Soil management to sustain strawberry production

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Trends in Southern European strawberry

- Evaluating cultivars for tolerance to pathogens
- Fumigant regulations: Fewer available, Lowering rates and frequency of application

FOCUS:

1) maximize efficacy (tarps, methods of application/equipment, rotation of fumigants)

2) non-fumigant technologies

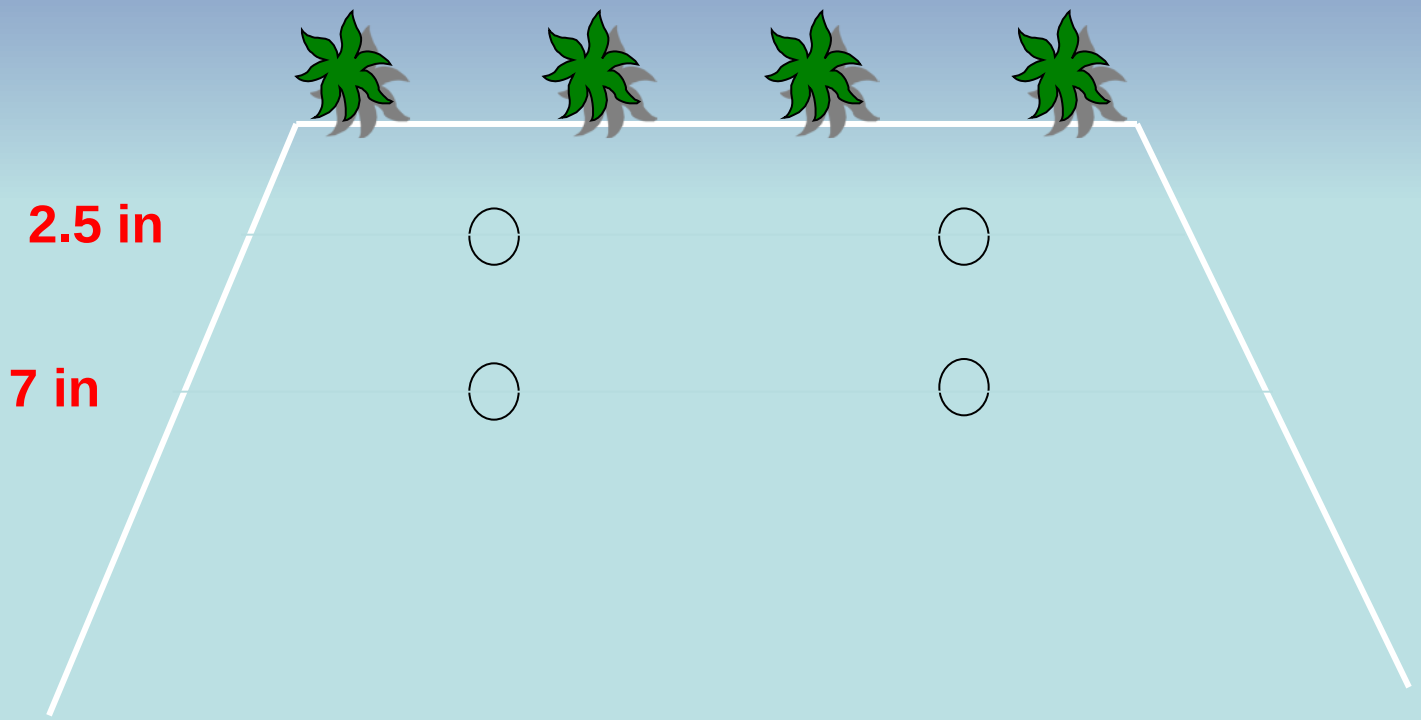
CONVENTIONAL

For better fumigation results

- Flat fumigation at high rates (85-90% control for *M. phaseolina* and *F. oxysporum*)
- Break or remove infested crowns
- Using TIF

Improving fumigant distribution with 2 additional ‘deep’ lines

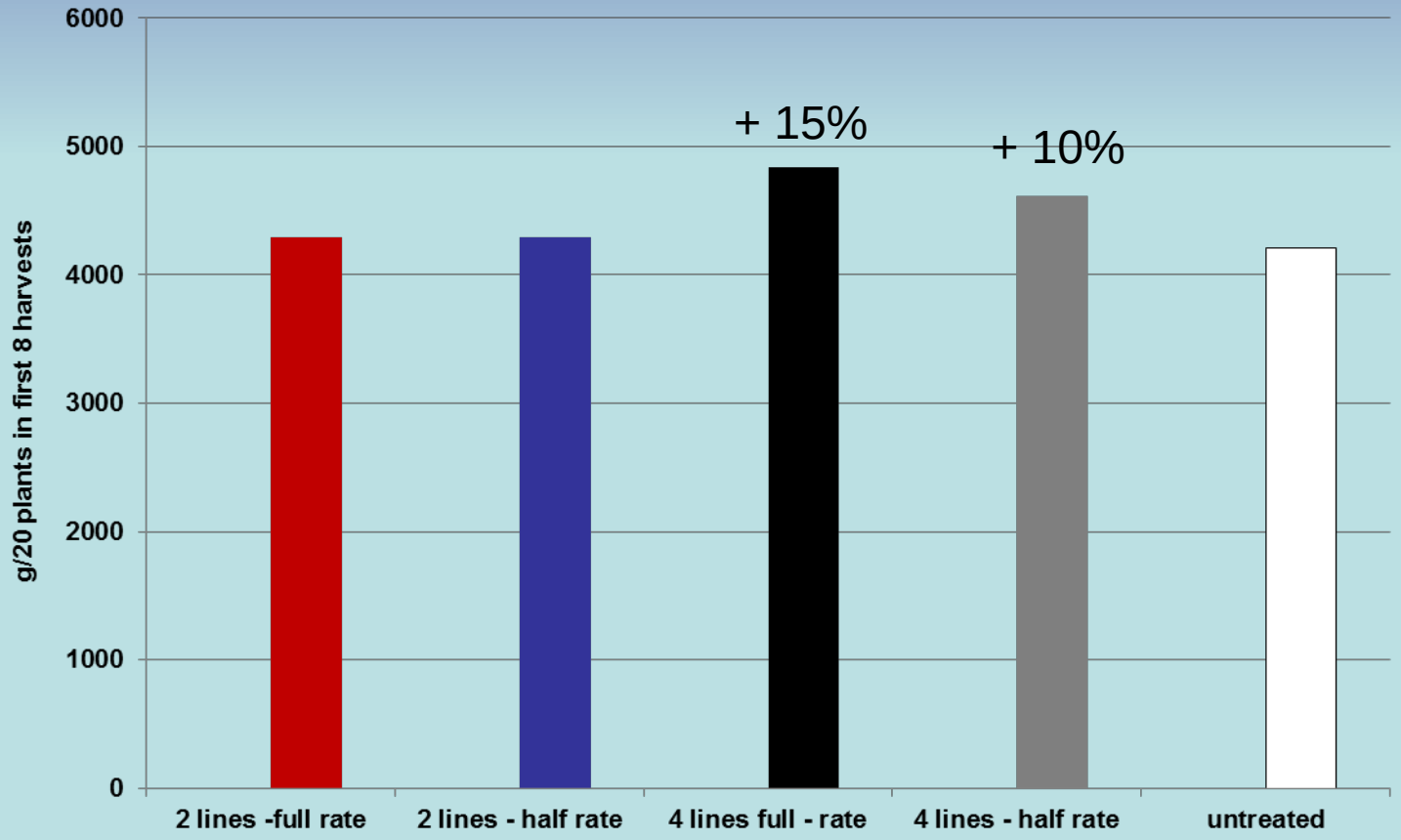
2013-2014



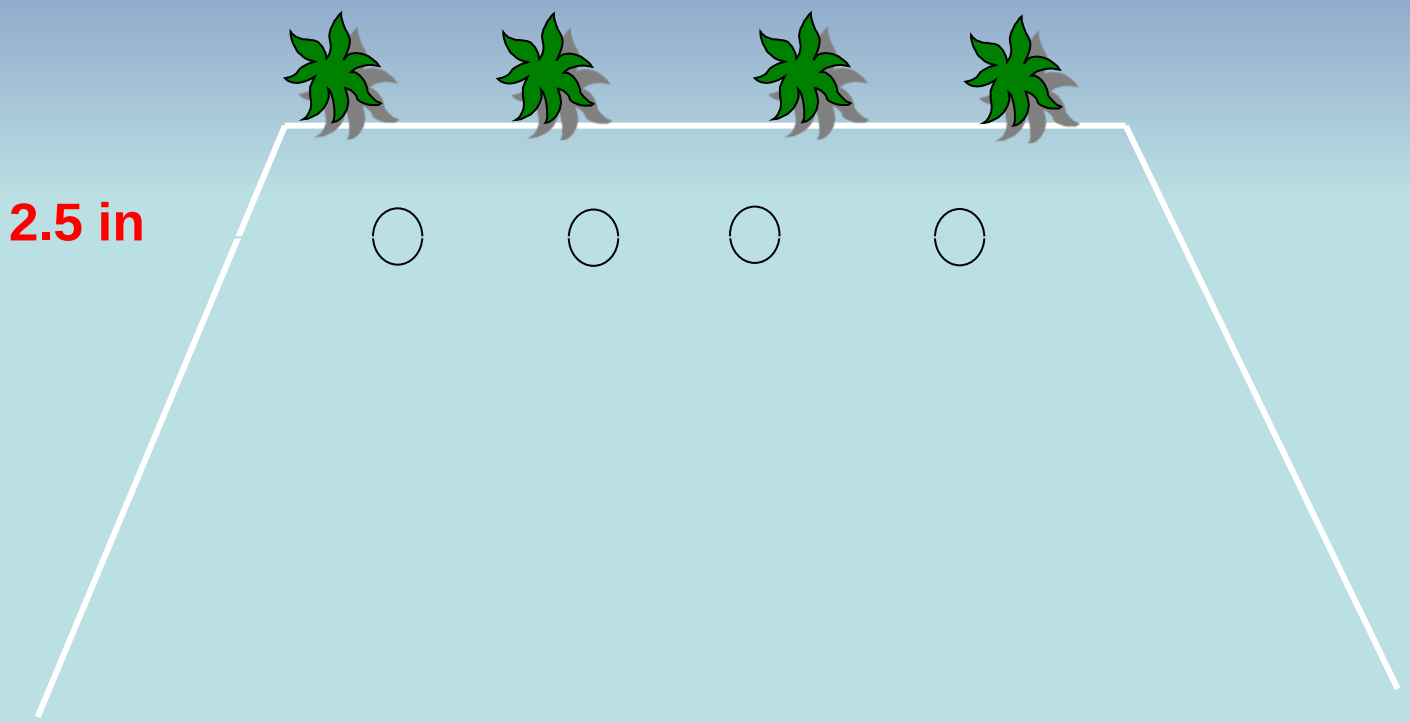
Fumigant concentration time exposure index

Marketable fruit yield

January 30 to March 18.



