Sustainable strawberry production

Steve Fennimore

University of California-Davis, Salinas, CA

Sustainable strawberry production

- Future of fumigation
- Define sustainable strawberry production
- Substrate production
- Soil disinfestation
- Improved soil management
- Summary
- Sustainability in the sense of IPM

Fumigation

- **Fumigants are likely to be more restricted in the future. This is not a new trend.**
  - **Regulations requiring less and less emissions, larger buffer zones, more sensitive sites, lower rate caps, worker safety regulations, VOCs and more …**
  - **Neighborhood and activist lawsuits against fumigation..**
- **Strawberry production systems that do not use fumigants are needed.**

Sustainability

- **“Farming systems that are capable of maintaining their productivity and usefulness to society indefinitely.” Mary Gold, Alternative Farming Systems Information Center.**
- **Methyl bromide fumigation as practiced in the past is no longer a long-term sustainable practice.**
- **We simply cannot drop fumigants and go 100% organic as some have suggested, as that is not sustainable either.**

What are sustainable strawberry systems?

- **Sustainable strawberry systems:**
  - **Allow the grower to remain profitable**
  - **Are reliable and consistent**
  - **Do not produce excessive nutrient runoff, emit pollutants or cause soil erosion or soil degradation**
  - **Produce a healthful quality fruit that the consumer wants**
  - **Are compatible with the current land tenancy**

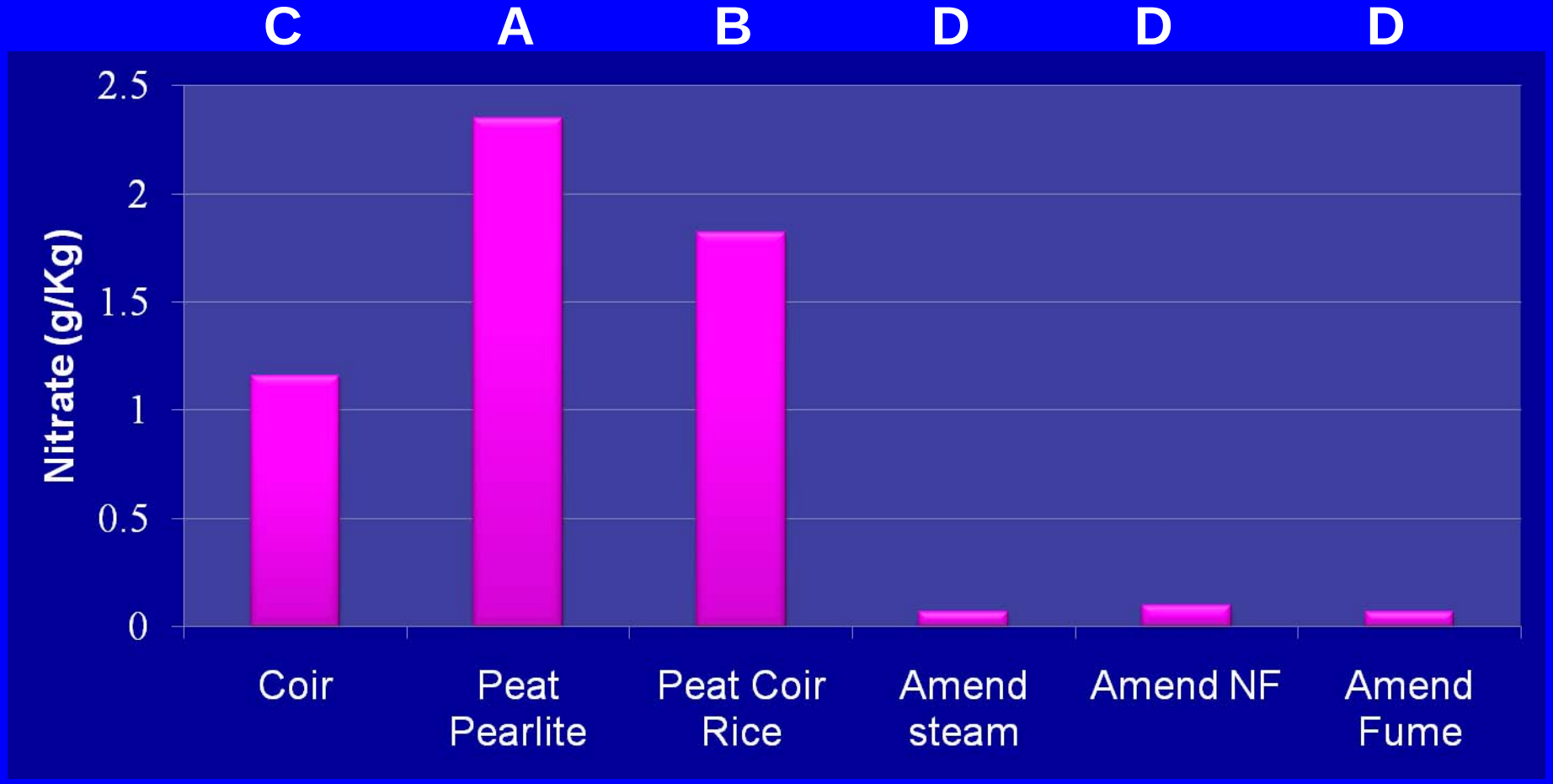
Potential sustainable strawberry production systems

