Fumigant and non-fumigant (and other?) research update

Oleg Daugovish, (UCCE-Ventura), Ruijun Qin, H. Ajwa, J. Gerik , S. Gao, B. Hansen, Tom Gordon (UC-Davis), and Joji Muramoto (UCSC),

2012-2014

New locations with Fusarium and Macrophomina related die-back in California:

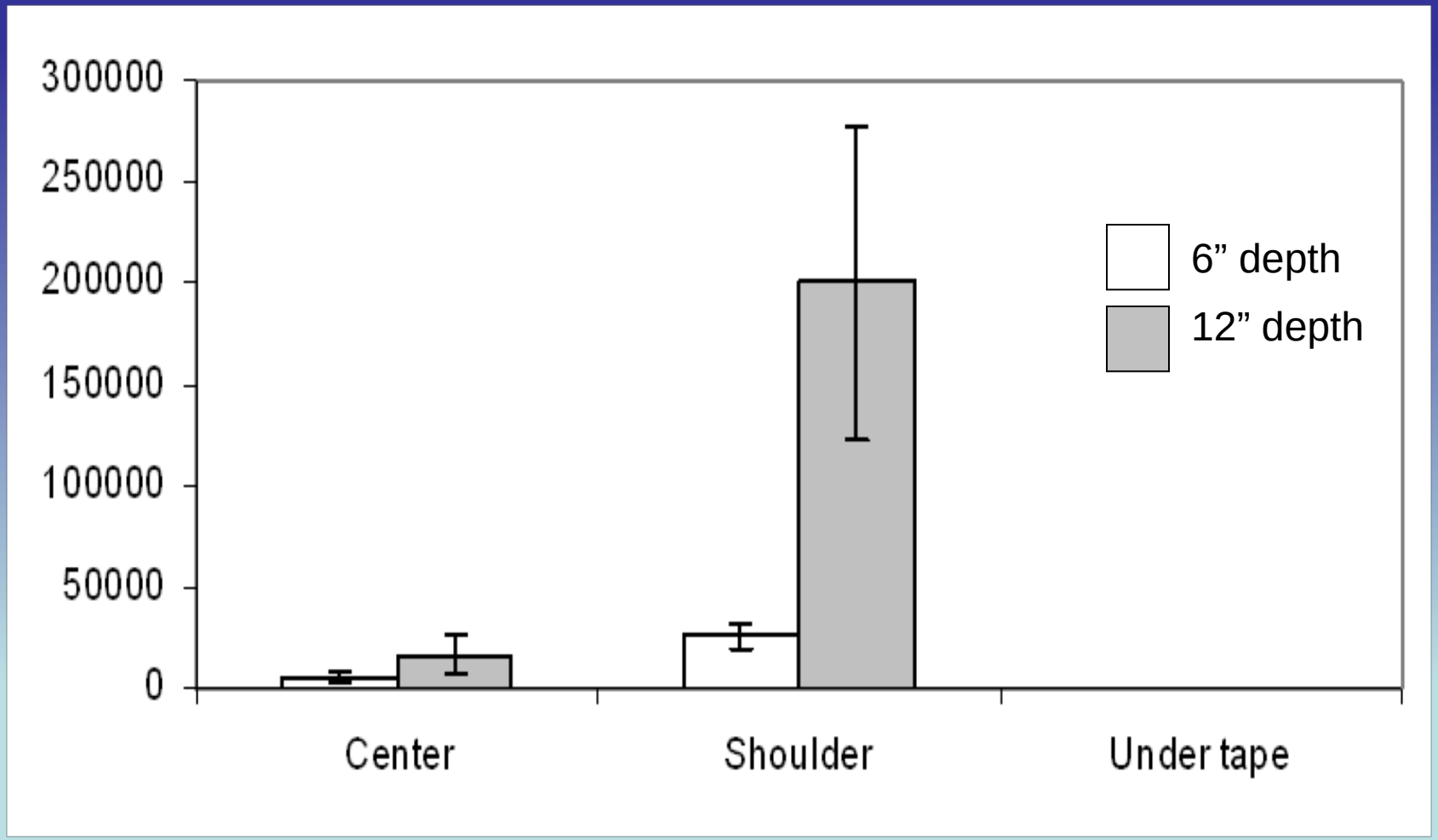
Fall and summer planted strawberry, drip fumigated

For better fumigation results

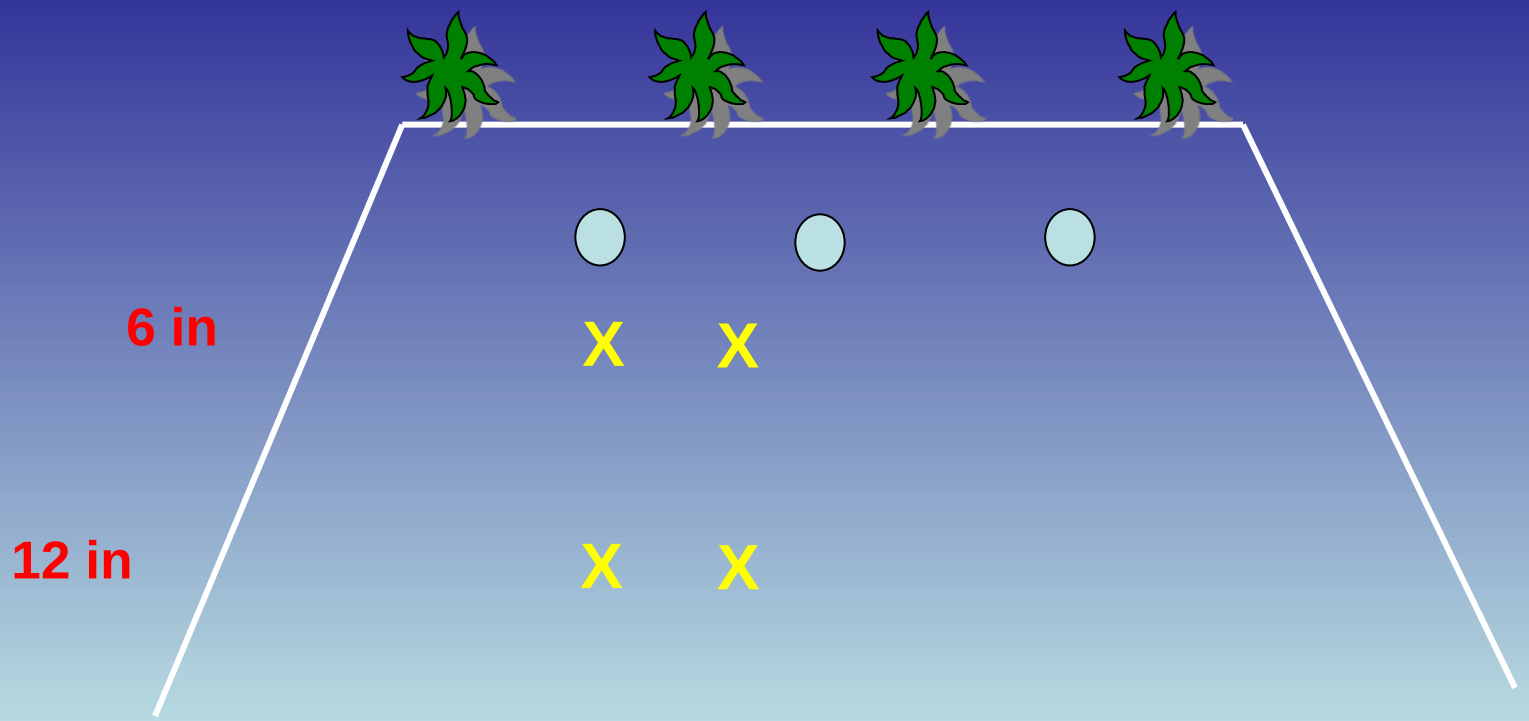
- Flat fumigation at high rates (85-90% control for *M. phaseolina* and *F. oxysporum*)
- Break or remove infested crowns
- Use VIF or TIF