4 Lines shallow layout



Materials and Methods

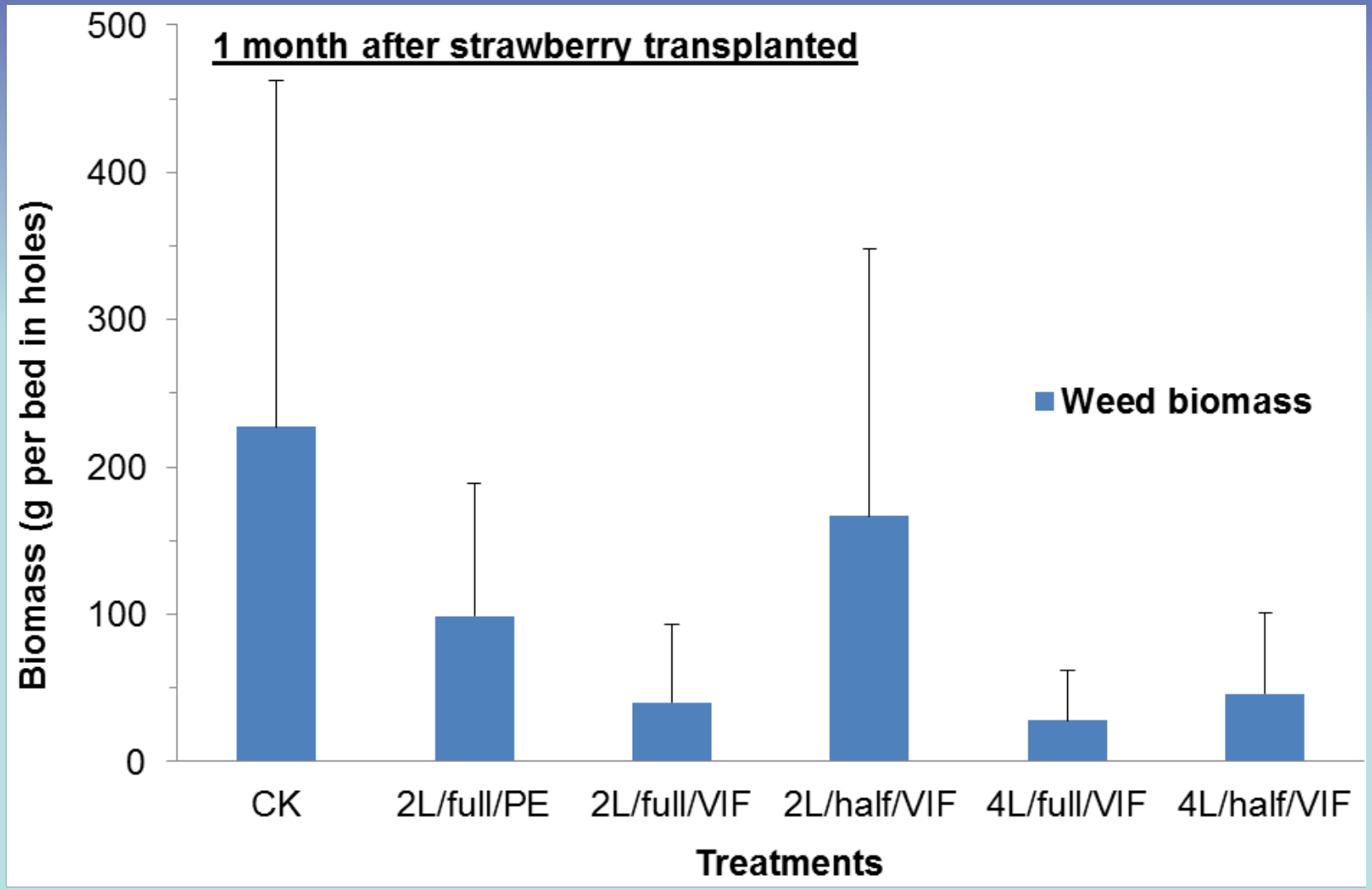
- Field trial (Sept. 2014-June 2015) at Oxnard, CA:
  - Raised-beds production system with sandy loam soil.
- Bed configuration:
  - 45” (bed width), 16” (bed height), 68” (bed center-center).
- Installation tube depths:
  - 2” deep.
- Fumigant:
  - Tri-Clor EC [a mixture of 94% chloropicrin (CP) and 6% inert ingredients]
- Film type:
  - PE vs. Virtually impermeable film (VIF; Filmtech Grozone, black).
- Application rate:
  - 224 lbs/ac (full rate) vs. 112 lbs/ac (half rate).

Fumigant behavior

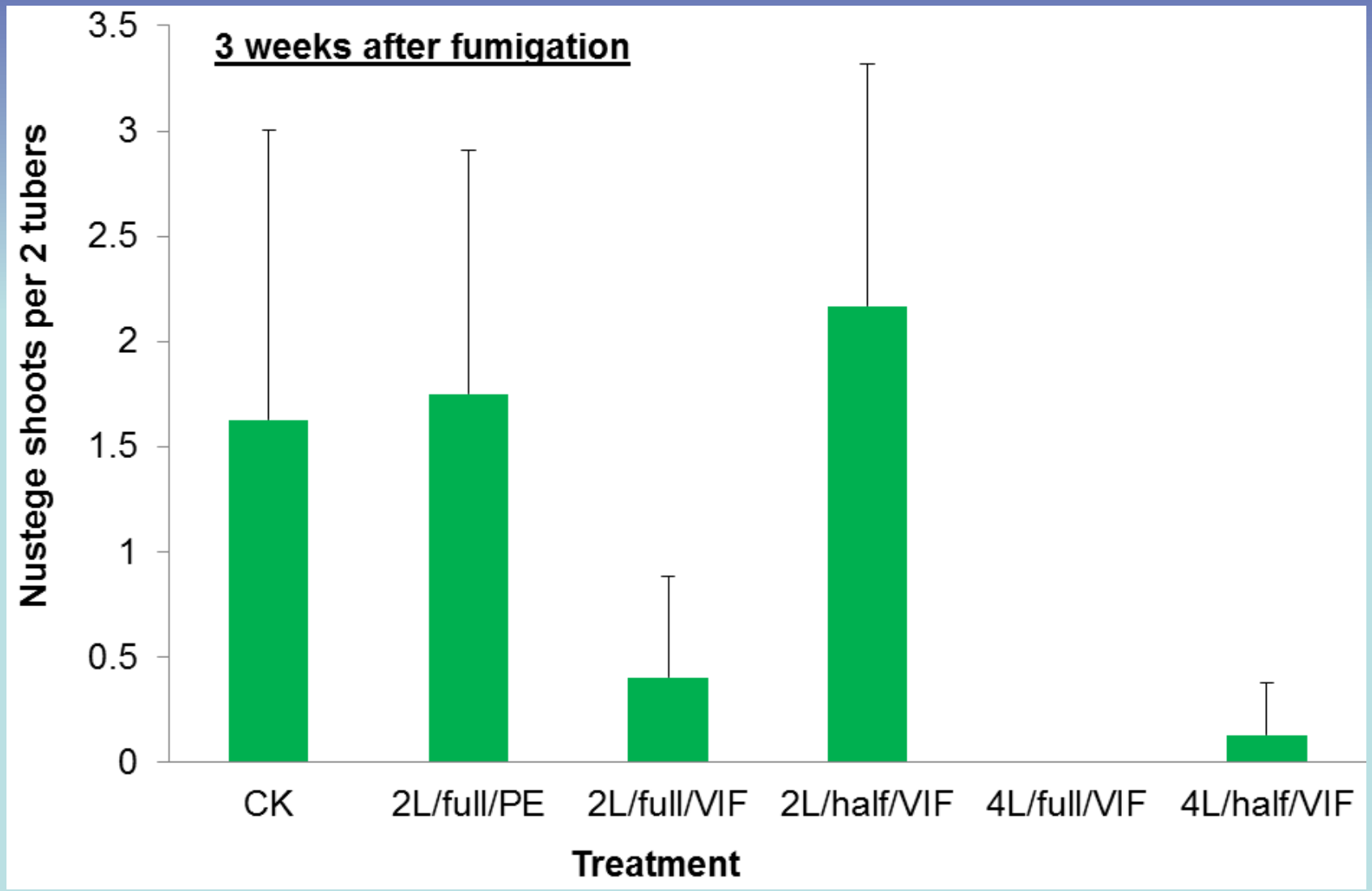
- **VIF-tarped beds had dramatically lower emission flux and much higher concentration than PE-tarped beds.**
- **Full rates > half rates, 4 lines > 2 lines**

Concentration-time exposure index ($\mu g\ cm^{-3}\ h$)