- Strawberry production in substrates
- Healthy soils
  - Soil amendments such as mustard seed meal
  - Management of soil microbial communities
- Soil disinfestation without fumigants
  - Anaerobic soil disinfestation (ASD)
  - Steam, heat
- Other ideas?

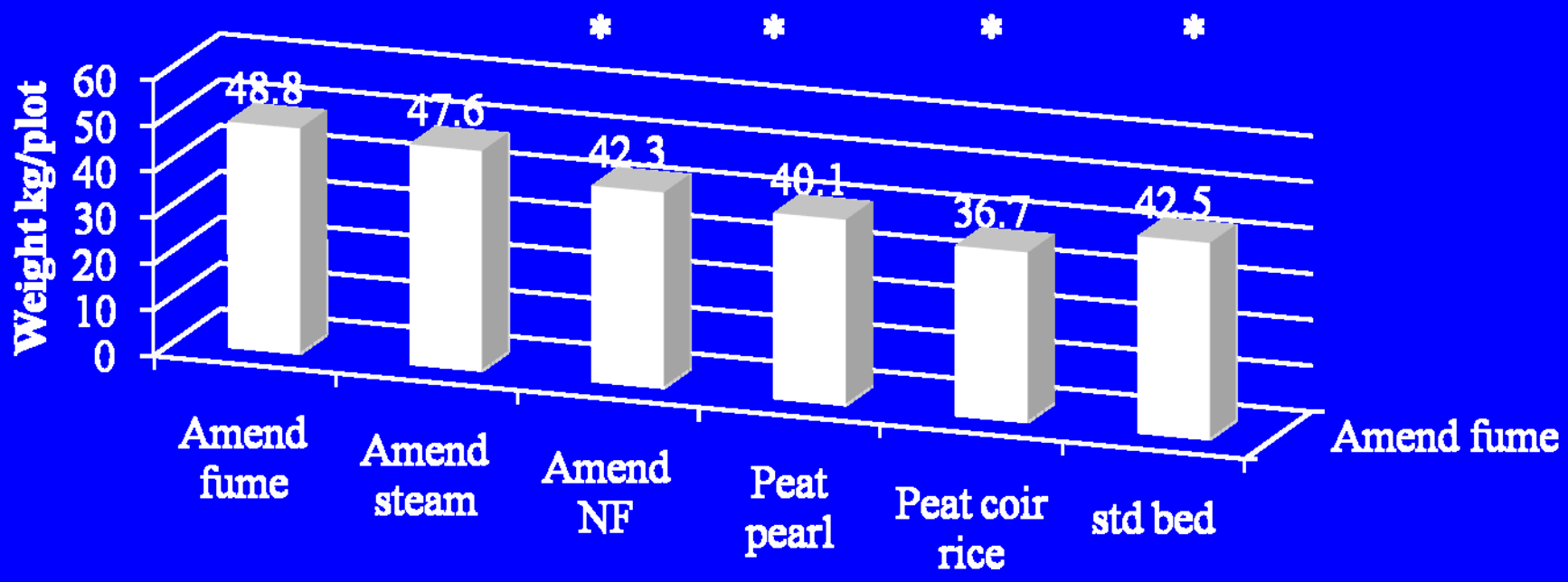
2009-10 RaBeTS trial

- Amended soil 50% + rice hulls 25% + coir 25%
- Peat 70% + Pearlite 30%
- Coir 100%
- Peat 50% + Coir 25% + Rice hulls 25%
- Standard Bed fumigated with MBPic or Pic
- All substrates had low, medium and high starter fertilizer