Drip fumigation under PE, 2 tapes, Oxnard

Beds fumigated with Piclor-60, 250 lbs/a

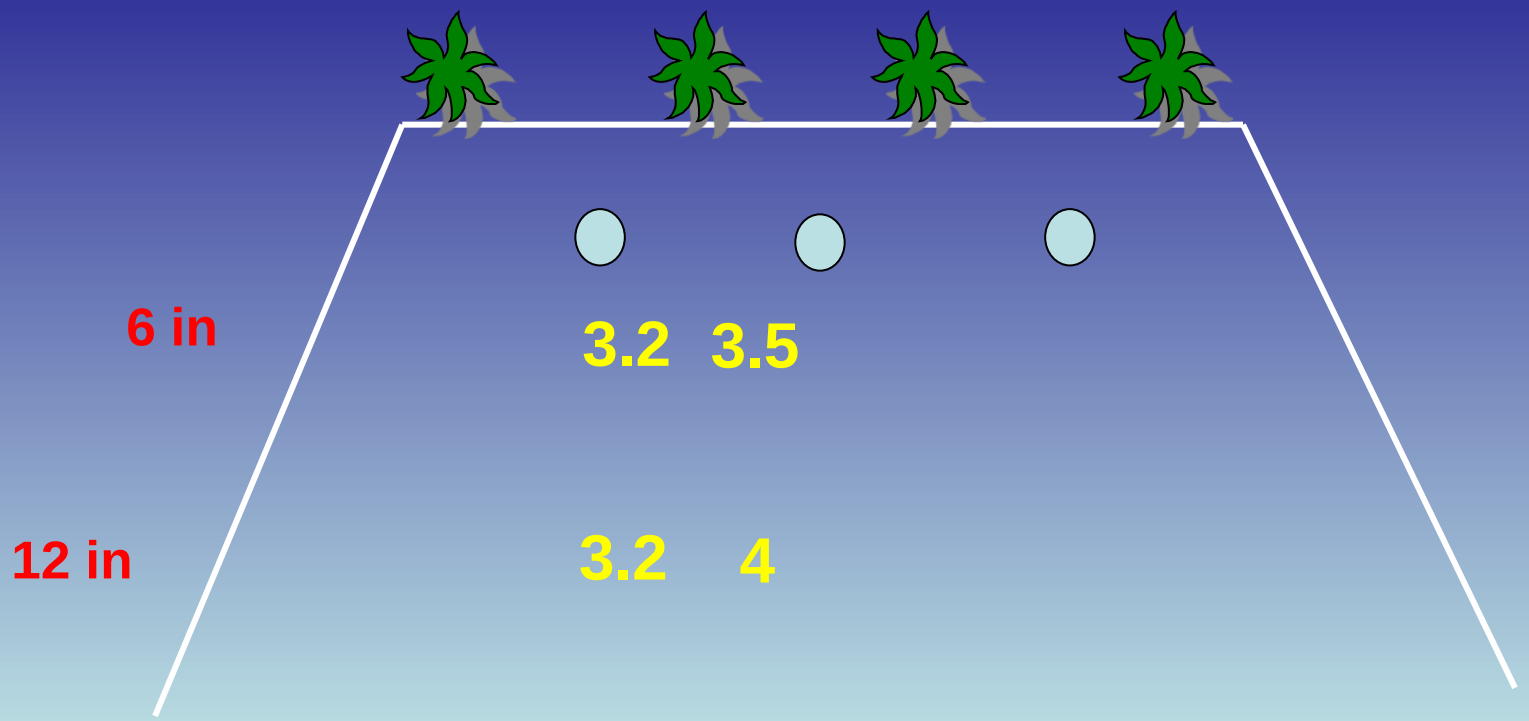


Starting At the End
of the season: Vapam via drip 50 gal/acre

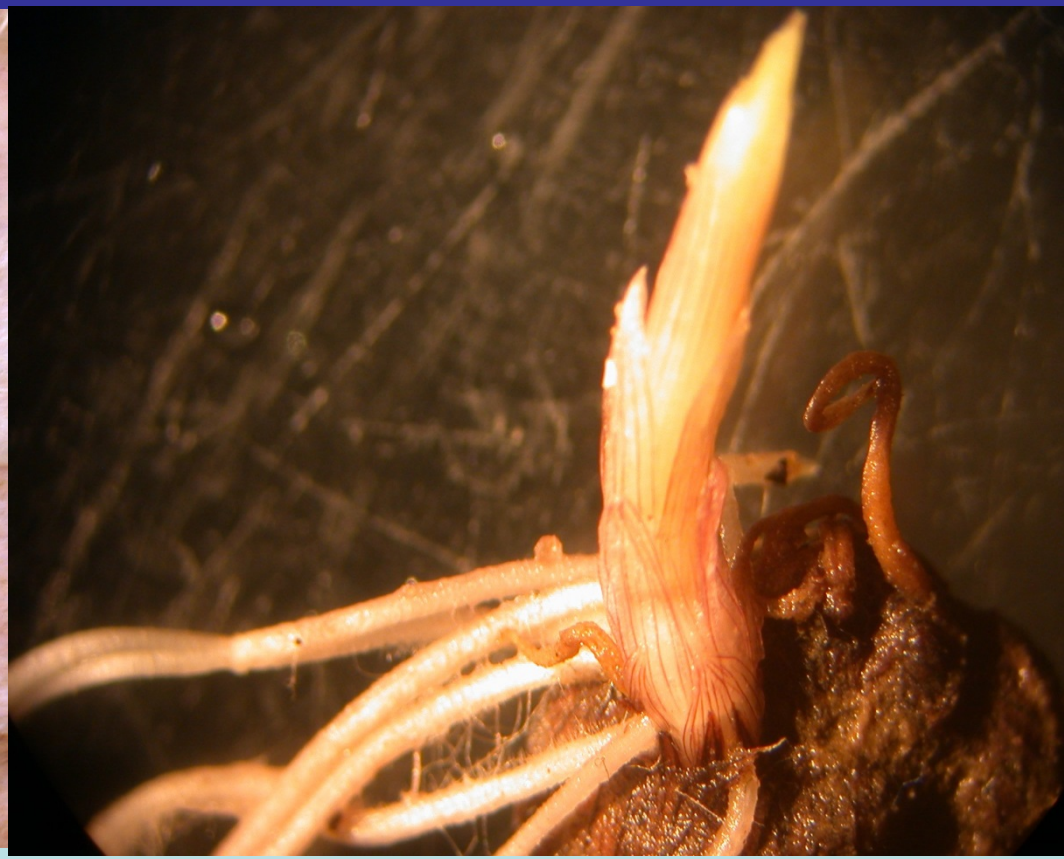


Yellow nutsedge shoots / 4 tubers

UNTRETED CHECK: 80-100% germination

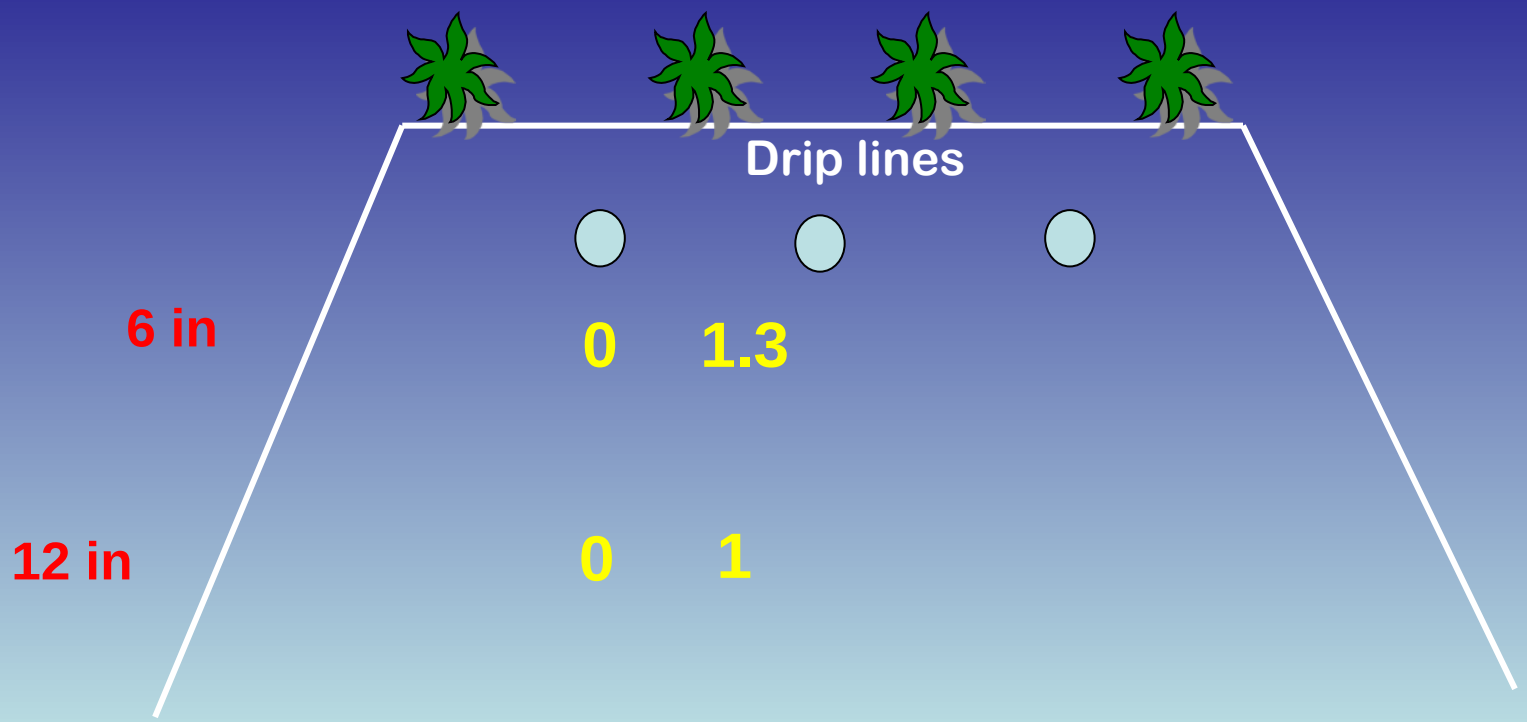


UNTREATED CHECK



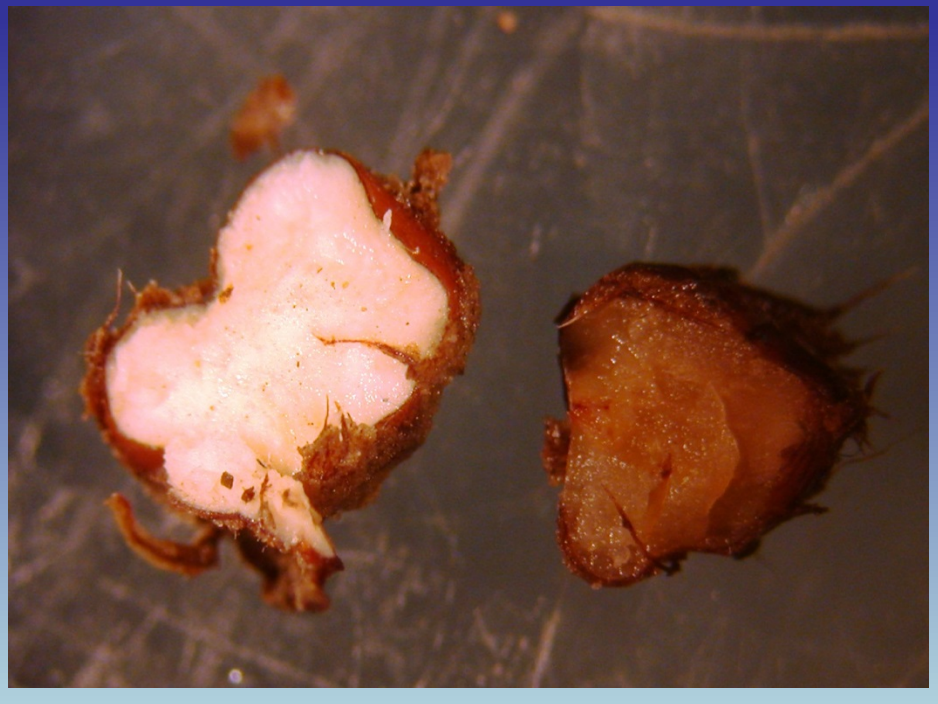
Yellow nutsedge shoots / 4 tubers

VAPAM: 0 to 33% germination



Depth was not important but location was

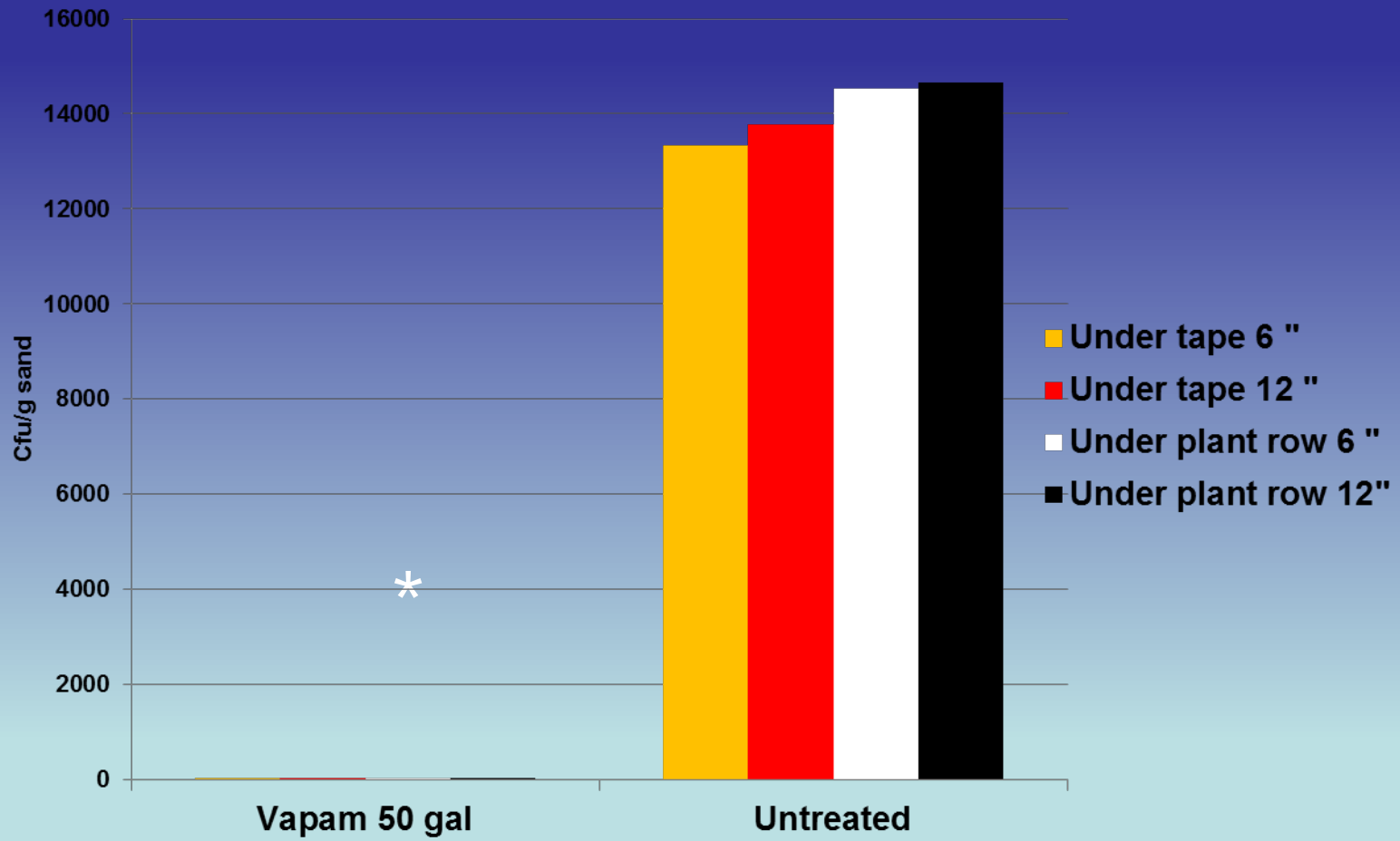
After VAPAM in PLANT ROWS



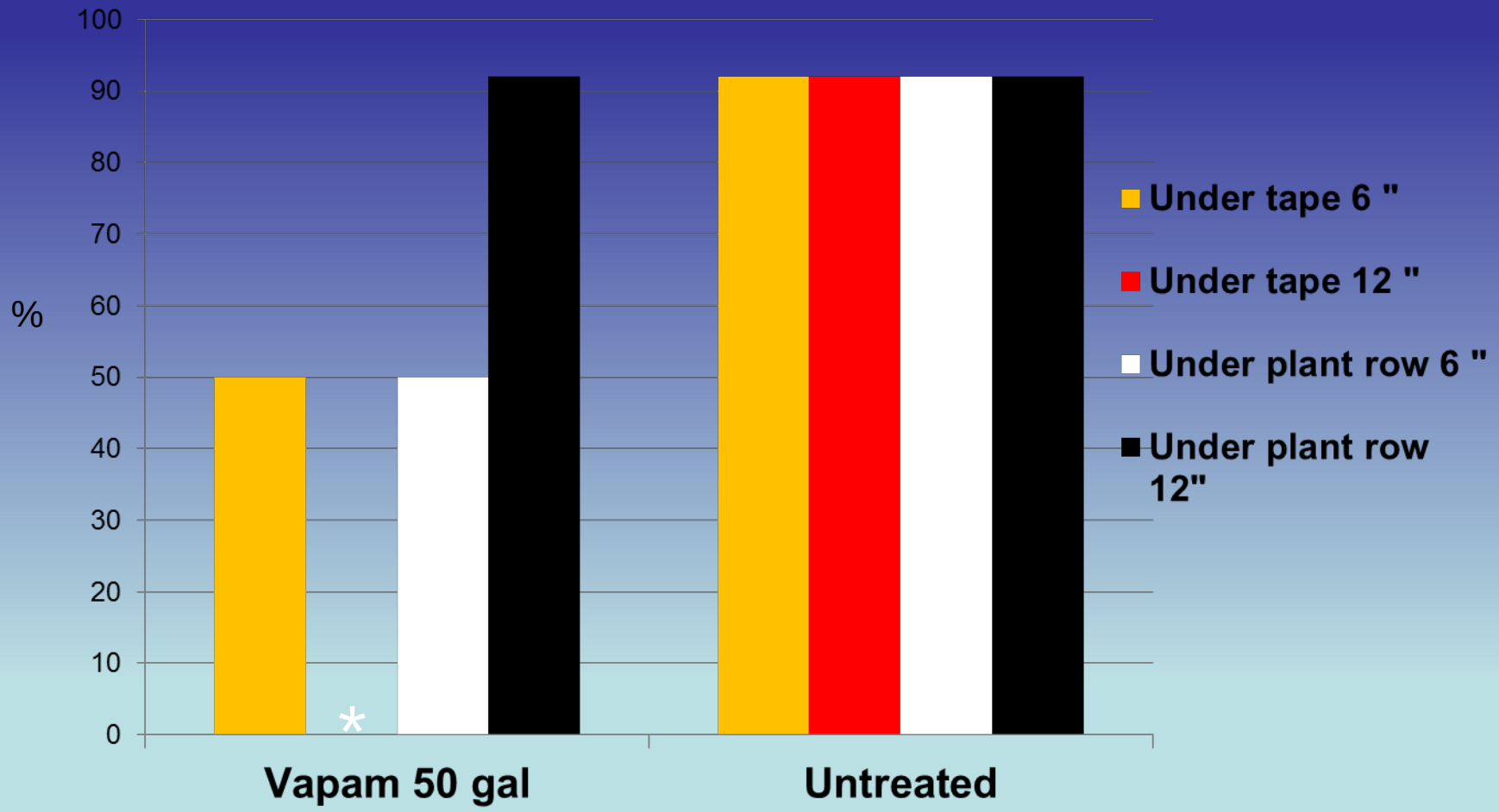
After VAPAM under the DRIP LINES

What about Fusarium?

F. oxysporum in sand inoculum

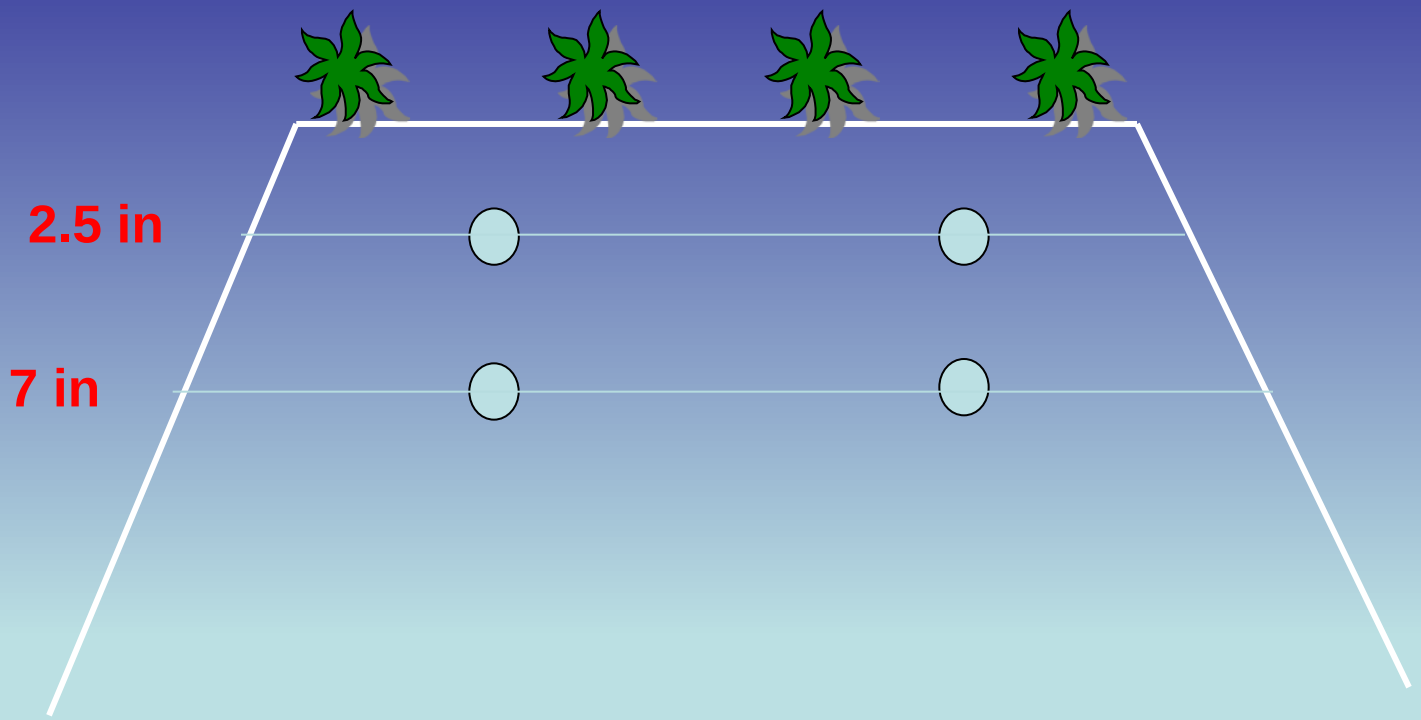


Recovery of *F. oxysporum* from infested crowns



What about Fall fumigation?

2013-2014: Improving fumigant distribution with 2 additional ‘deep’ lines