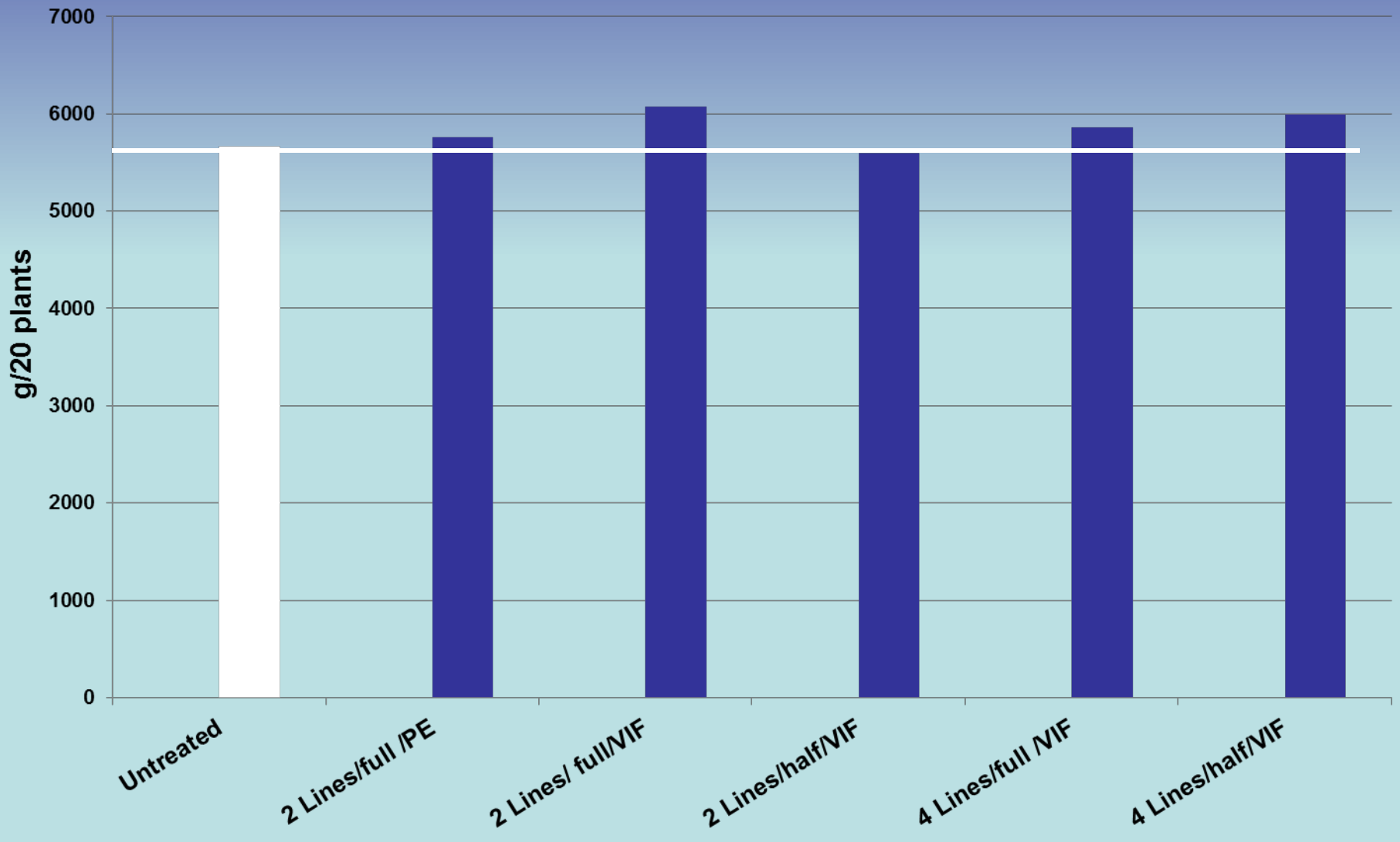
Weeds in planting holes



Yellow nutsedge shoots



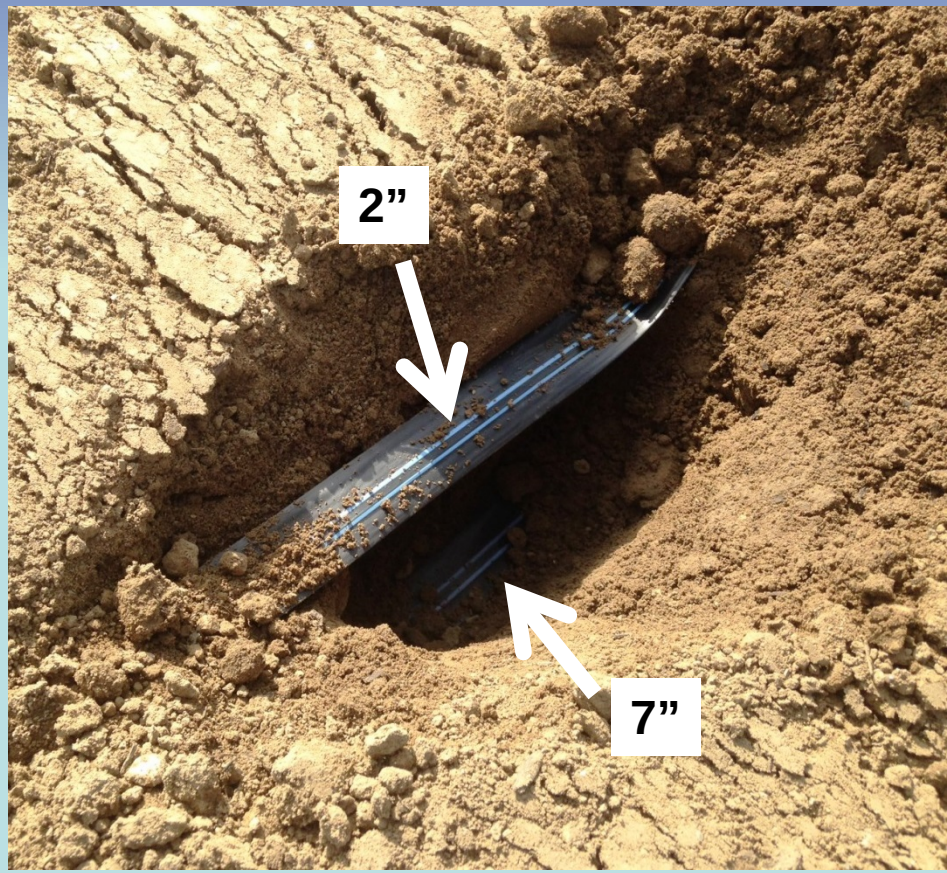
Early (Dec-March) fruit yields



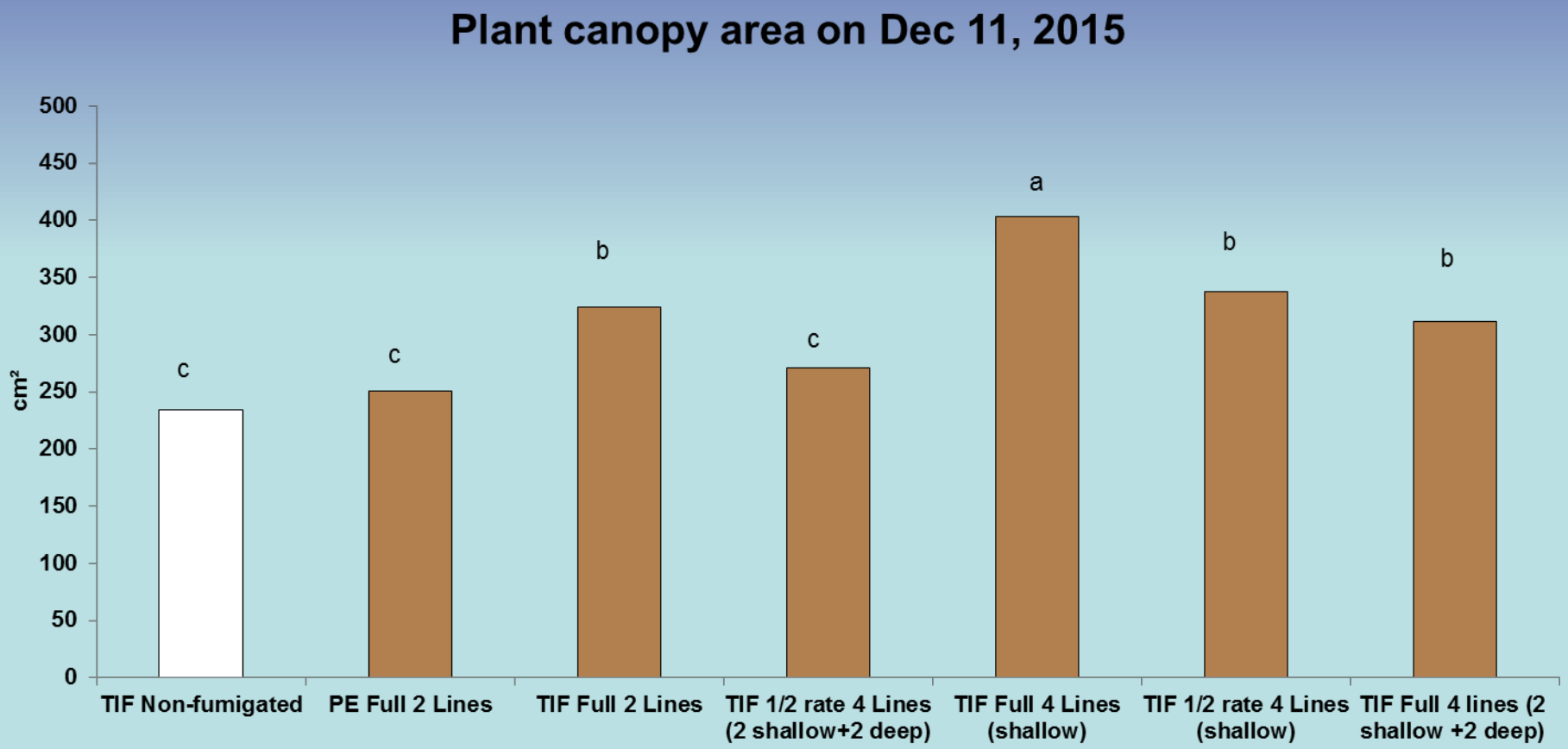
Mortality per 300 ft bed (*F.oxysporum* isolated)

May 2015

2015-16: Fusarium infested field, 200 lbs/a Pic, with 2, (2+2) or 4 lines



2015-16: Fusarium infested field, 200 lbs/a Pic



Weeds

	Broadleaf weeds in planting holes/50 ft of bed	Y. nutsedge shoots/3 tubers
TIF Non-fumigated	3.75	5.25
PE Full 2 Lines	4.75	5.5
TIF Full 2 Lines	0.5	3.5
TIF 1/2 rate 4 Lines (2 shallow+2 deep)	1.25	1.75
TIF Full 4 Lines (shallow)	1	2.5
TIF 1/2 rate 4 Lines (shallow)	0.5	3.75
TIF Full 4 lines (2 shallow+2 deep)	2	1

ORGANIC

Effective ASD = C-source + water + plastic mulch

- Need C-source uniformly mixed
- Standard LDPE mulch – sufficient
- Black mulch as good as clear
- 3 inches of water - sufficient
- 3 weeks duration in summer

$3, 000 /acre

For C-source:

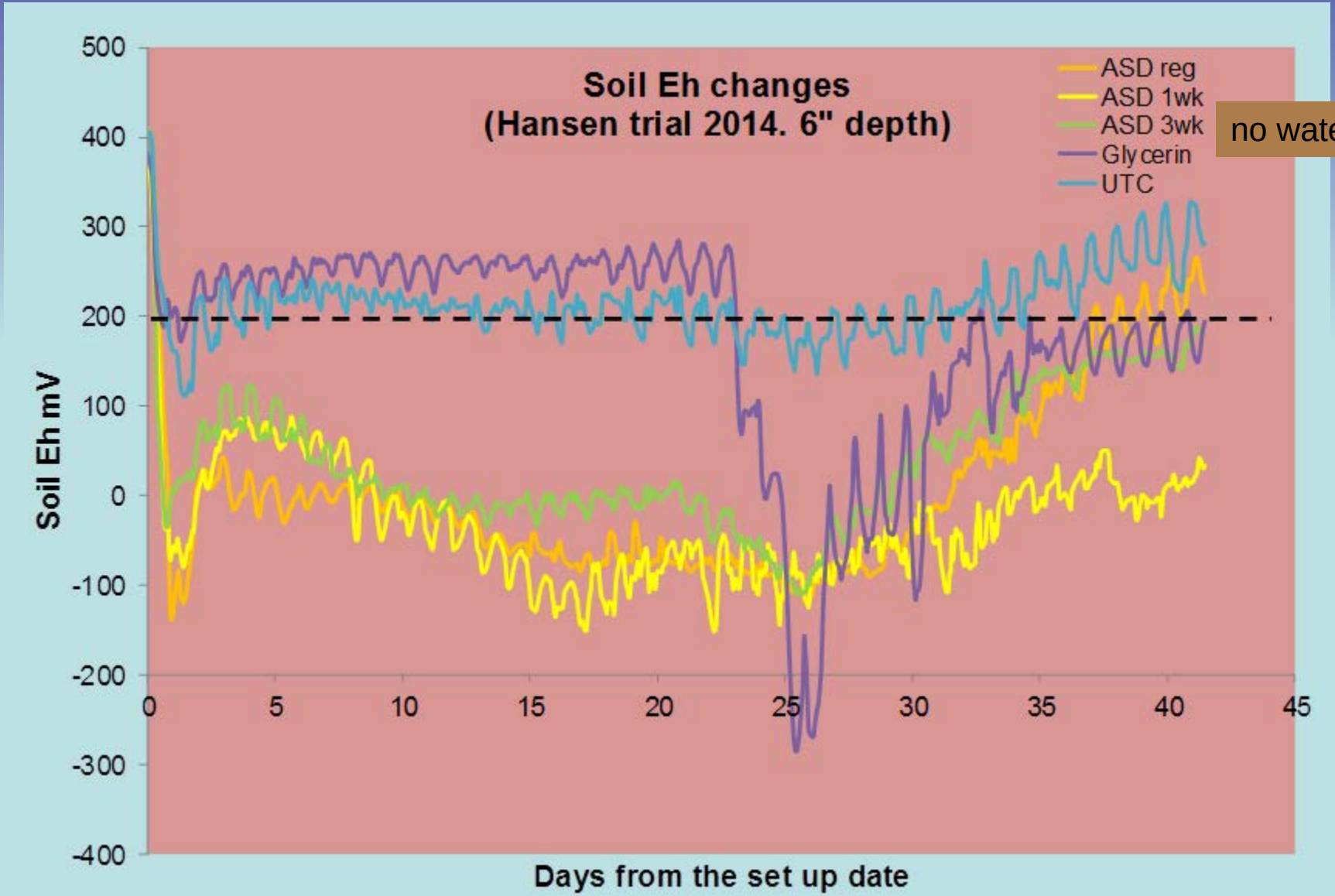
- Apply Glycerin at 4% by volume via drip vs rice bran at 9t/acre

For water:

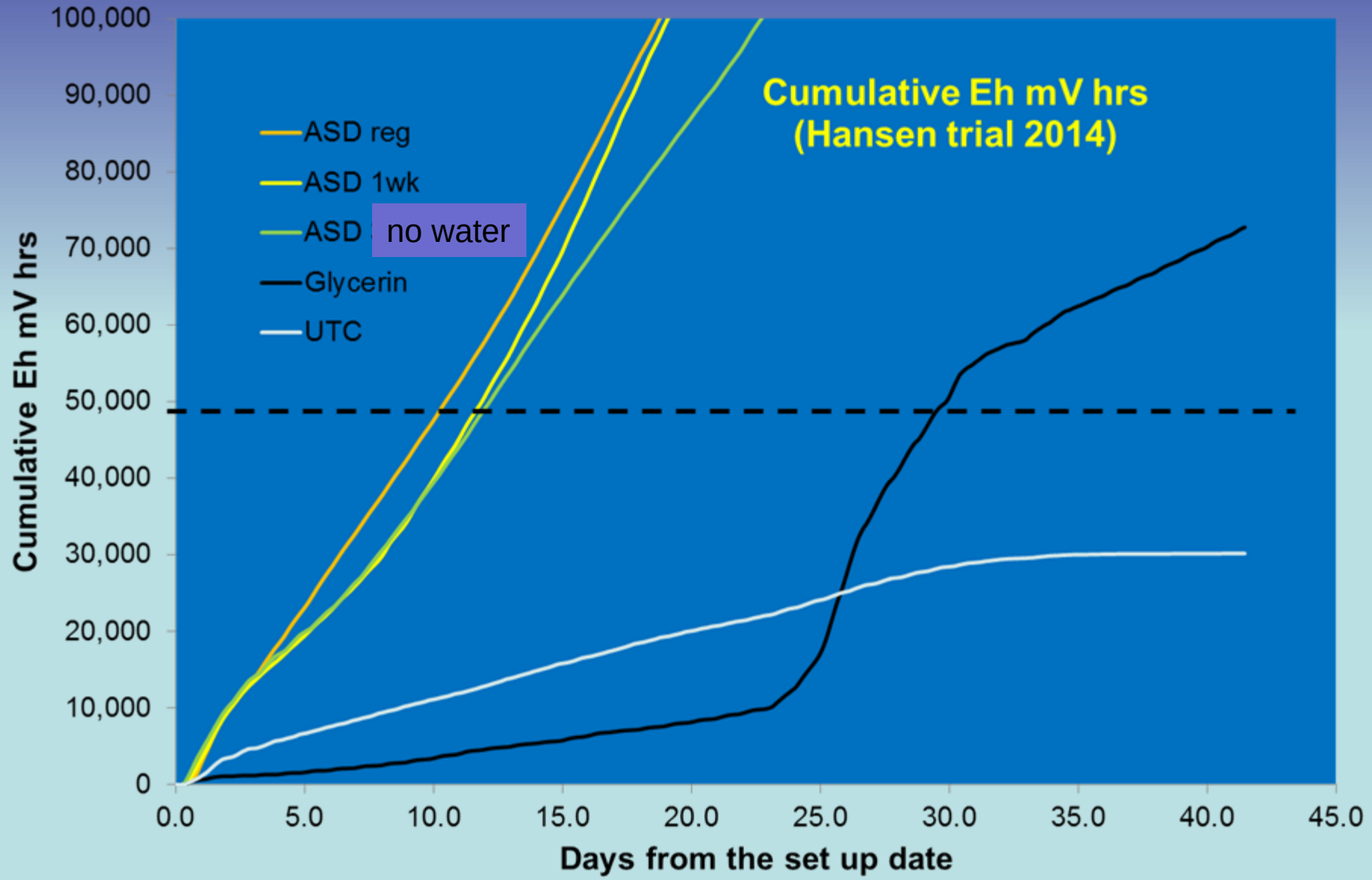
- Delay drip irrigation 1 wk after bedding
- Apply no water after bedding
- Drip-irrigate immediately