May 24, 2010 MBA nitrate status-medium preplant fertilizer



Fruit yield MBA



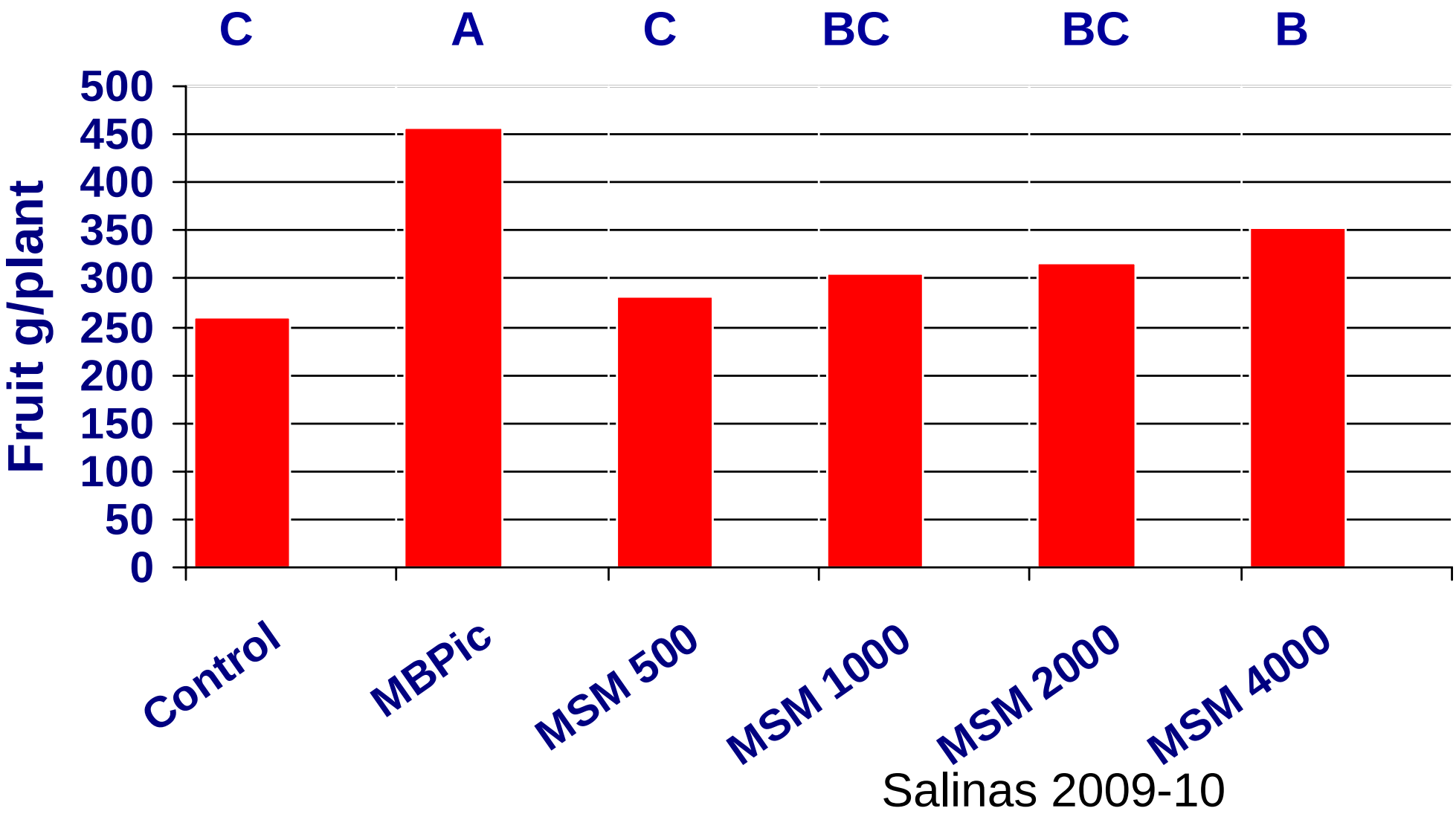
Summary - substrates

- Peat, coir and peat/coir/rice all appeared to retain NO_3 similarly.
- Acceptable strawberry yields can be produced on substrates and amended soils.
- It is probably time to develop a budget so that the costs can be evaluated.
- We also need to look at the mobility of this system given that much of the land is leased.

Healthy soils

- The objective is to cultivate soils in a healthy soil environment.
- In practice this would mean management of the field in such a way that minimizes pathogen infestation and increases beneficial organisms.
- Includes soil amendments, microbial inoculants and others….

Strawberry fruit yield response to mustard seed meal



Salinas 2009-10

Mustard meal results

- Weed control with mustard meal was poor.
- Suppression of Pythium with mustard meal was not consistent.
- Yield responded to mustard meal rate at Spence, but not MBA.