Treatments

1) Untreated - 2 lines underunder TIF
2) Two shallow drip lines – full rate under PE
3) Two shallow drip lines - full rate under TIF
4) Two shallow drip lines - 1/2 rate under TIF
5) Four drip lines (2 shallow & 2 deep) - full rate under TIF
6) Four drip lines (2 shallow & 2 deep) - 1/2 rate under TIF

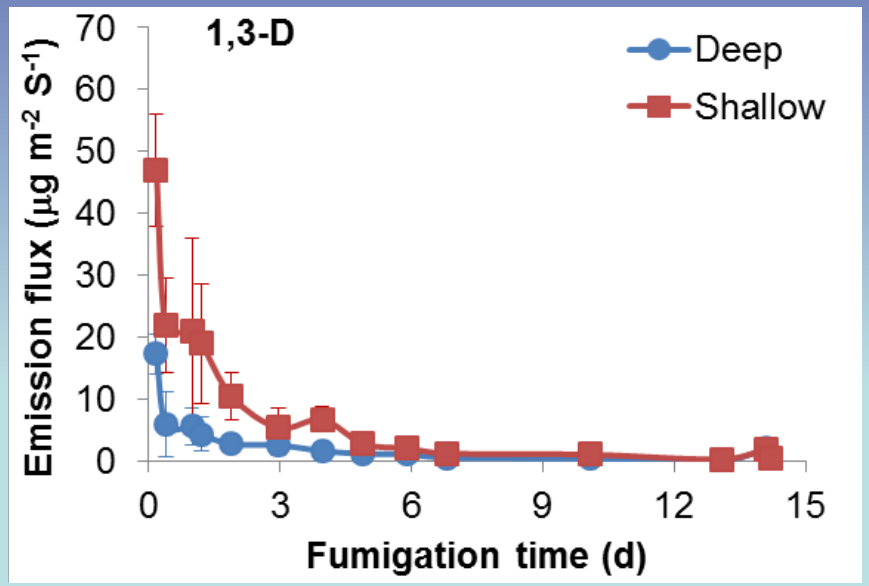
Pic-Clor 60 EC 300 lbs/ac vs. 150 lbs/ac (1/2 rate); a mixture of 56.7% CP, 37.1% 1,3-D, and 6.2% inert.

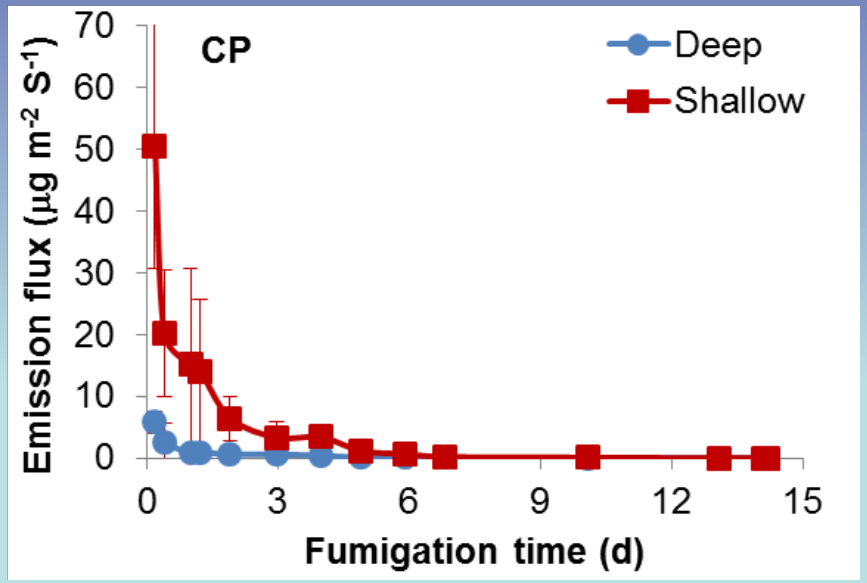
Measurements

- During fumigation period (Aug. 16-Aug. 30):
  - **Emission (passive chamber): Full rate TIF treatments (bed and furrow).**
  - **Fumigant concentration under film above soil surface (AU).**
  - **Fumigant gas in soil profile.**
  - **Pathogen survival at the end of fumigation.**
- **After fumigation:**
  - **Plant performance and fruit yield**