ASD

Anaerobic conditions



Anaerobic conditions



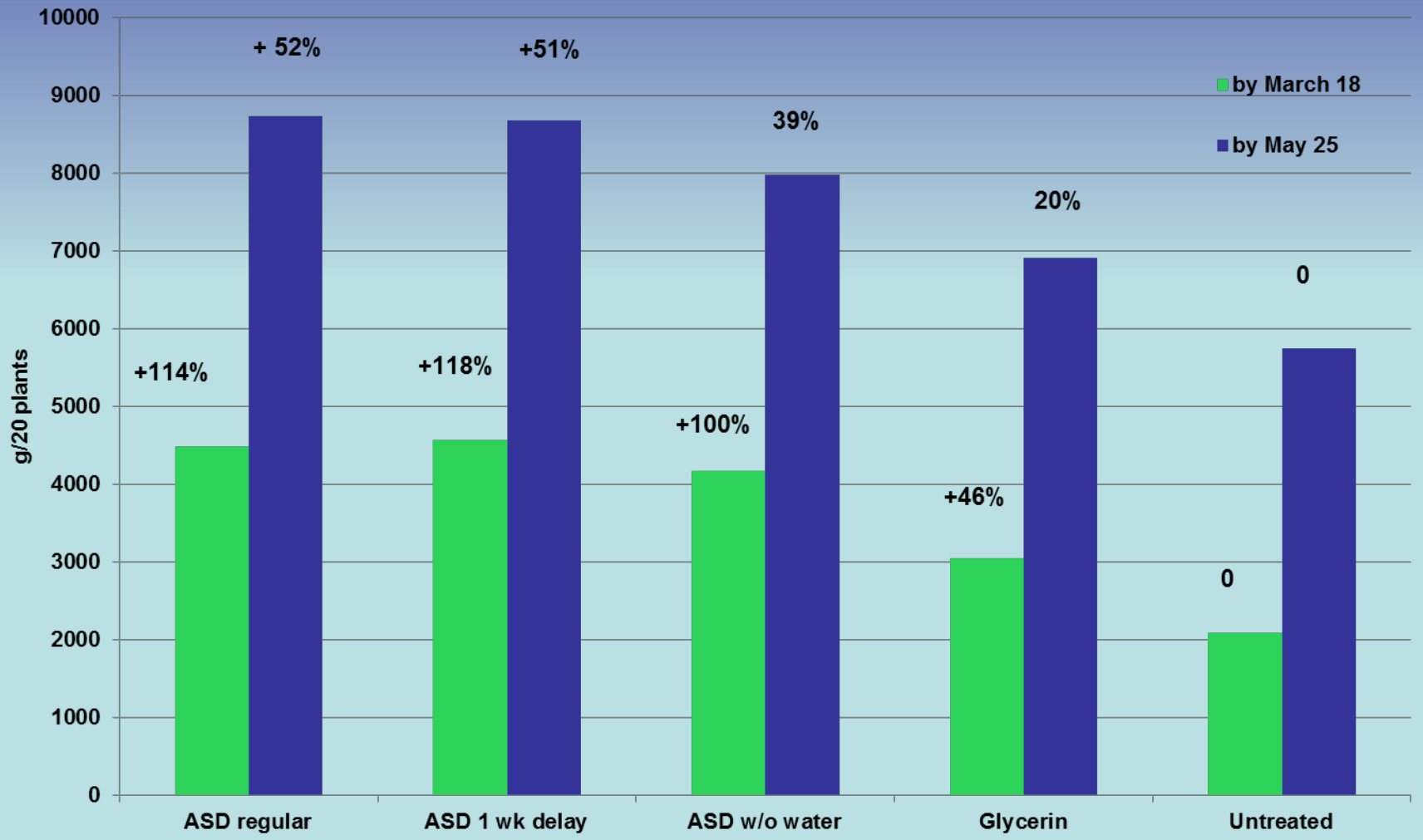
Dec 28, 2014

ASD/9t rice bran

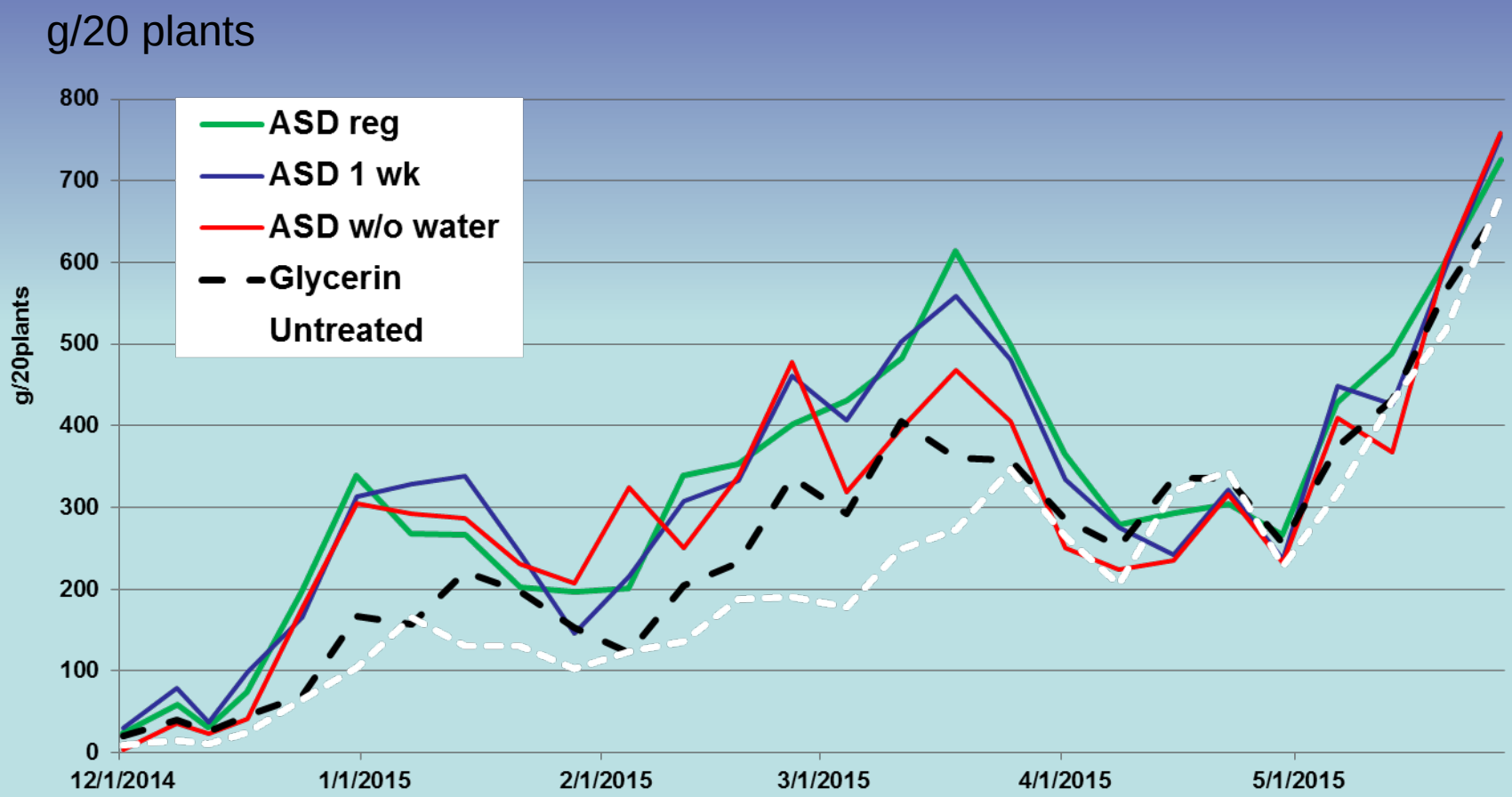
ASD/glycerin

Untreated

Marketable yield

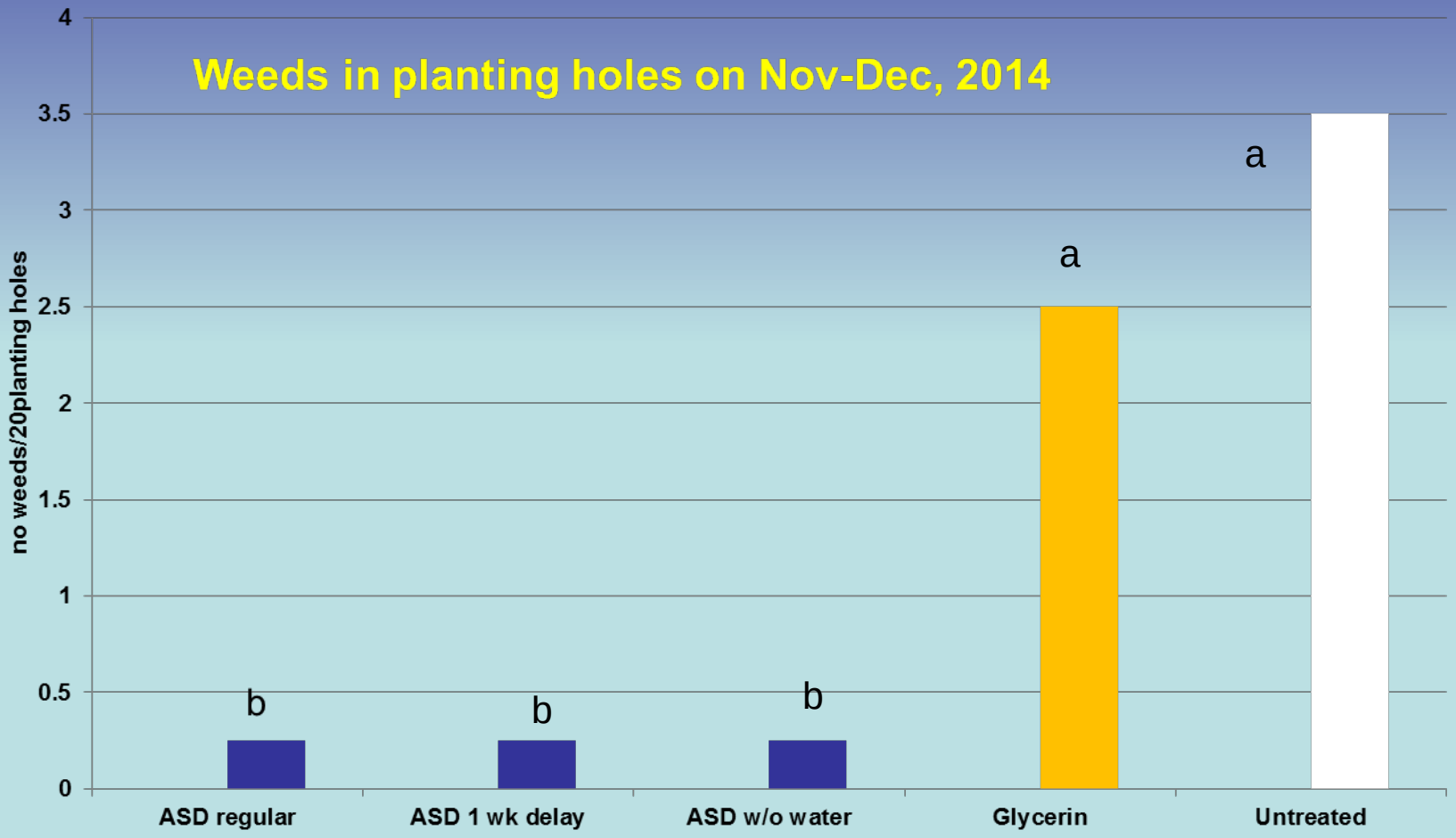


Marketable yield: Dec-May



Glycerin (applied in August) in beds in June

Weeds


Weeds in planting holes on Nov-Dec, 2014
no weeds/20planting holes
4
3.5
3
2.5
2
1.5
1
0.5
0
b
b
b
a
a
ASD regular
ASD 1 wk delay
ASD w/o water
Glycerin
Untreated

Soil in ASD with 9T rice bran vs untreated

- **Lower bulk density, ECe (salinity), likely due to differences in infiltration and leaching**
- **30-35% greater volumetric water content at 8-16 cm soil depth (water holding capacity)**
- **Twice more residual Olsen P_20_5 at 0-30cm (12 inch) soil profile in planting holes**
- **Similarity of microbial communities among all treatments with rice bran, distinctly different from those observed in untreated and glycerin treatments.**

Adding rice bran to soil for ASD

Anaerobiosis

Organic acids

pH reduction

Micronutrient availability

Available Nitrogen

Infiltration and salt leaching

Available Phosphorus

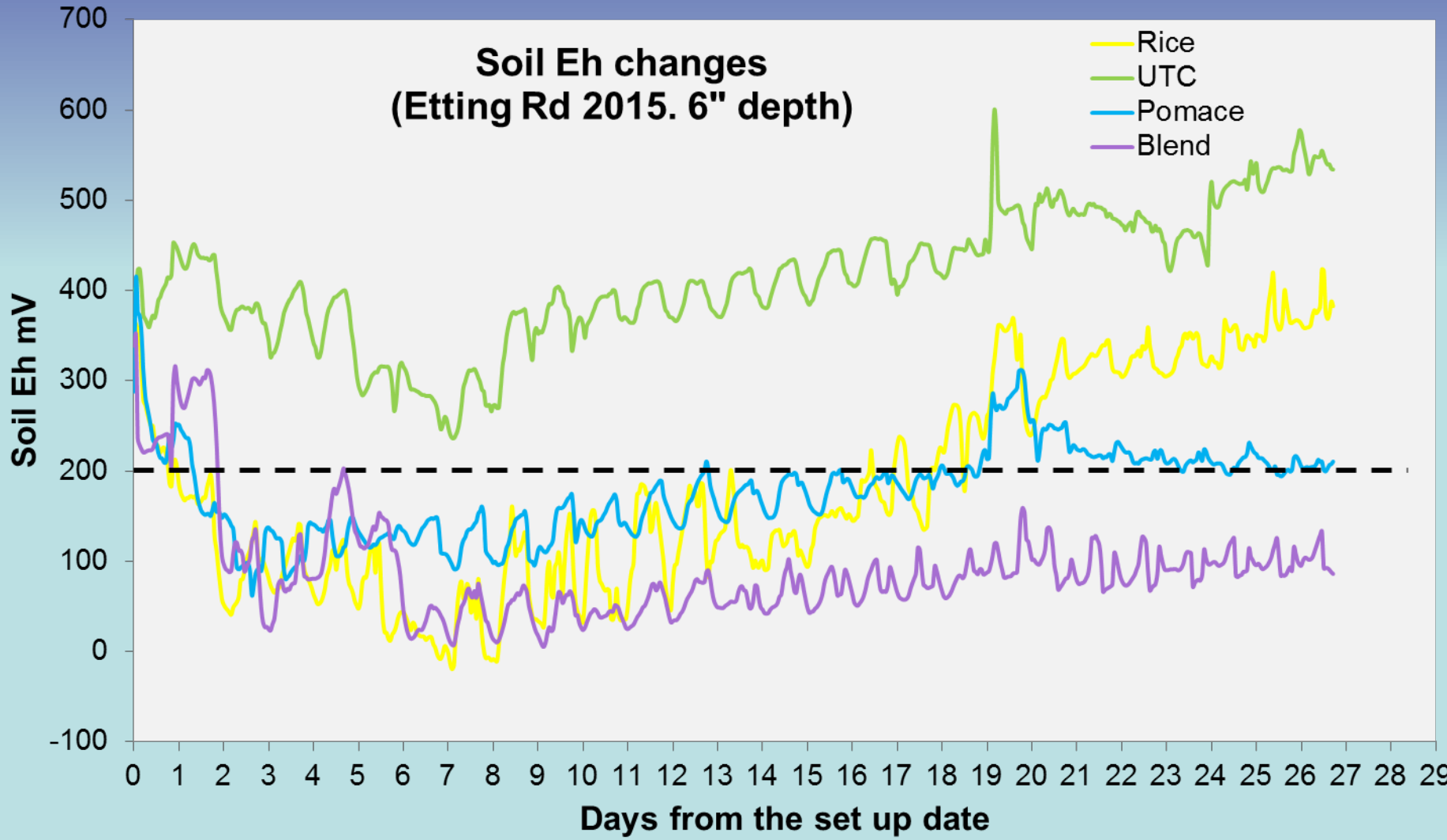
Microbial population shifts → Interaction with pathogenic organisms?

Short vs long term?

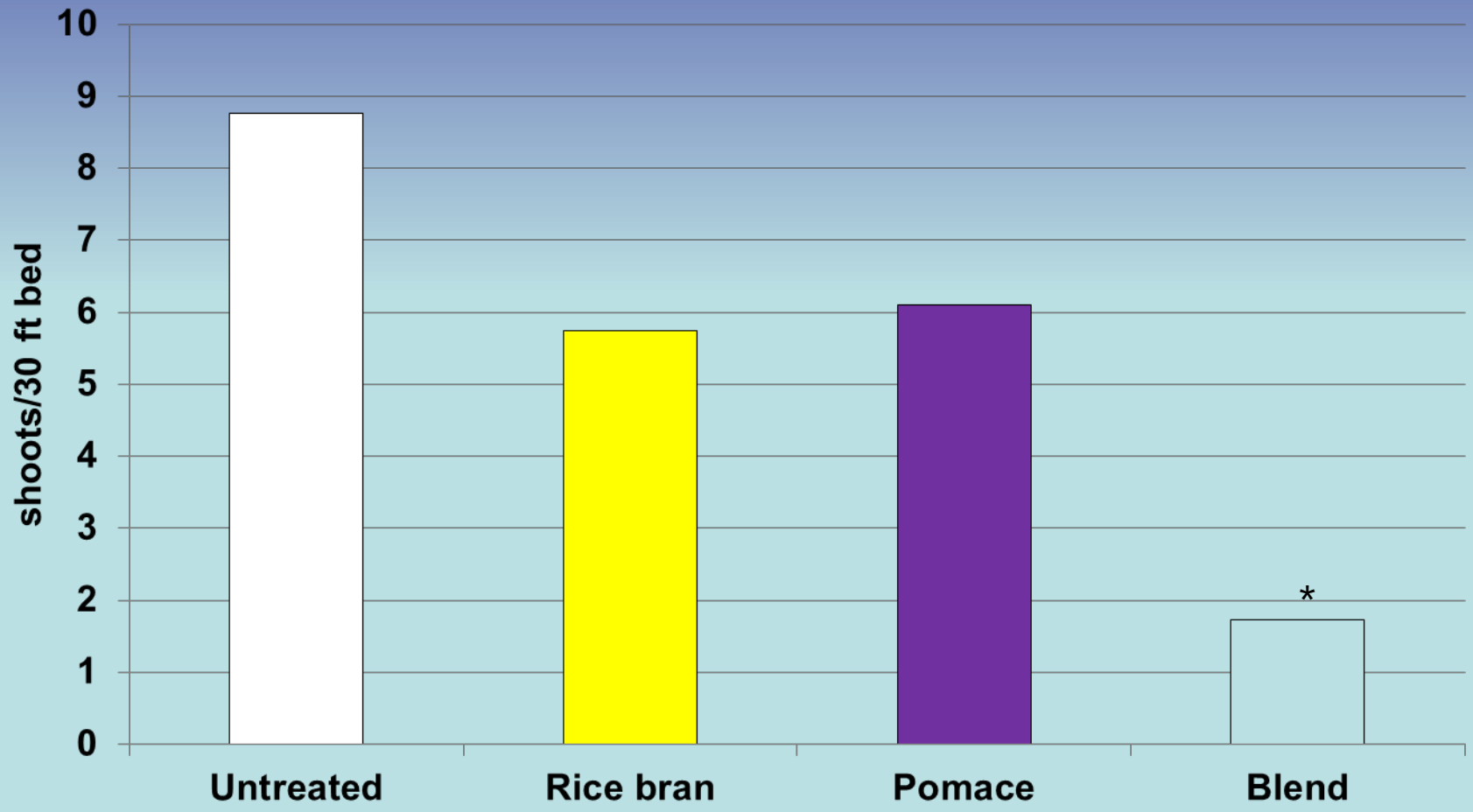
Other C-sources and soil environments?