Soil disinfestation without fumigants

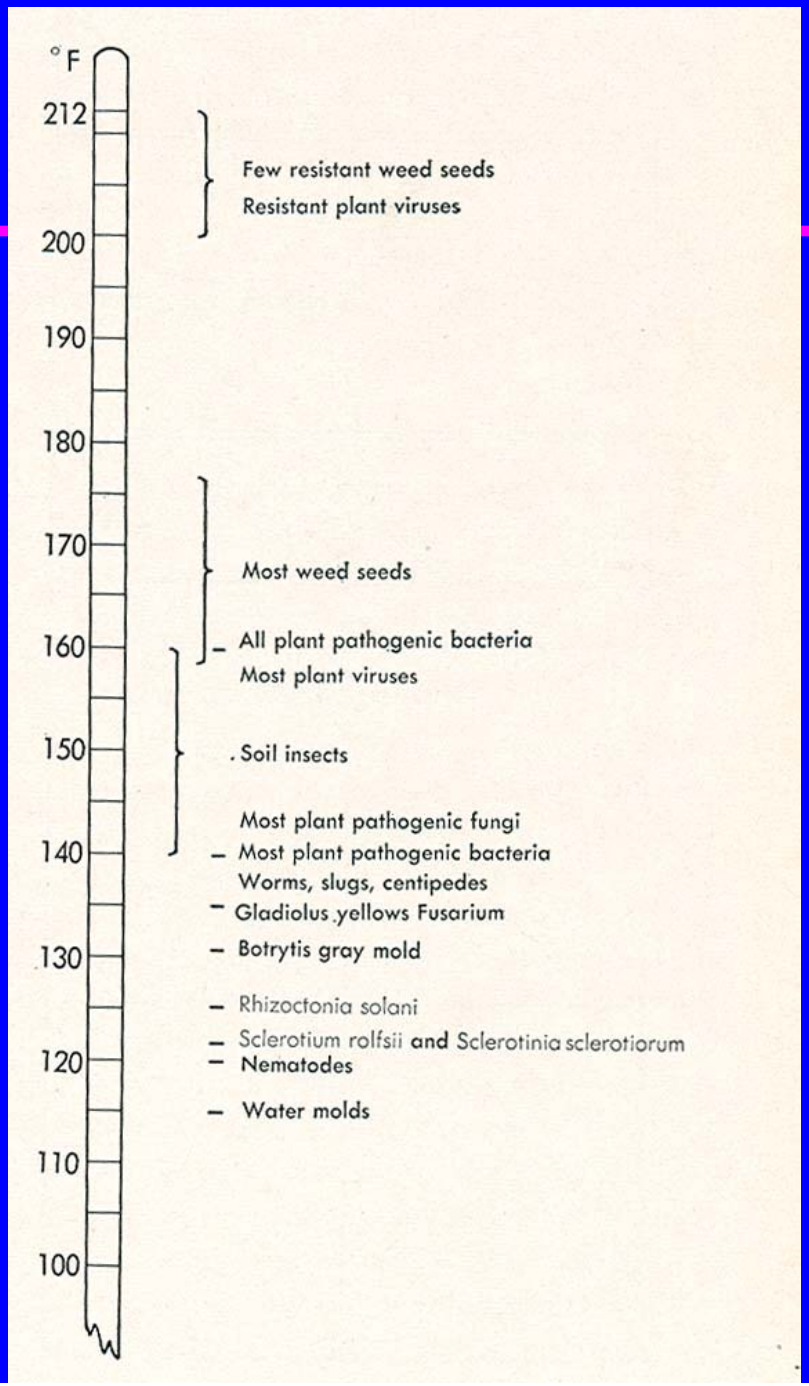
Soil disinfestation

- Control or suppression of pathogens and weeds in the soil.
- Fumigants have been used for this purpose for decades.
- Non fumigant methods of soil disinfestation:
  - Anaerobic soil disinfestation
  - Steam
  - Heat

Anaerobic Soil Disinfestation (ASD)

- ASD was developed in the Netherlands and Japan as an alternative to MB fumigation.
- ASD requires an organic carbon source, covering & irrigating to saturate the soil to create conditions for anaerobic decomposition of the organic carbon.
- The byproducts of anaerobic decomposition have proved toxic to many fungal pathogens and nematodes.