Fumigant emissions from bed

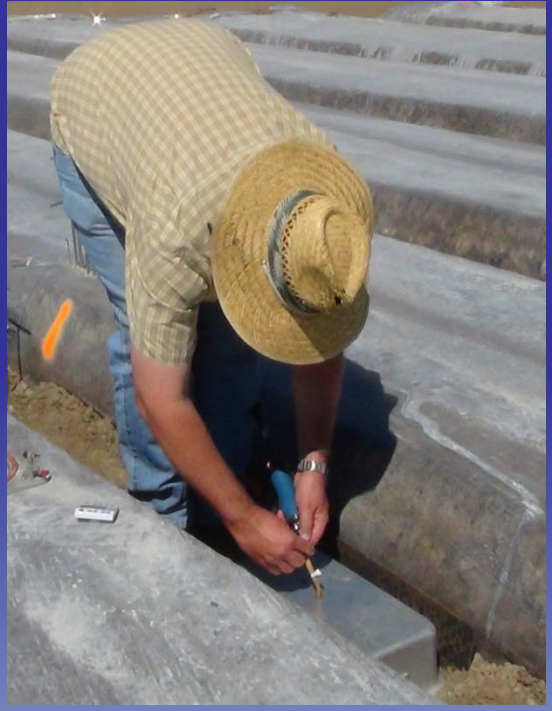
Deep vs. shallow application:

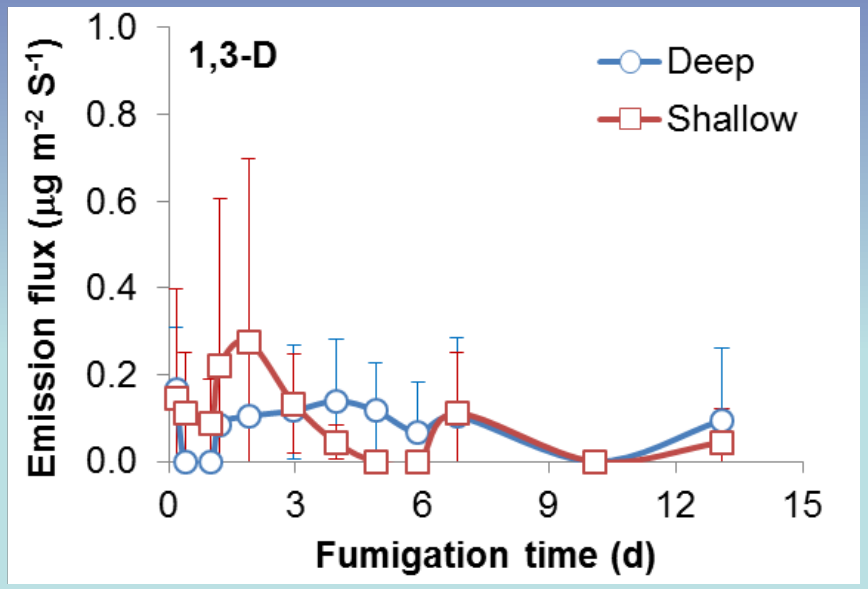


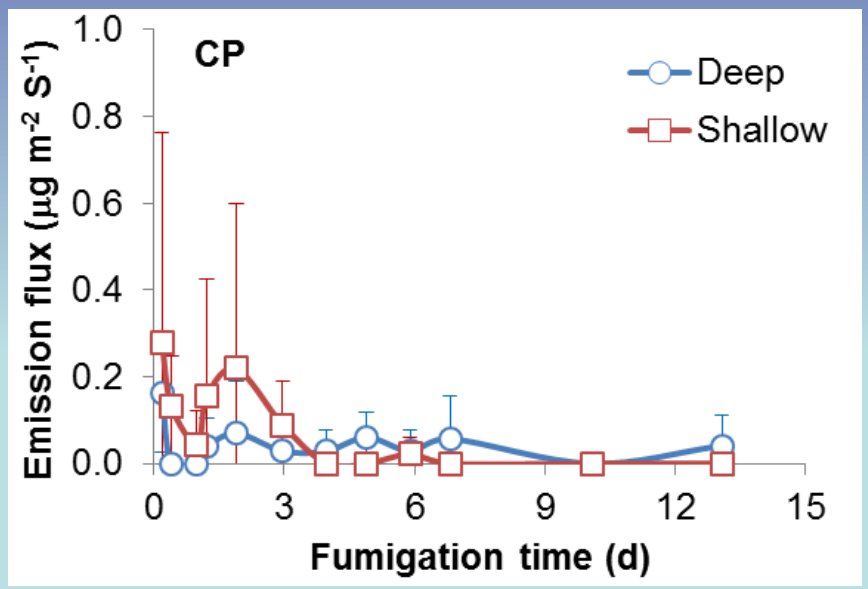


Fumigant emission from furrow

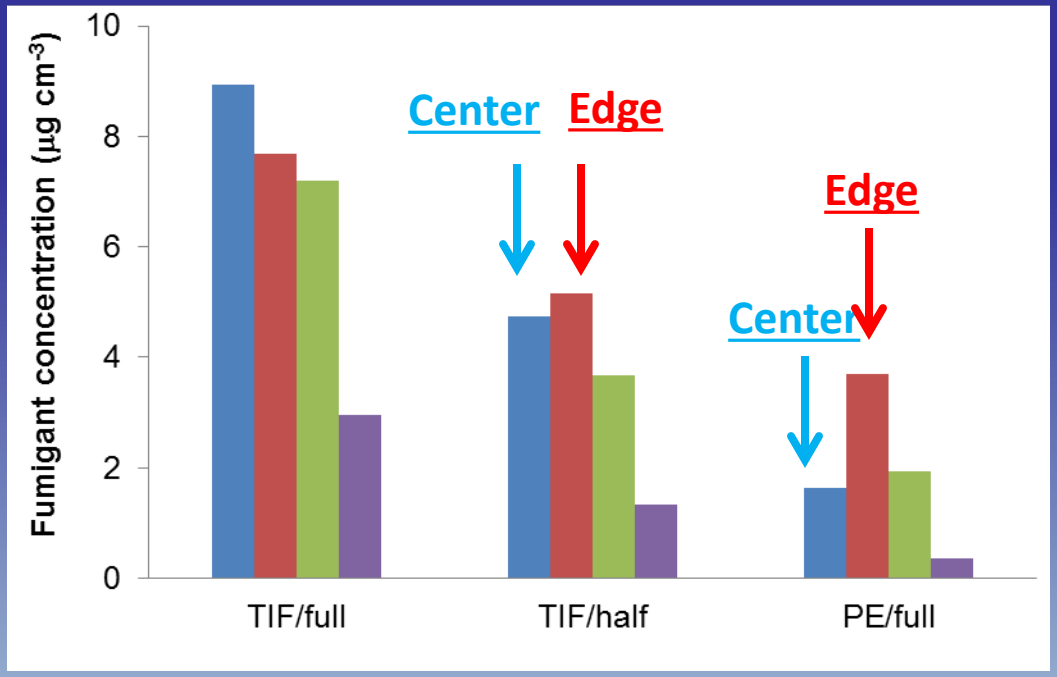
Deep- vs. shallow-application:

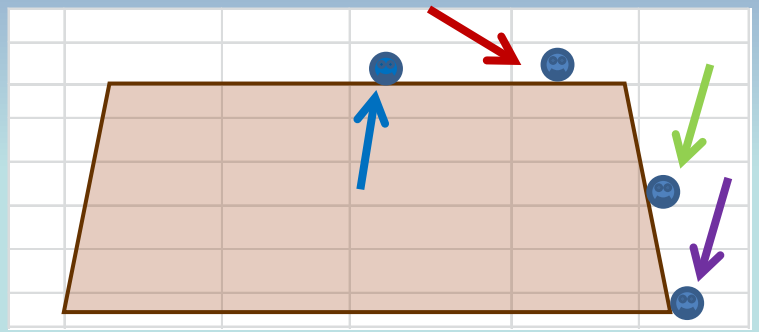




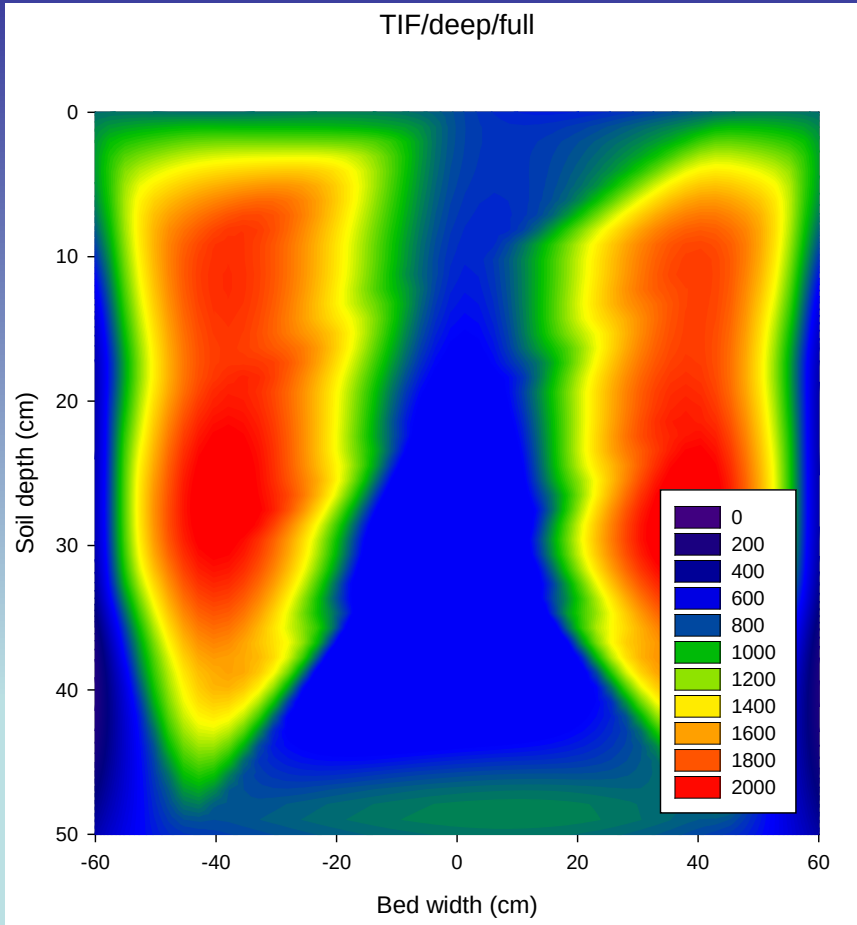


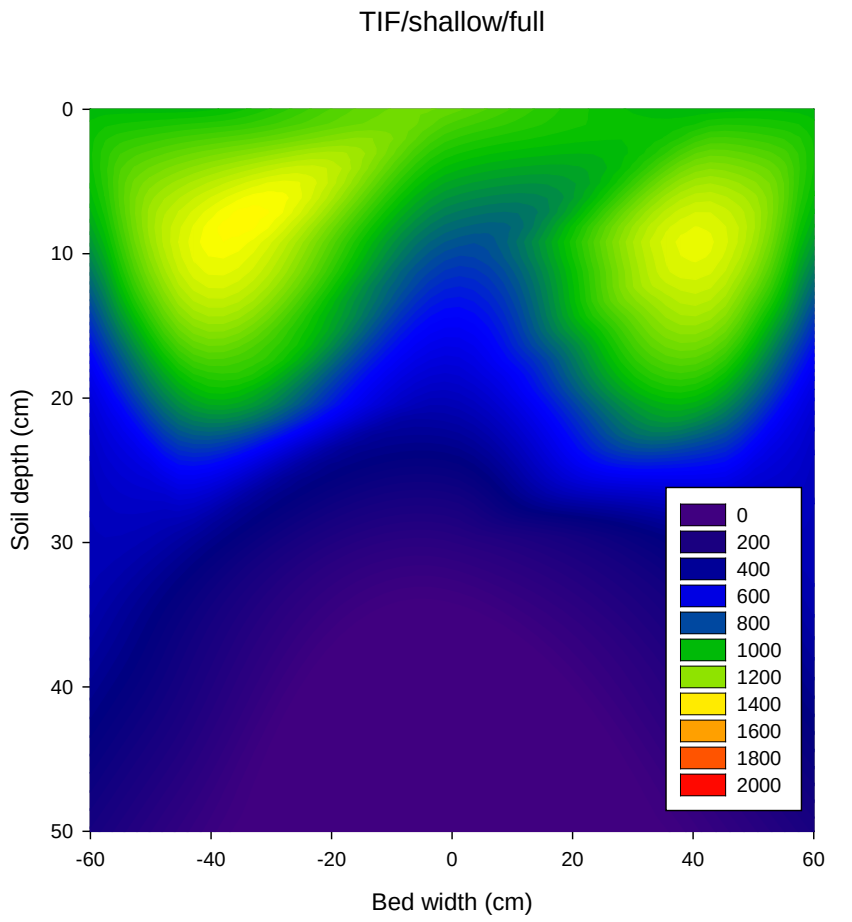
Fumigant concentration under film





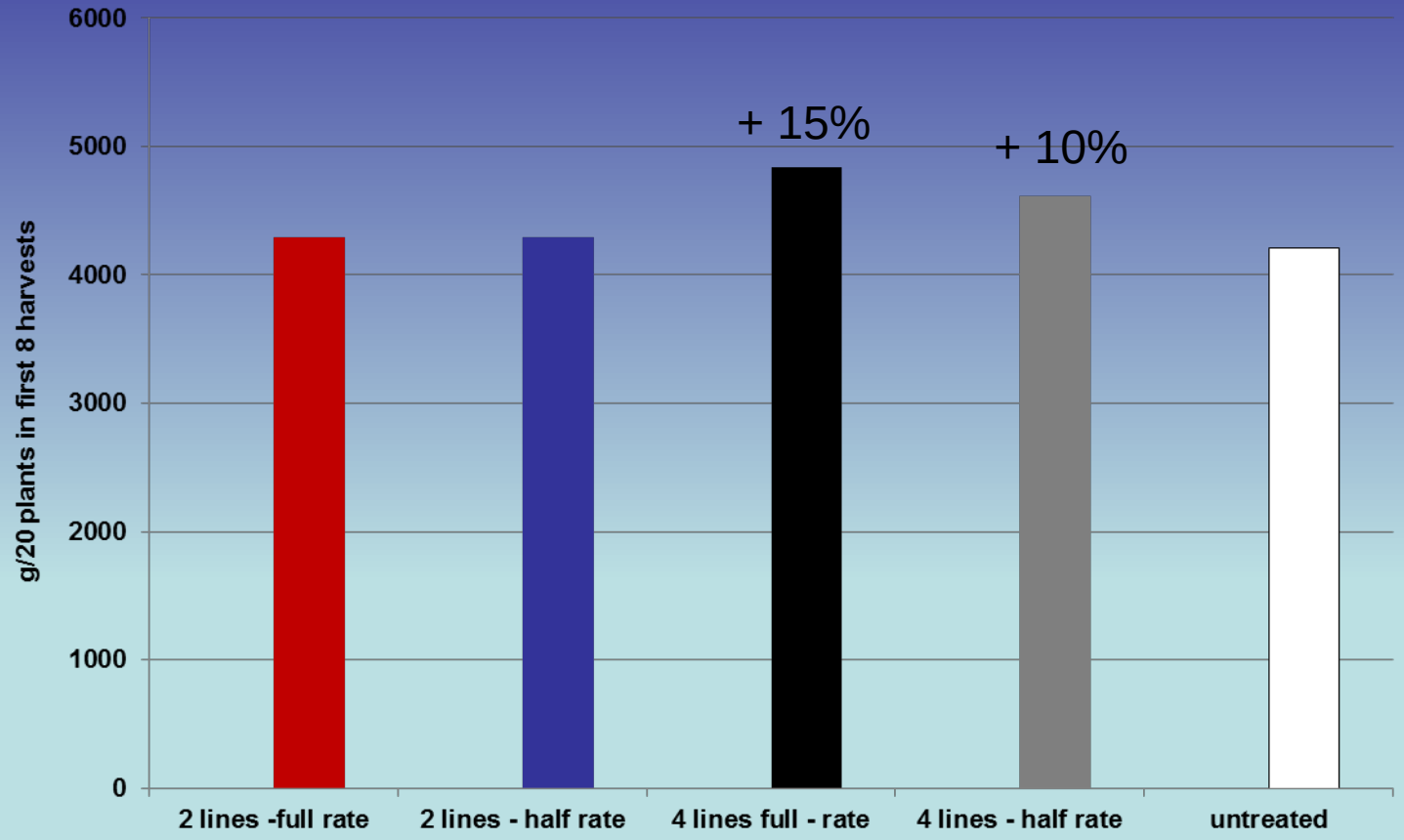
Fumigant concentration time exposure index





Marketable fruit yield

January 30 to March 18.



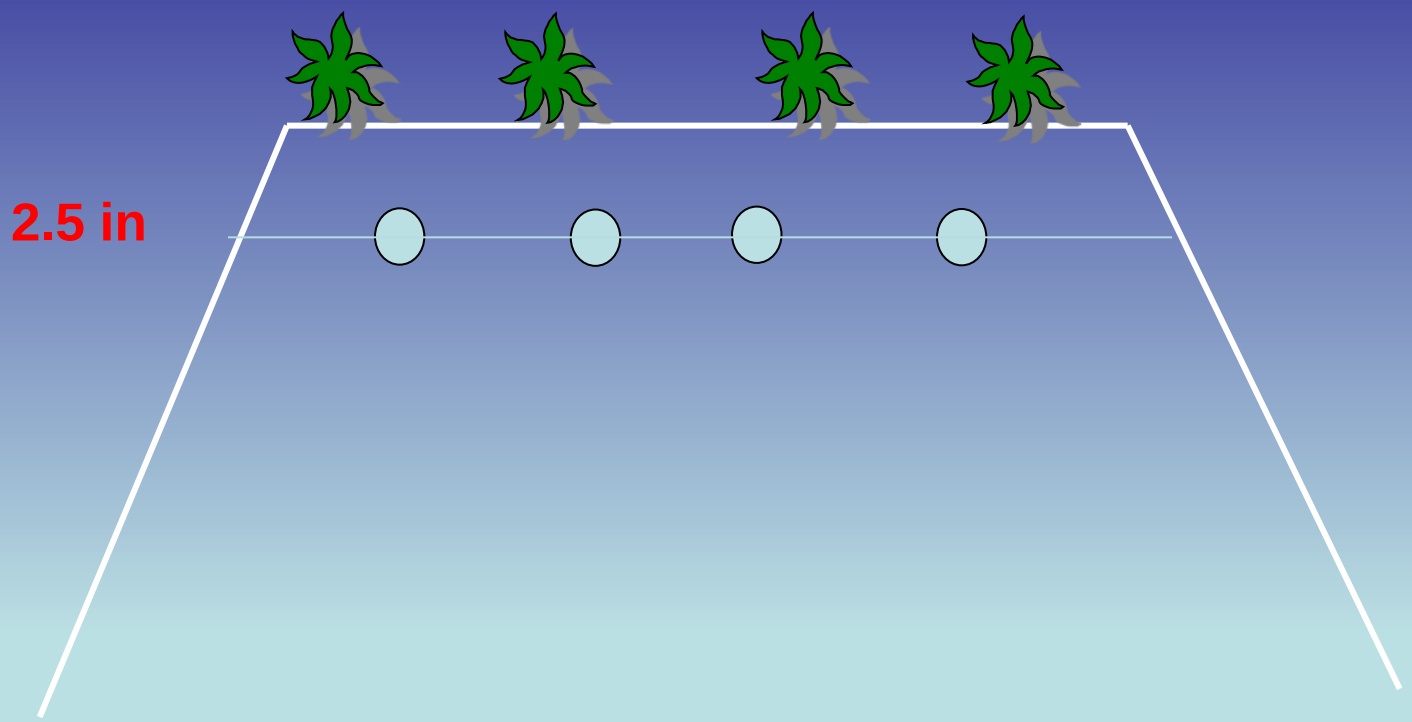
2014-15 fumigation experiment

A) 2 drip lines - non-fumigated control under VIF (CK)
B) 2 drip lines - full rate under PE (2L/full/PE)
C) 2 drip lines - full rate under VIF (2L/full/VIF)
D) 2 drip lines - 1/2 rate under VIF (2L/half/VIF)

E) 4 drip lines - full rate under VIF (4L/full/VIF)
F) 4 drip lines - 1/2 rate under VIF (4L/half/VIF)

- The flow rate for one drip tape in the treatment A-D is approximately 2 times to that in the treatment E-F, so similar application rate was achieved in the 2-line- or 4-line-treatments .
- Tri-Clor Fumigant (a mixture of 99% CP and 1% inert ingredients) was applied with a full rate of 224 lbs/ac and a half rate of 112 lbs/ac.