Grape pomace, rice bran and blend (rice+almond mix) in organic field

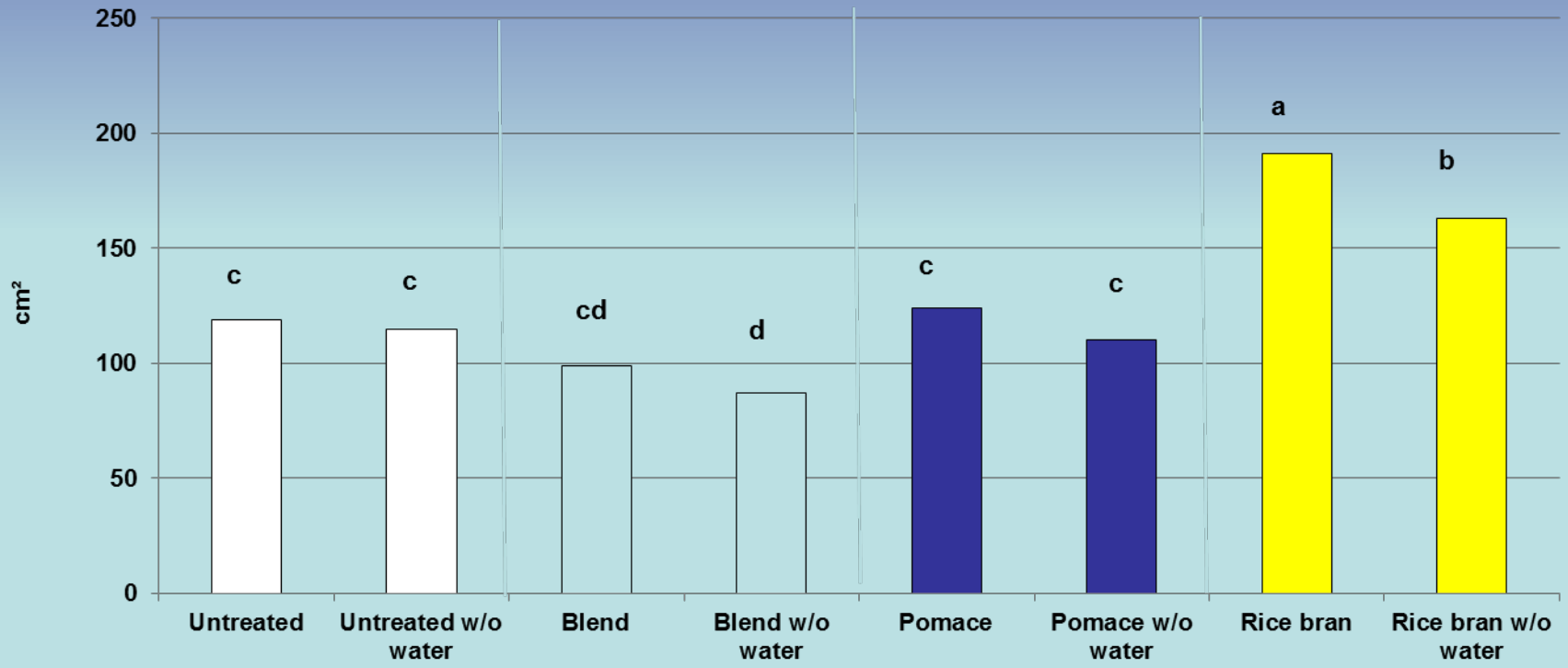
Anaerobic conditions in sandy soil



Yellow nutsedge germination 6 WAP



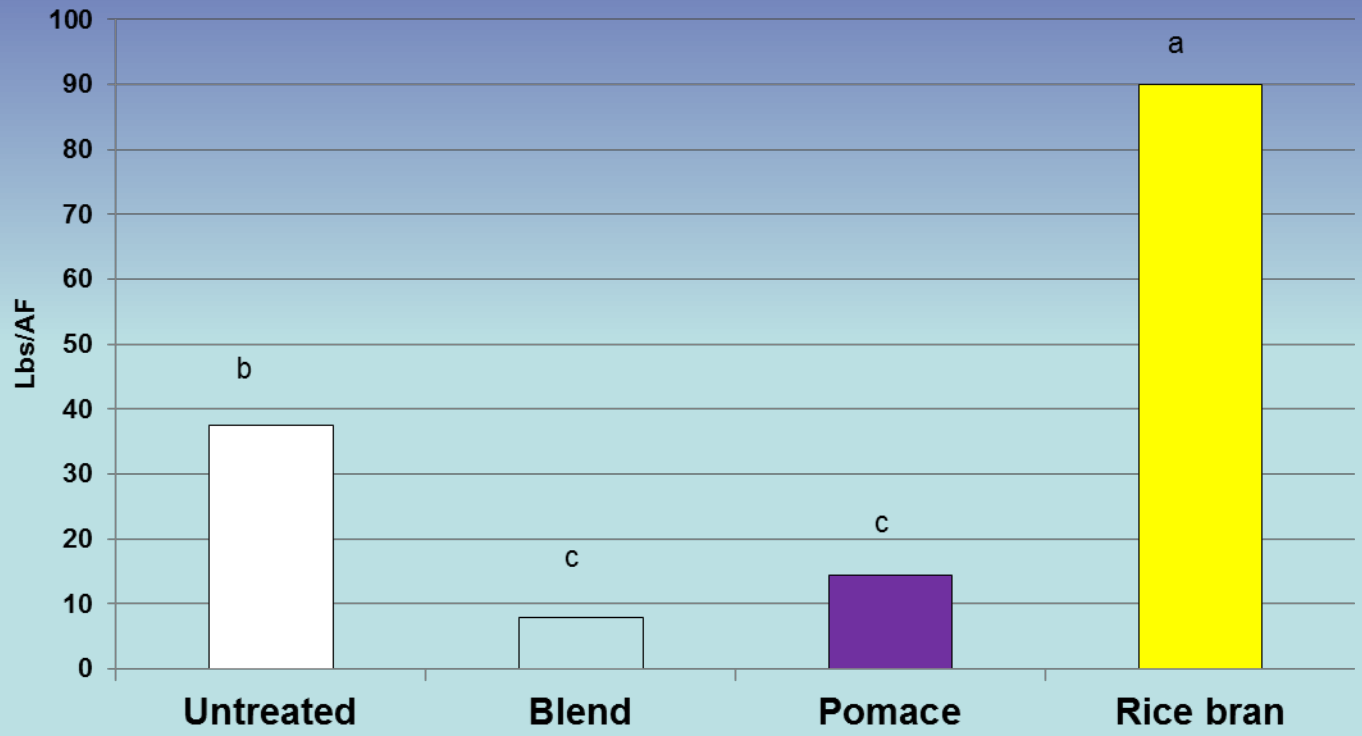
Plant size/canopy area 6 WAP



6 Weeks after planting (WAP)

Untreated **Pomace** **Blend** **Rice bran**

NO_3-N
on Nov 5 at 0 -12”



~~MB~~ Rice bran alternatives

C-sources:

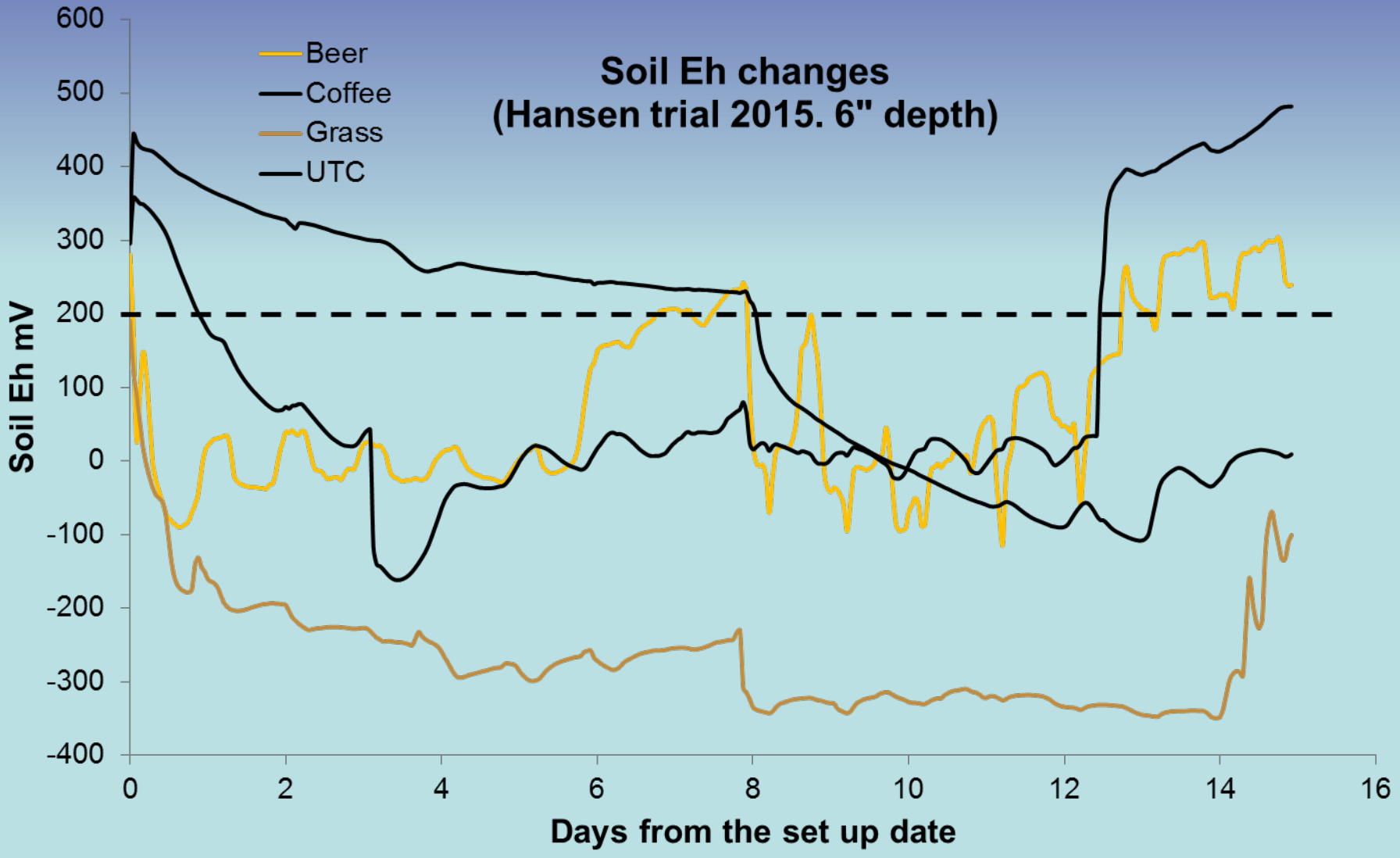
favorable C/N ratio, local, available, cheap

Coffee grounds
(Roasting plant at Camarillo)

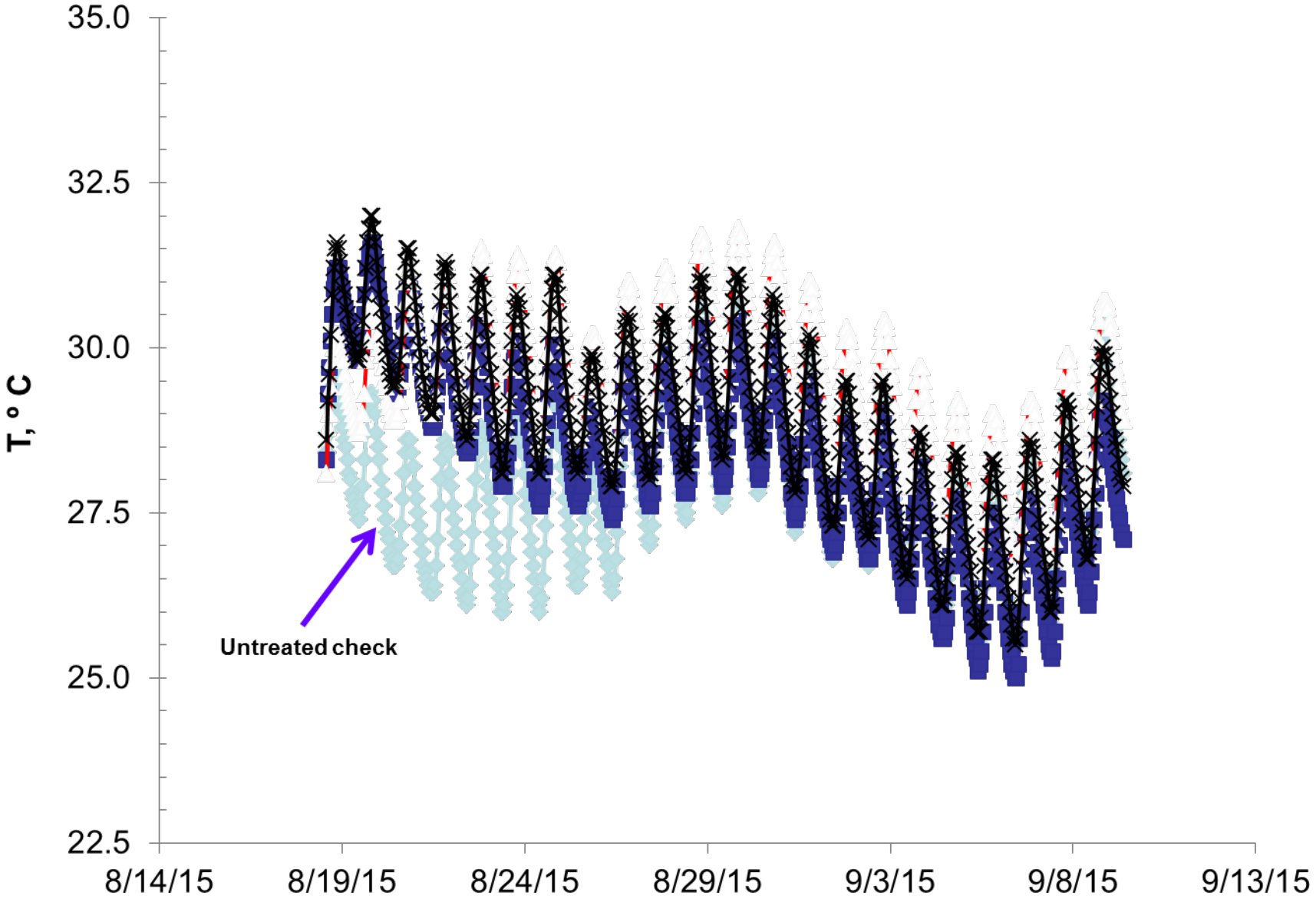
Spent grain
(Surf Brewery, Ventura)