Shennan and Murimoto



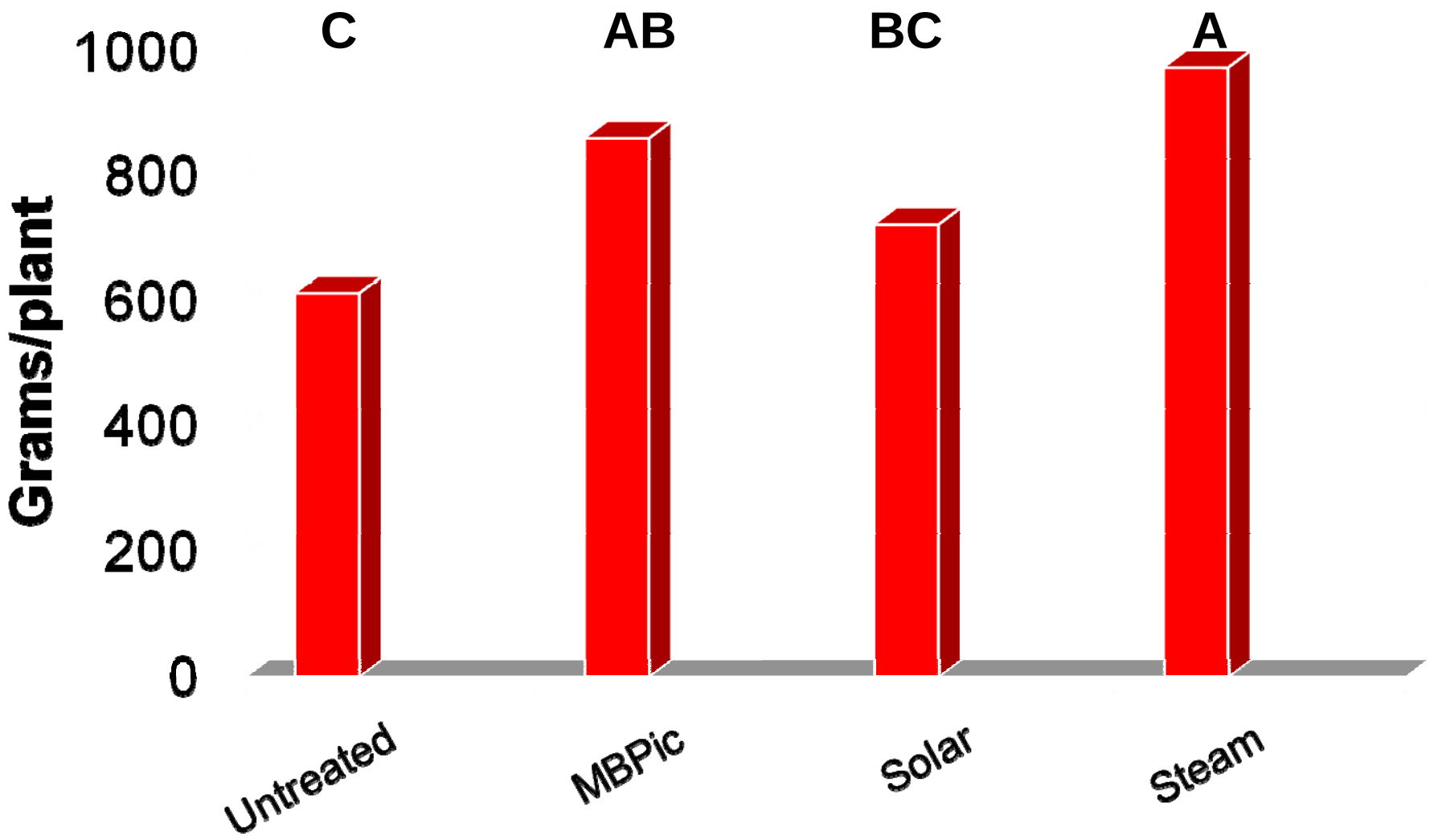
Steam

Steam applied to heat soil to >158°F for 20 minutes will kill most pathogens, nematodes and weed seed.