4 shallow tape layout

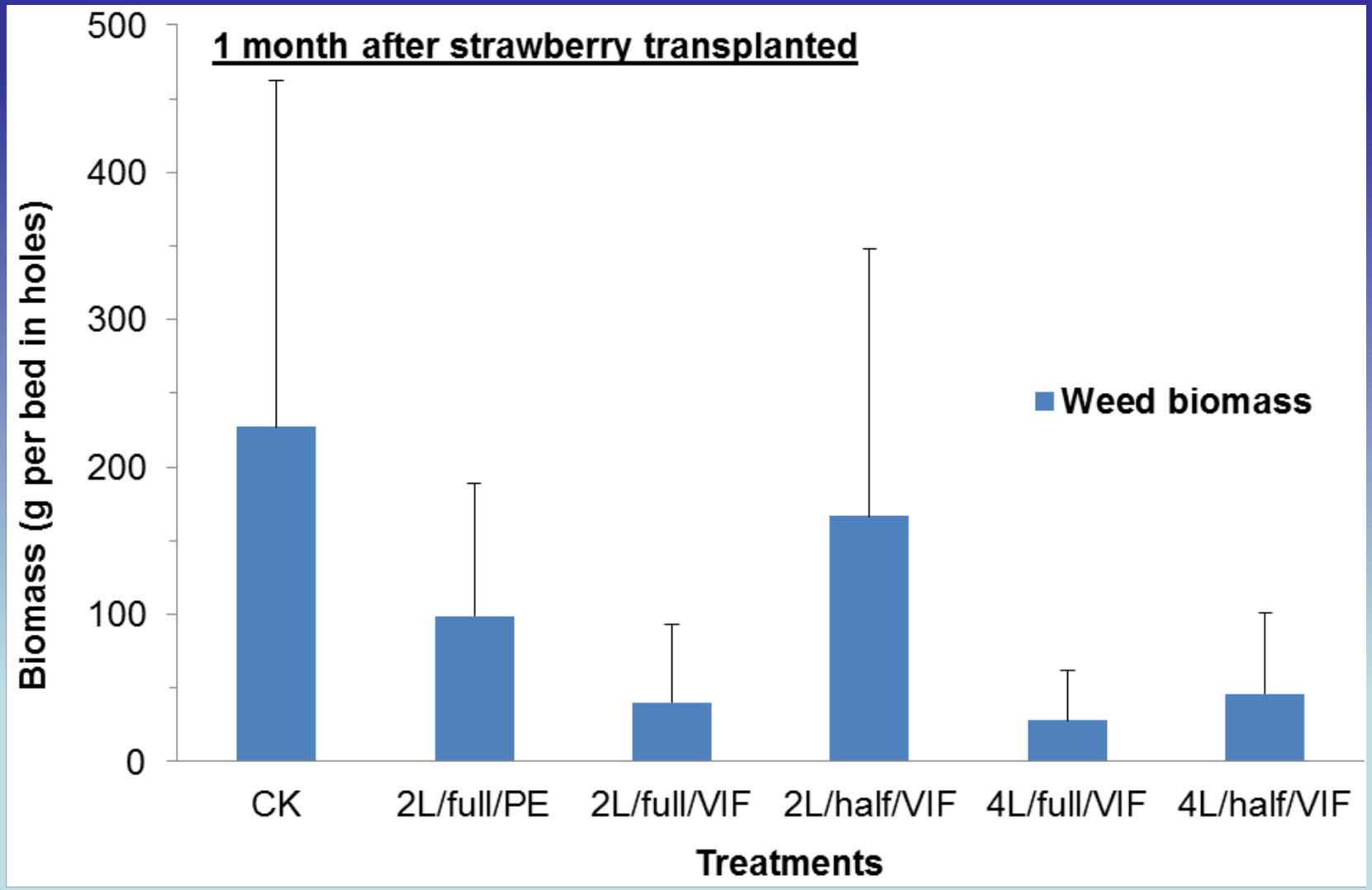



Installing 4 drip tapes

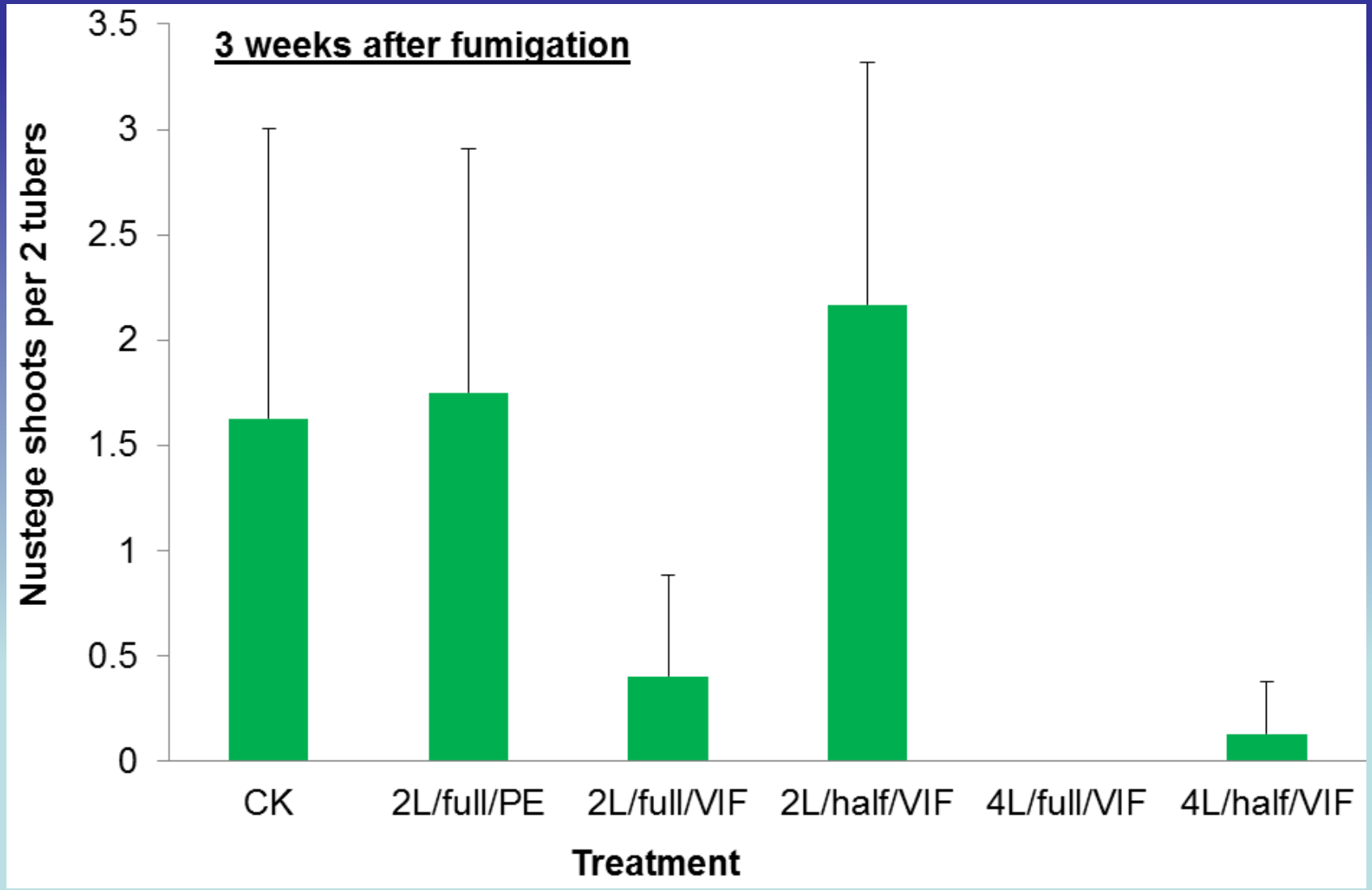
Fumigant behavior

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

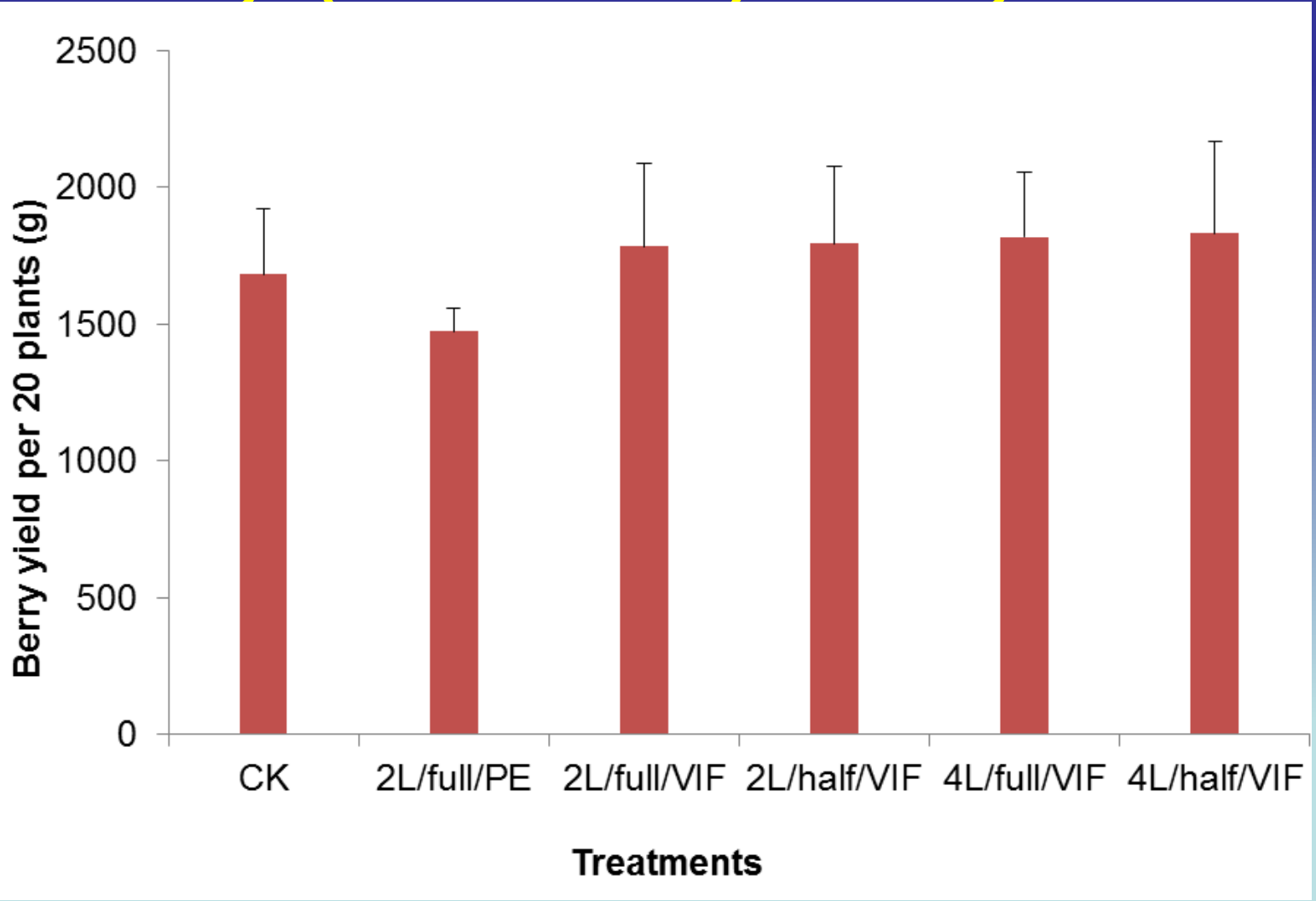
Weeds in planting holes



Yellow nutsedge shoots



Early (Dec-Feb) fruit yields



2011-2014 Strawberry irrigation trials (U. Laval and UC)

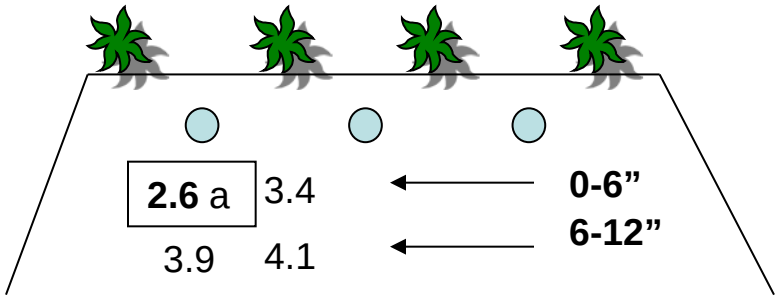
Conclusions for Watsonville-Salinas

Treatments: GROWER STANDARD, WET, DRY, VARIABLE

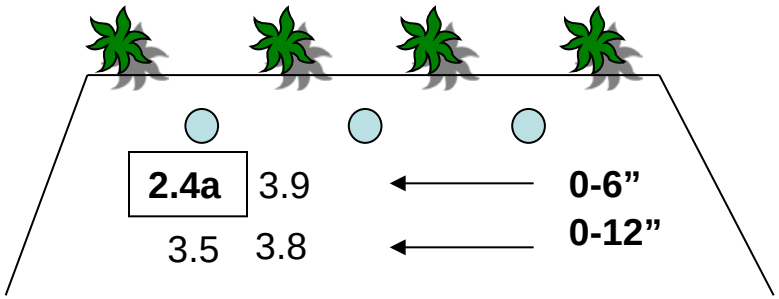
Optimum tension threshold for maximum yield in clay soils was about 10 cbars (Watsonville-Salinas)