Grass clippings
(Southland Sod at Camarillo)

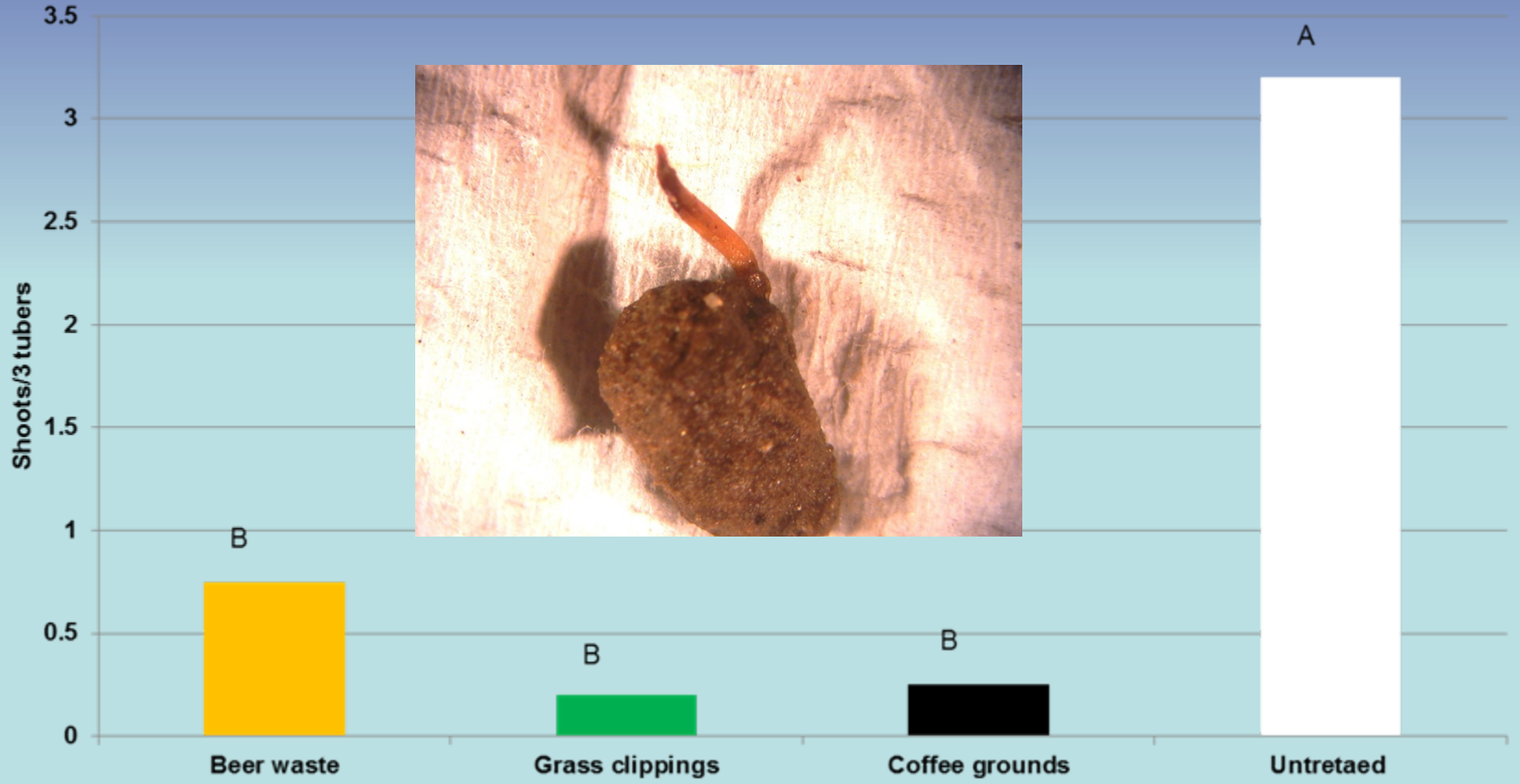
Anaerobic conditions in clay loam soil (9 t dry weight /acre)

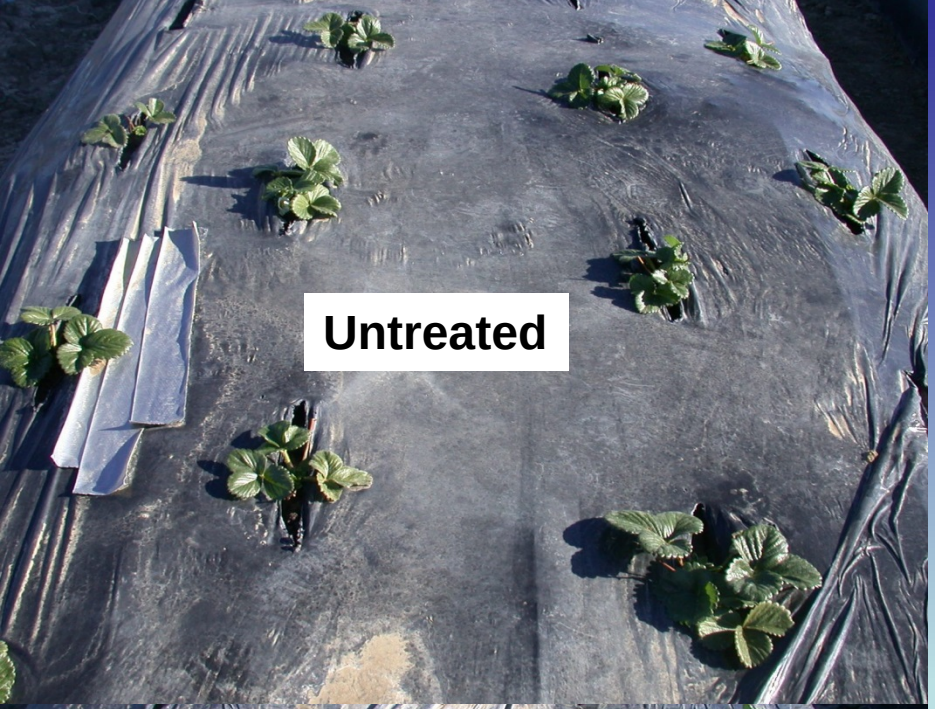


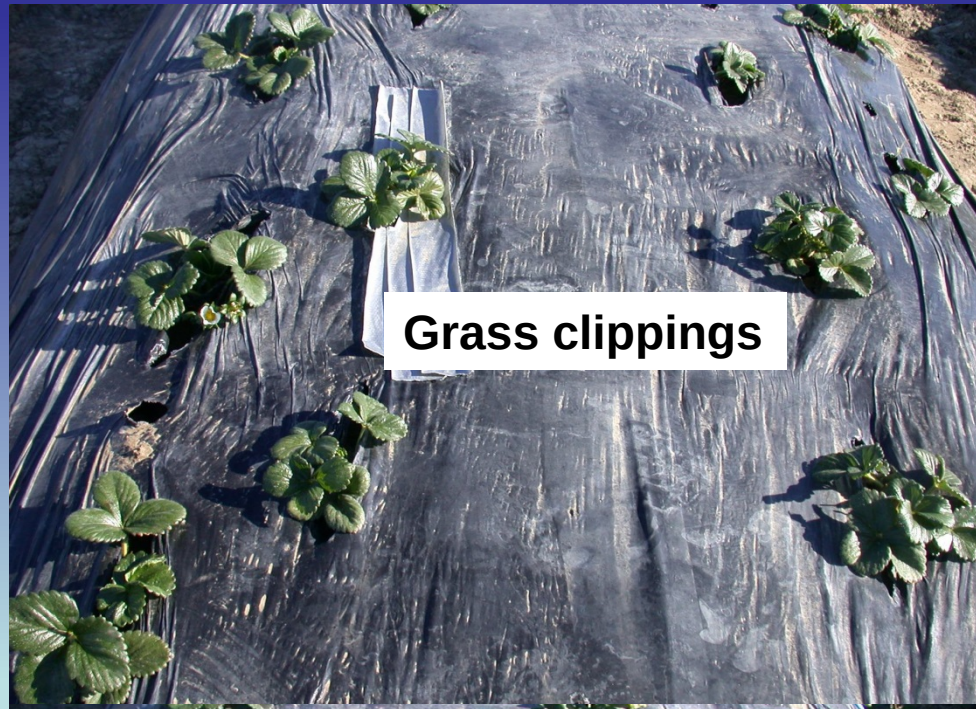
Soil temperature at 15 cm in clay loam soil