K.F. Baker, 1957

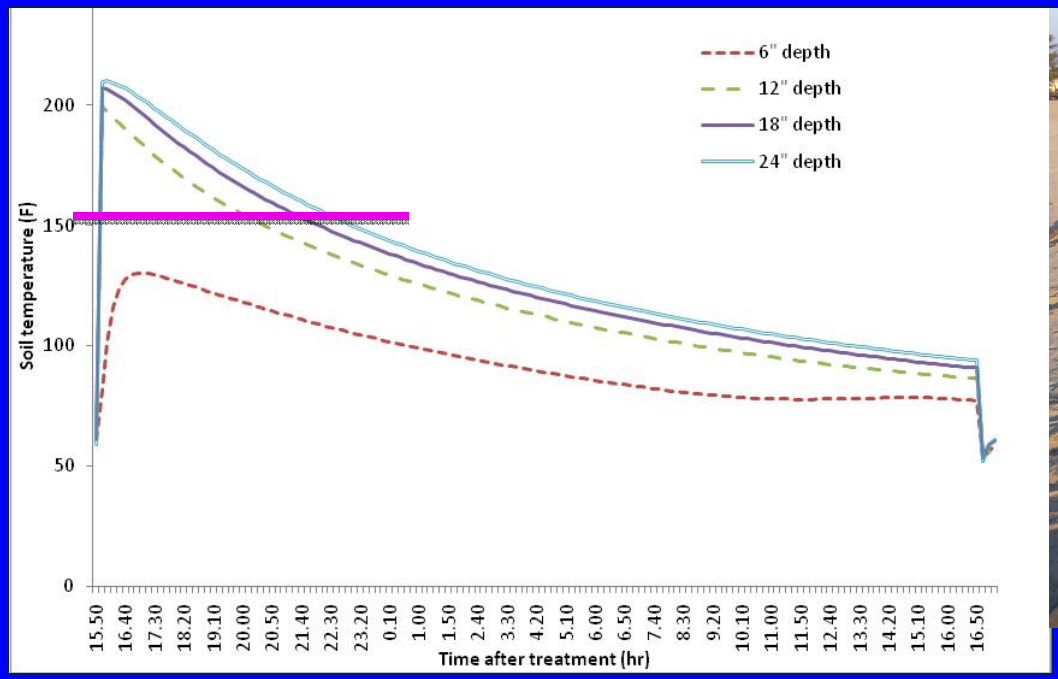
Strawberry yield at Salinas 2008-09

Steam works

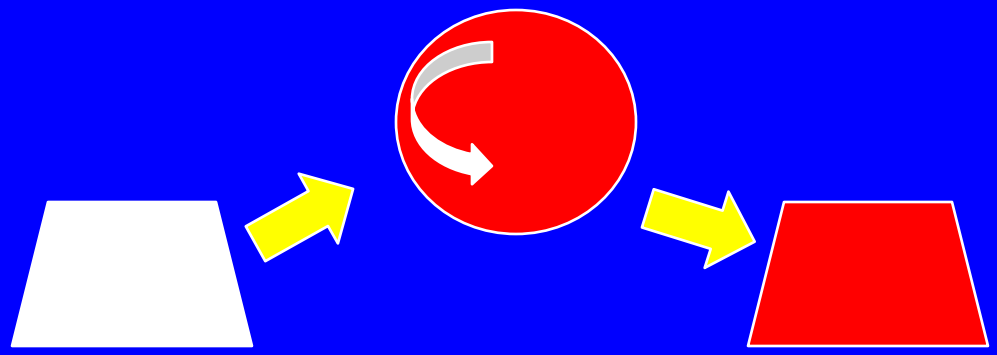


LSD = 0.05

Steam application to moving soil

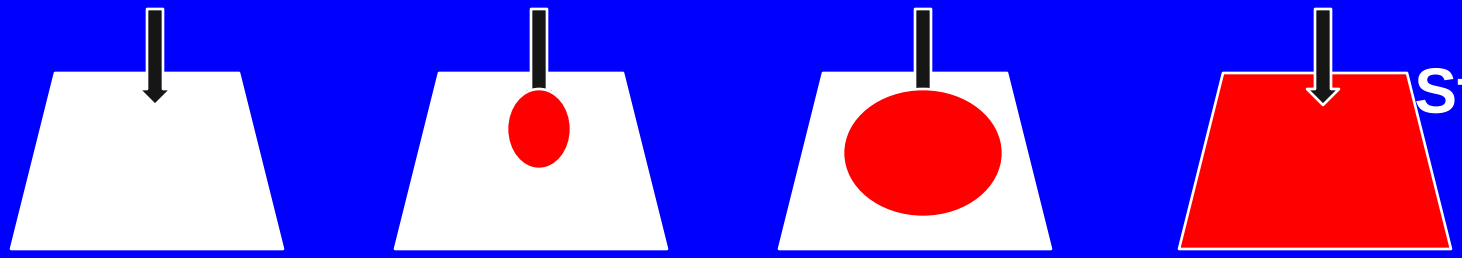


Steaming soil: moving vs. stationary



Time min 0 4 .

Moving soil



Time min 0 5 10 20.

Stationary soil

THE MACHINE AT WORK

Current efforts

- We are currently designing a mobile propane-fired steam applicator.
- Steam will be mechanically mixed with the soil.
- Our goal is to treat at least 1 acre per day.

