are < \$650/acre.
- ◆ The keys to reducing the costs will be to reduce machine costs and increase labor use efficiency.
- ◆ Two key factors of this application are:
 - Only 1.5% of the field area is treated
 - The auger serves as a soil agitator which increases the efficiency of steam distribution in the tree site.

Conclusion/ Ideas

- ◆ The auger steam injection system looks promising. Potential costs are < \$650/acre.
- ◆ Can we develop a similarly efficient system for strawberry?
- ◆ How much of the strawberry field do we need to treat?
- ◆ The steam system appears most practical in organic situations to treat “problem” areas of the field.