2014 EC = electrical conductivity, dS/m

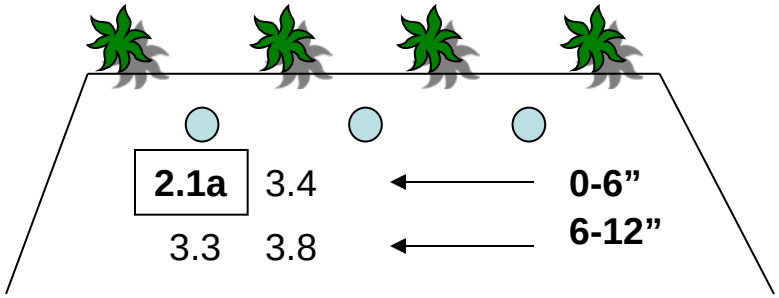
Grower



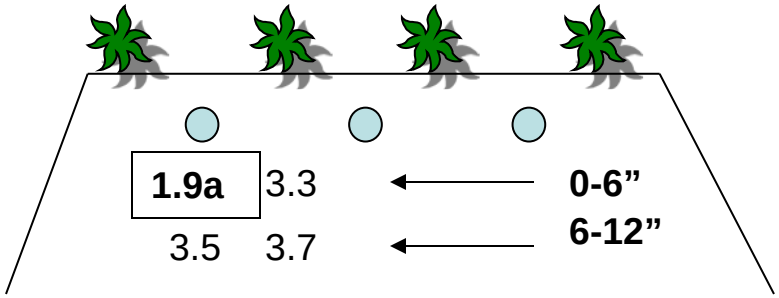
Roots



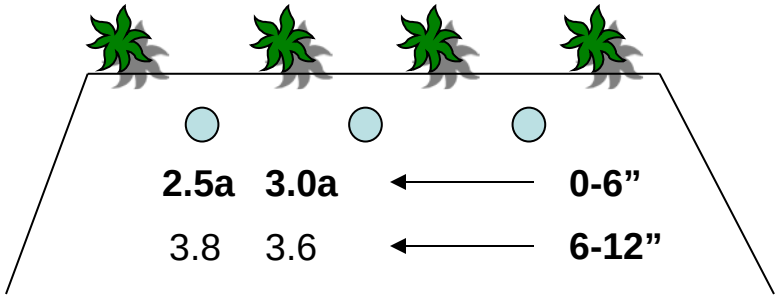
Wet



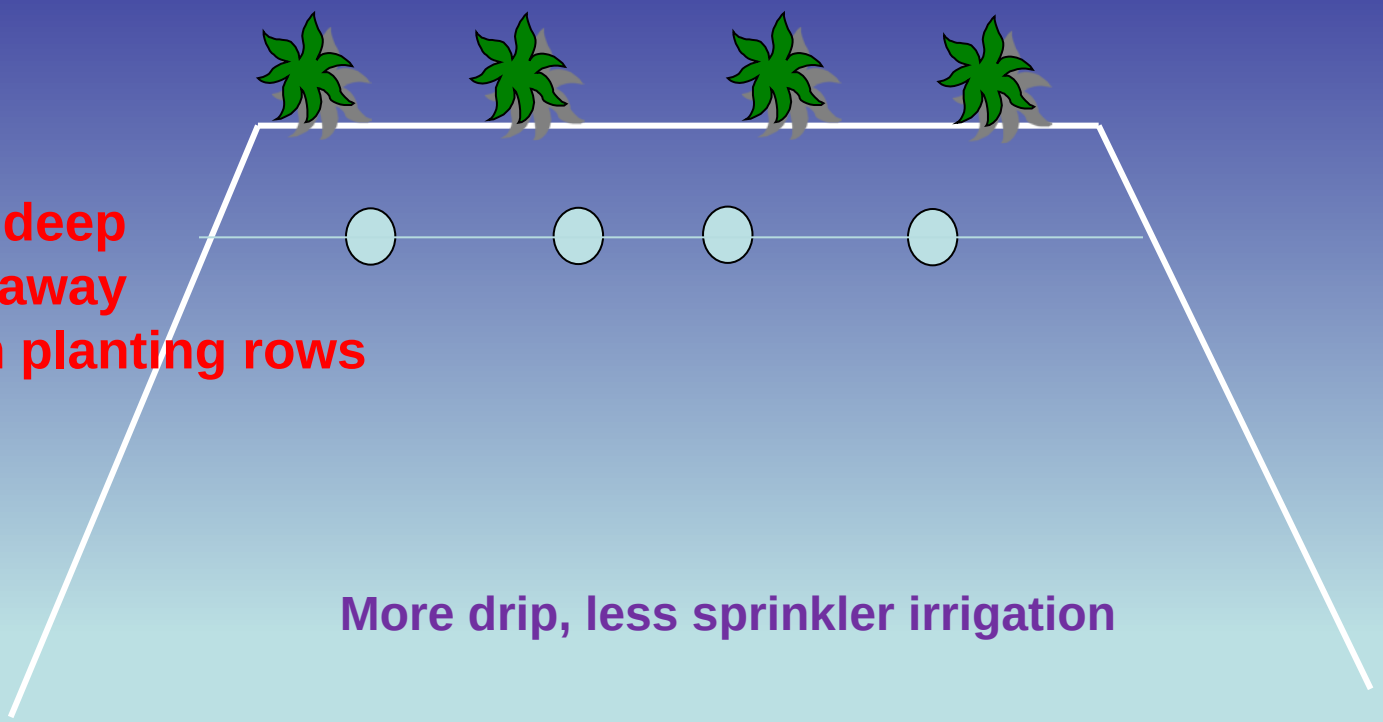
Variable



Dry



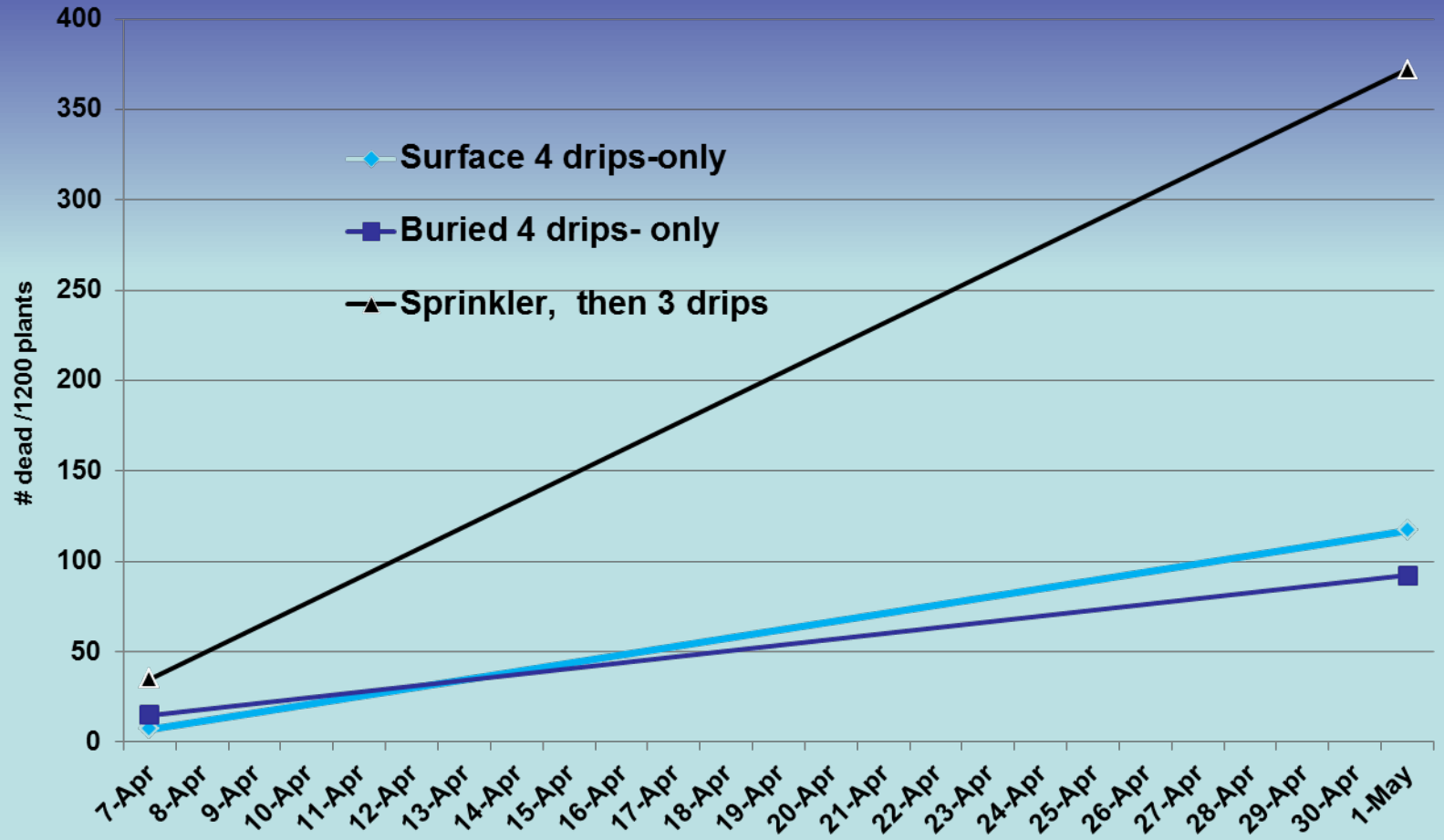
Plant establishment with 2 additional ‘shallow’ lines (Oxnard and S. Maria) or 1 (Watsonville)

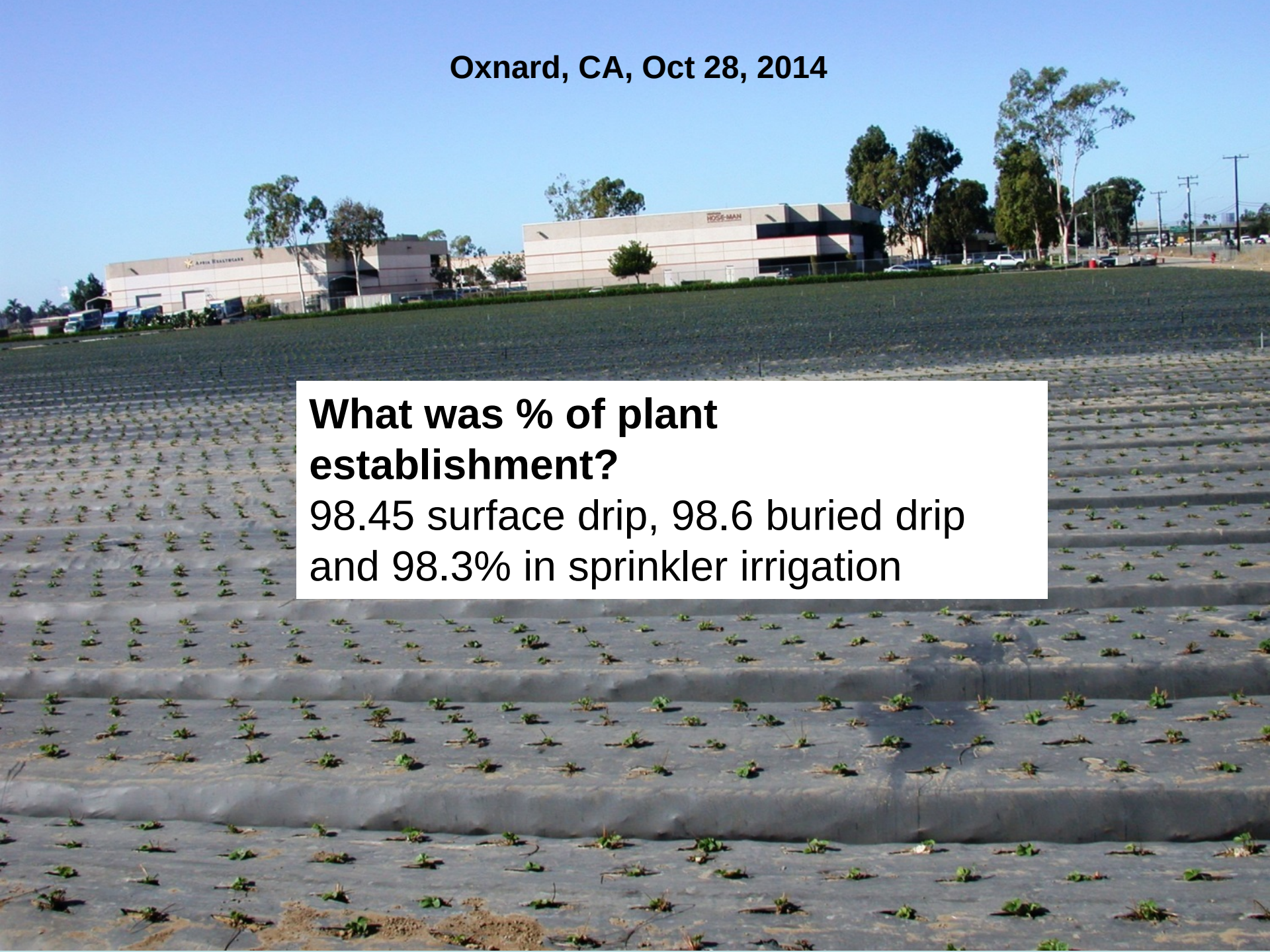


http://www.youtube.com/watch?v=K2TNXAGK_TM

- Placing 4 tapes: depths and locations
- sprinkler irrigation – wet furrows hold plastic during Santa Ana winds
- View plants established on 4 drip lines vs sprinkler irrigated, followed by 3 drips.