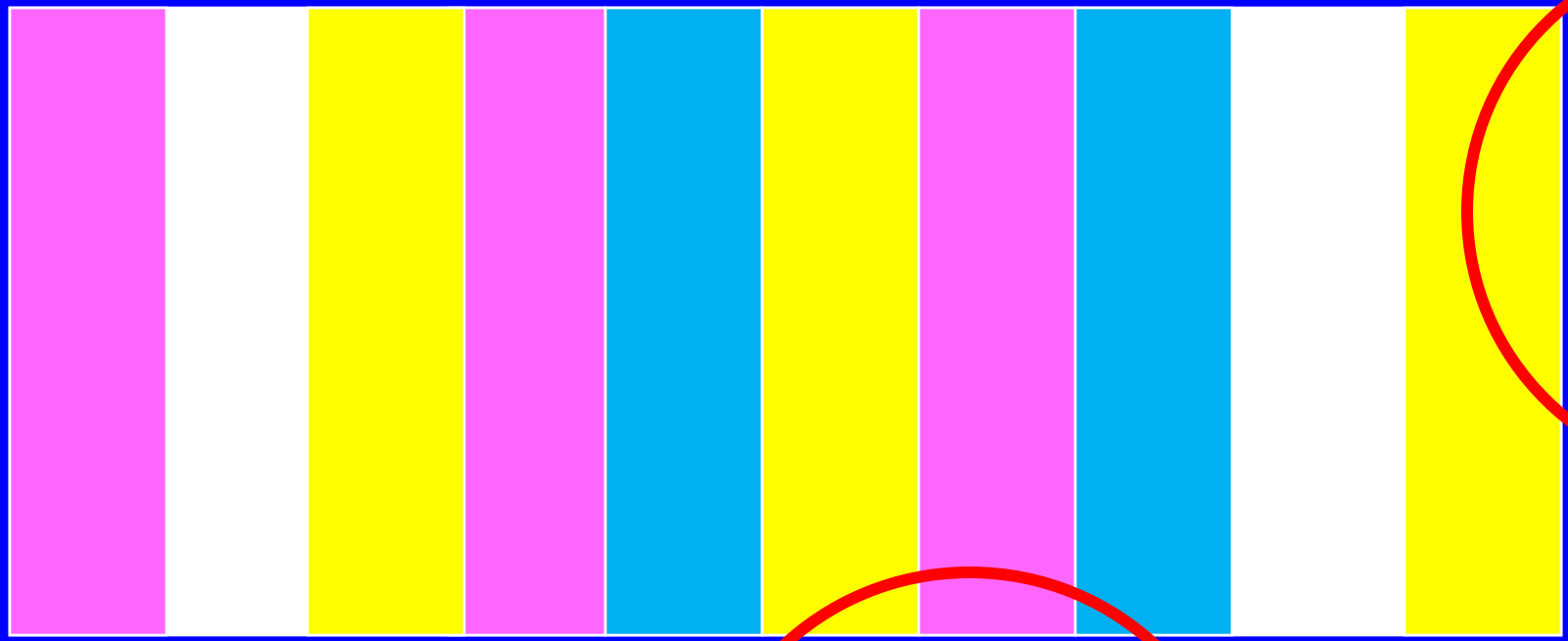
Assumptions

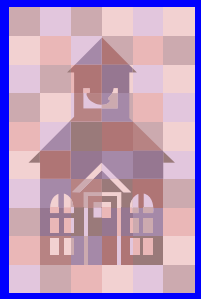
- Fumigants will remain the most cost-effective means for soil disinfestion where they can be used in strawberry fields.
- The percentage of acres that can be fumigated will decline due to regulatory restrictions.
- The need to produce strawberry without fumigants will increase.
- Many different tools are needed to produce strawberry without fumigants.

Areas that can not be fumigated

1. Organic-compliant production fields
2. Areas in fumigant buffer zones
3. Areas where the fumigant needs exceed the township cap limits

A field impacted by sensitive sites





Conclusion/ Ideas

- Substrate production will work, but is it economical and portable on leased ground?
- Is it possible to develop a better soil health management system to clean up an infested field?
- How effective is ASD over large areas? Will water consumption and hills limit the adoption of this method?
- Can a steam generator be developed that is fuel efficient and can treat large areas?
- Can several of these treatments be integrated into one system?

The basics of pest management

- **Field Selection**
  - Field history
- **Prevention**
  - Prevent pathogens and weed seed from entering the field
  - Substrate production
- **Control**
  - ASD
  - Steam