Yellow nutsedge shoots from buried tubers



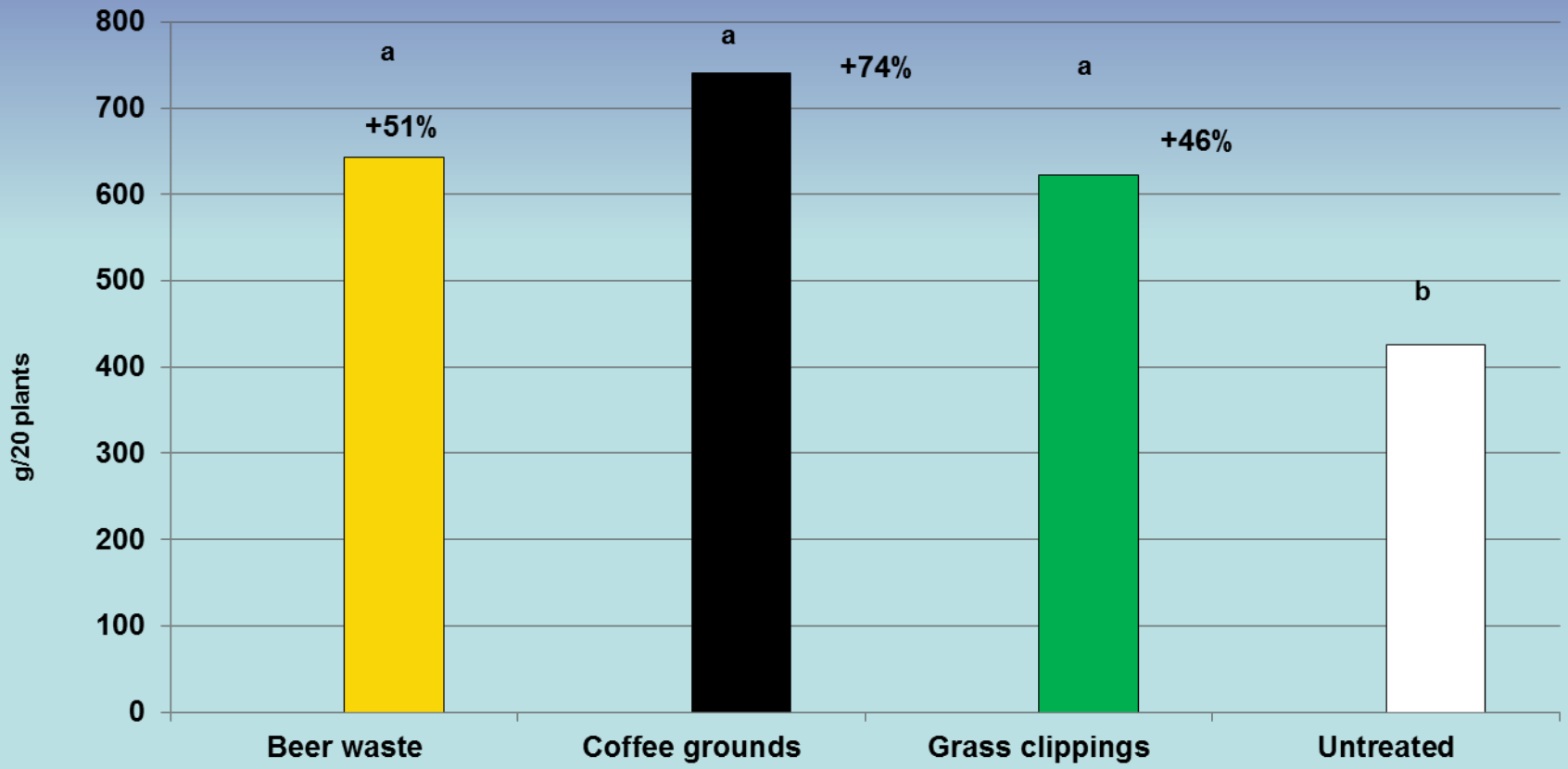

Untreated


Grass clippings

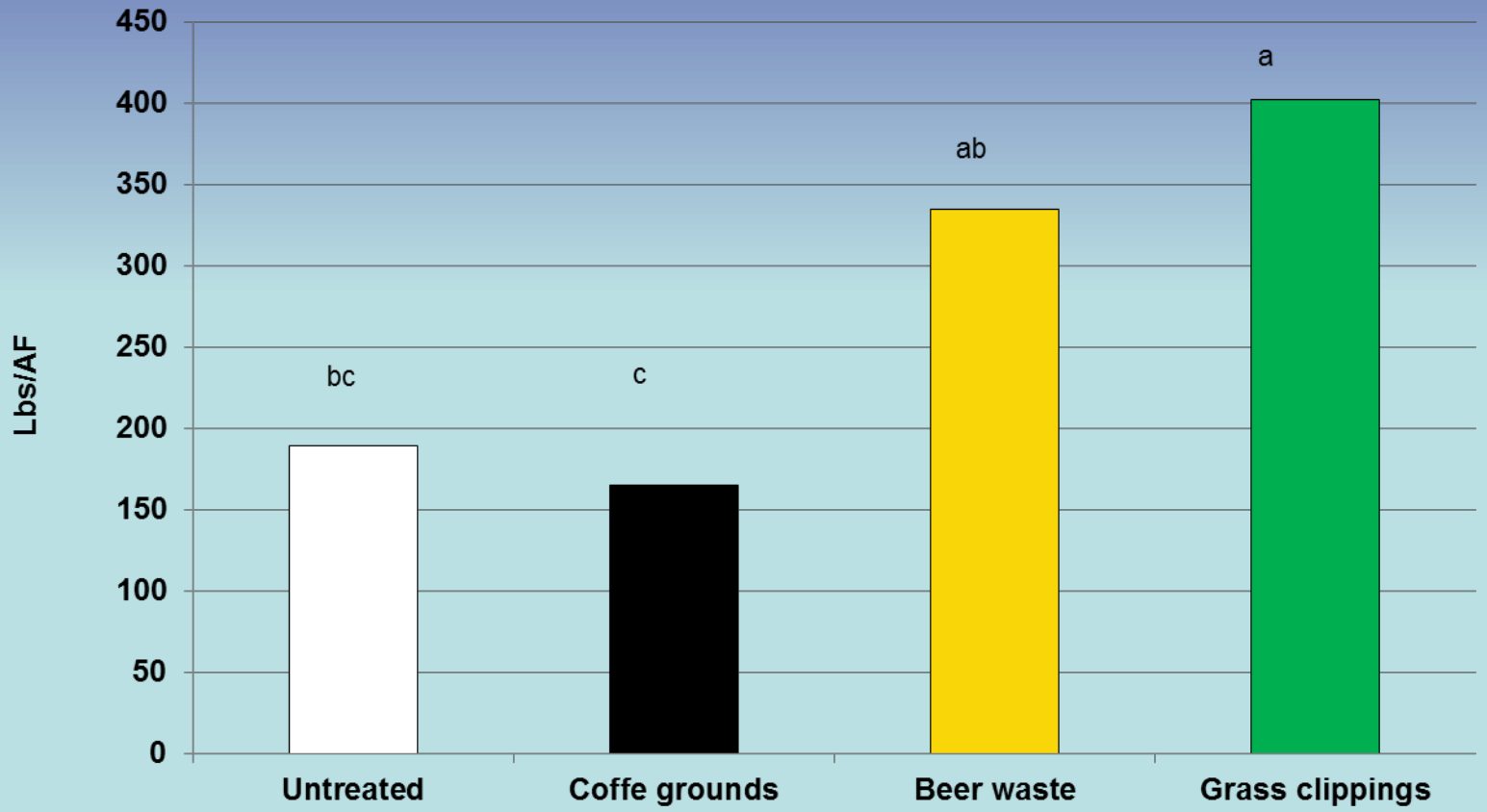

Beer waste


Coffee grounds

Marketable yield: December, 2015

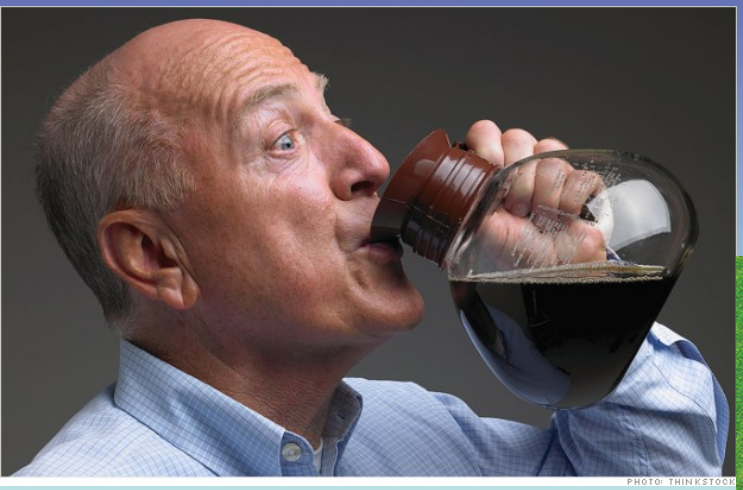


NO_3-N
on Nov 5 at 0 -12”



With 9 T /acre Rice bran we expect NO3 at 100-150 Lbs/AF

C-sources research support



Continuation of ASD work

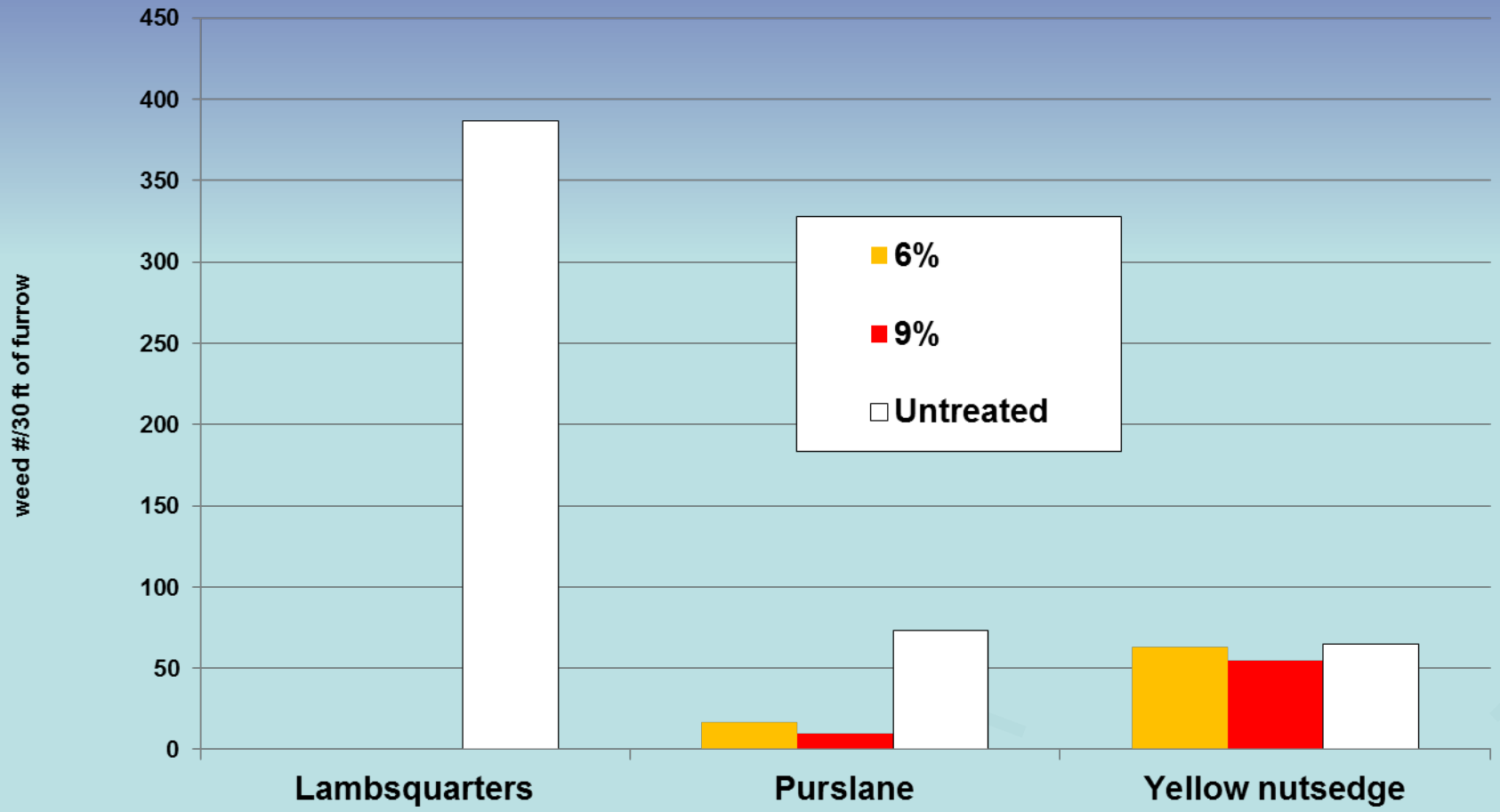
- C-sources that are cheap, abundant, local and cater to particular microbial groups?
- Changes in soil physical properties over time
- Since we don’t eradicate the problems: intergrade ASD with other strategies (rotation, fumigation, steam, varieties)

‘Suppress’ organic herbicide

Untreated

‘Suppress 9% v/v

Weed densities 10 days after ‘Suppress’ application at 6 or 9% v/v to furrows



Dry biomass of plants remaining after ‘Suppress’ application

‘Suppress’ | Untreated

Untreated

‘Suppress 9% v/v

7days after ‘Suppress’ 27days after ‘Suppress’

Contact with no residual activity or translocation

Acknowledgements:

- Jose Romero and Hector Gutierrez
- UC Hansen staff
- UCCE Master Gardeners
- CSC
- Solimar Farms
- Farm Fuel

Foliar fungicides: **Switch > Abound = Captan = Pristine > other**

Pre-plant dips: **Switch > Captan = Pristine = Abound**

Cultural management: **Production field mortality and yield losses:**
Daughters on drip < on sprinkler in nursery