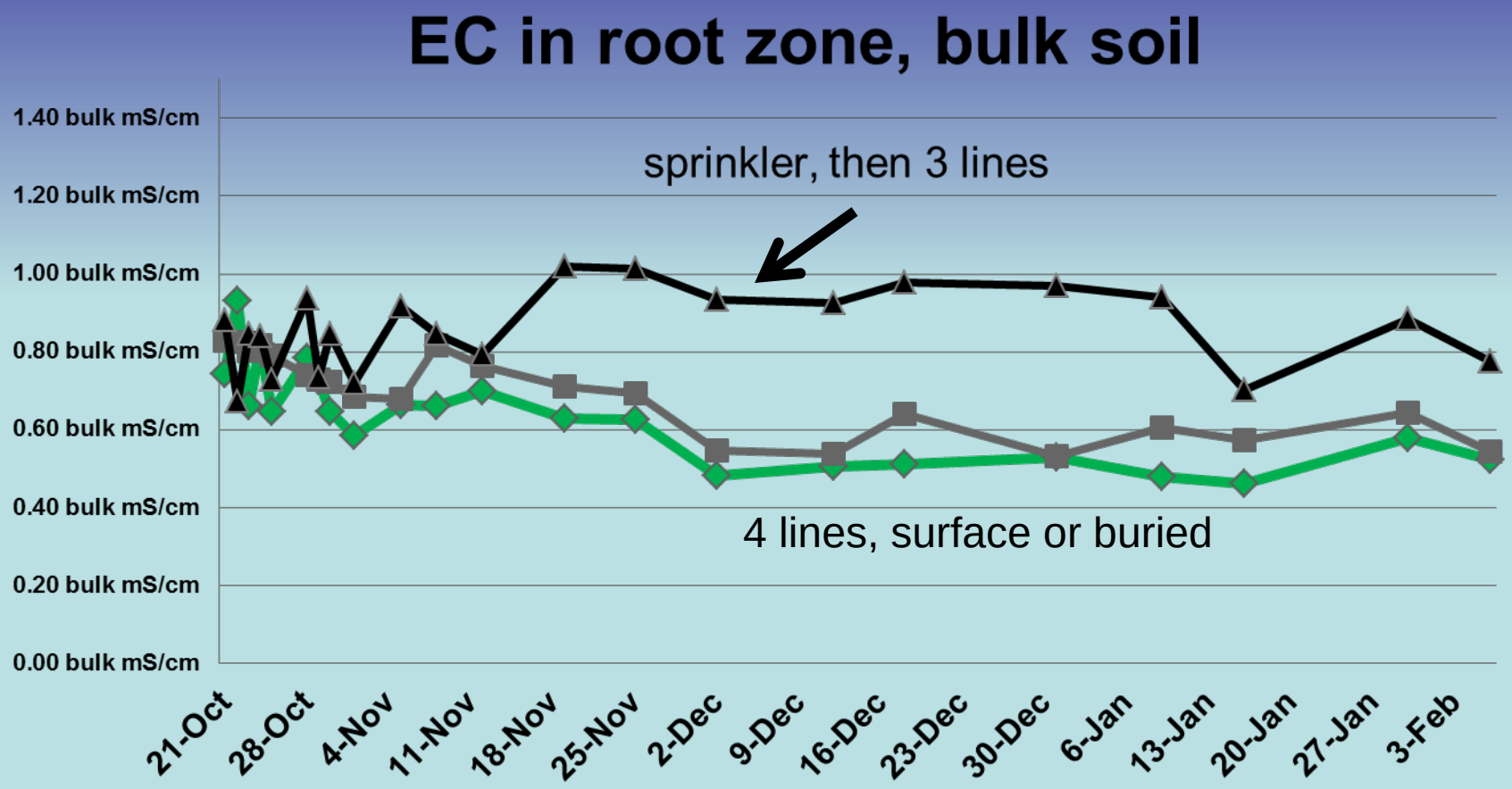
Oxnard: irrigation affecting plant mortality due to *F. oxysporum*



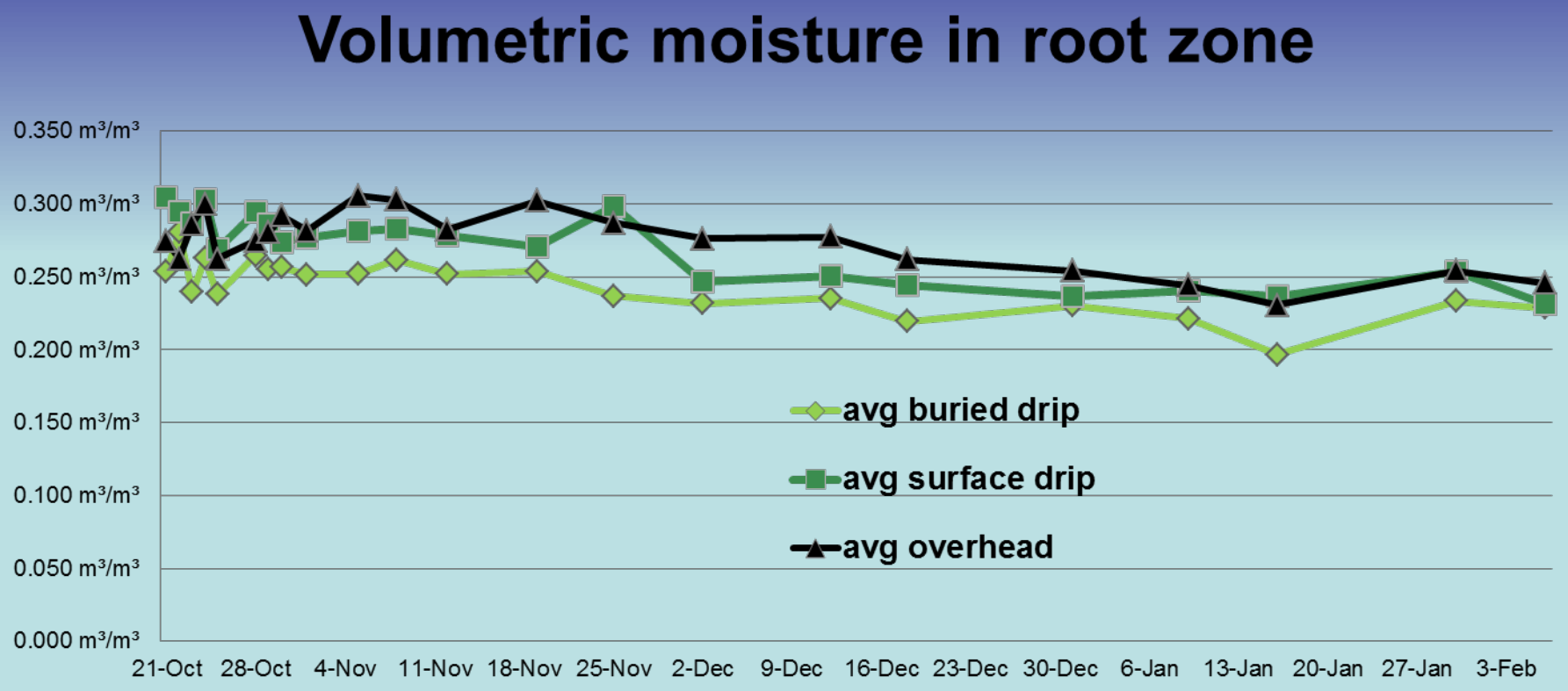

Oxnard, CA, Oct 28, 2014
What was % of plant establishment?
98.45 surface drip, 98.6 buried drip and 98.3% in sprinkler irrigation


Protiotek
MENU
ENTER

4-drip vs sprinkler



4-drip vs sprinkler



Soil Analyses 0-6 “ Nov 19

	4 drip surface	4 drip buried	Sprinkler, then 3 drip
chloride	0.64 meq/L	0.79 meq/L	2.74 meq/L
sodium	5.89 meq/L	7.09 meq/L	9.97 meq/L
EC sat paste	3.66 dS/m	4.21 dS/m	3.99 dS/m
sulfate	39.2 meq/L	36.3 meq/L	45.2 meq/L

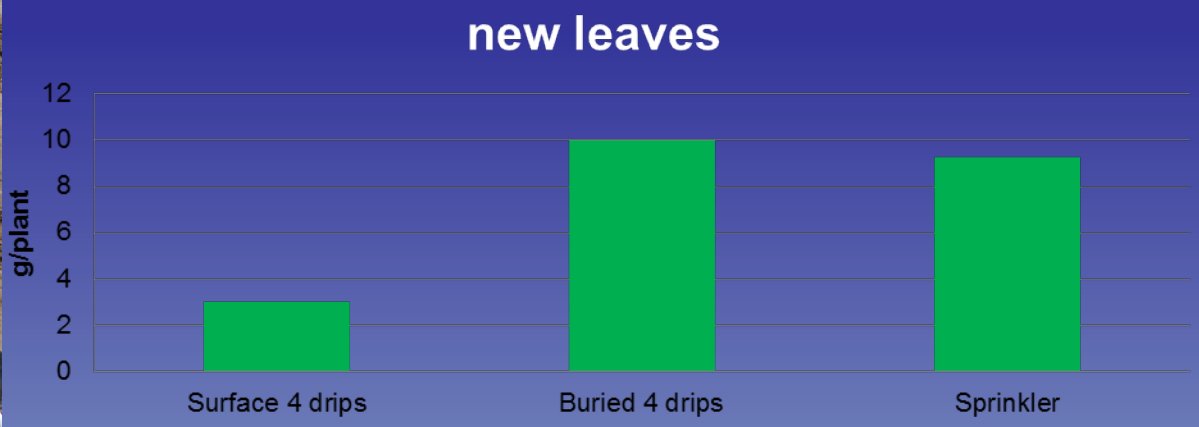
No differences in Ca, Mg, K or B, slightly heavier soil in sprinkler block

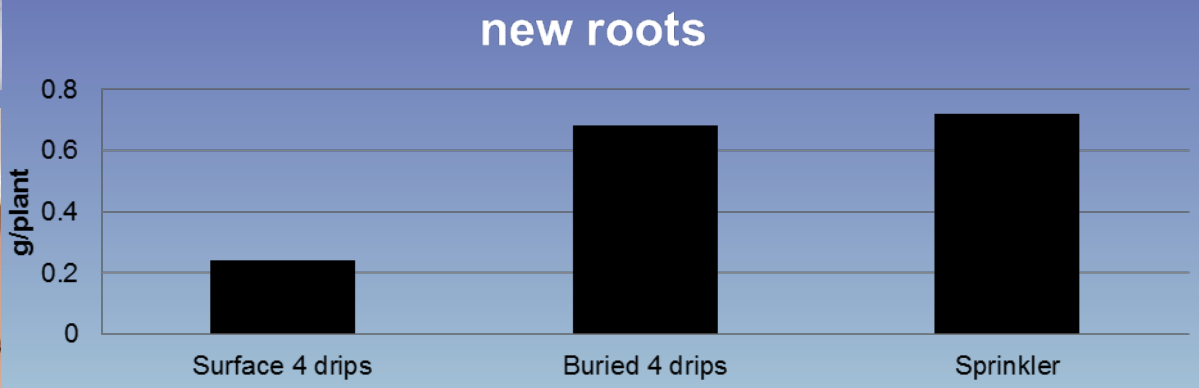
Plant Tissue Analyses, Feb 18

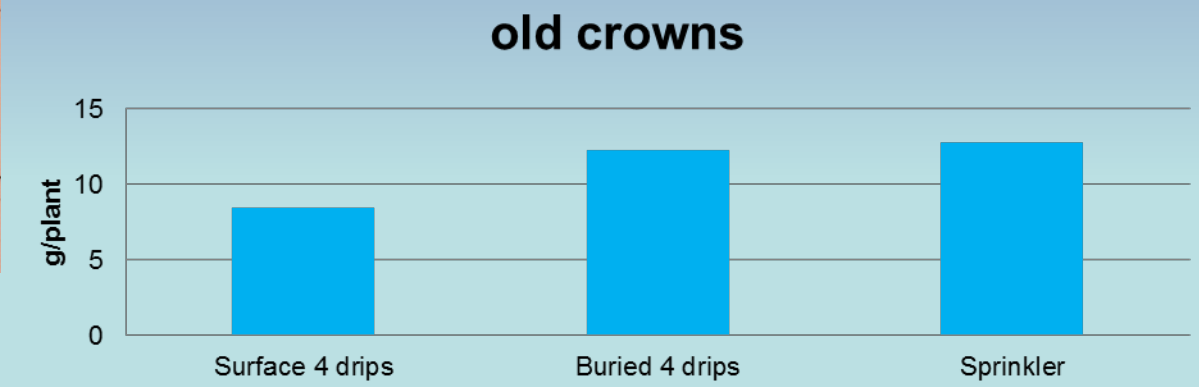
	4 drip surface	4 drip buried	Sprinkler, then 3 drip
Nitrate -N	931 ppm	668 ppm	905 ppm
Phosphate -P	2030 ppm	2040 ppm	2450 ppm
Zinc	21.9 ppm	24.1ppm	27.7 ppm
Manganese	76 ppm	109 ppm	174 ppm

No differences in Ca, Mg, K, or Fe, - slightly heavier soil in sprinkler block

Plant dry biomass, Dec 12







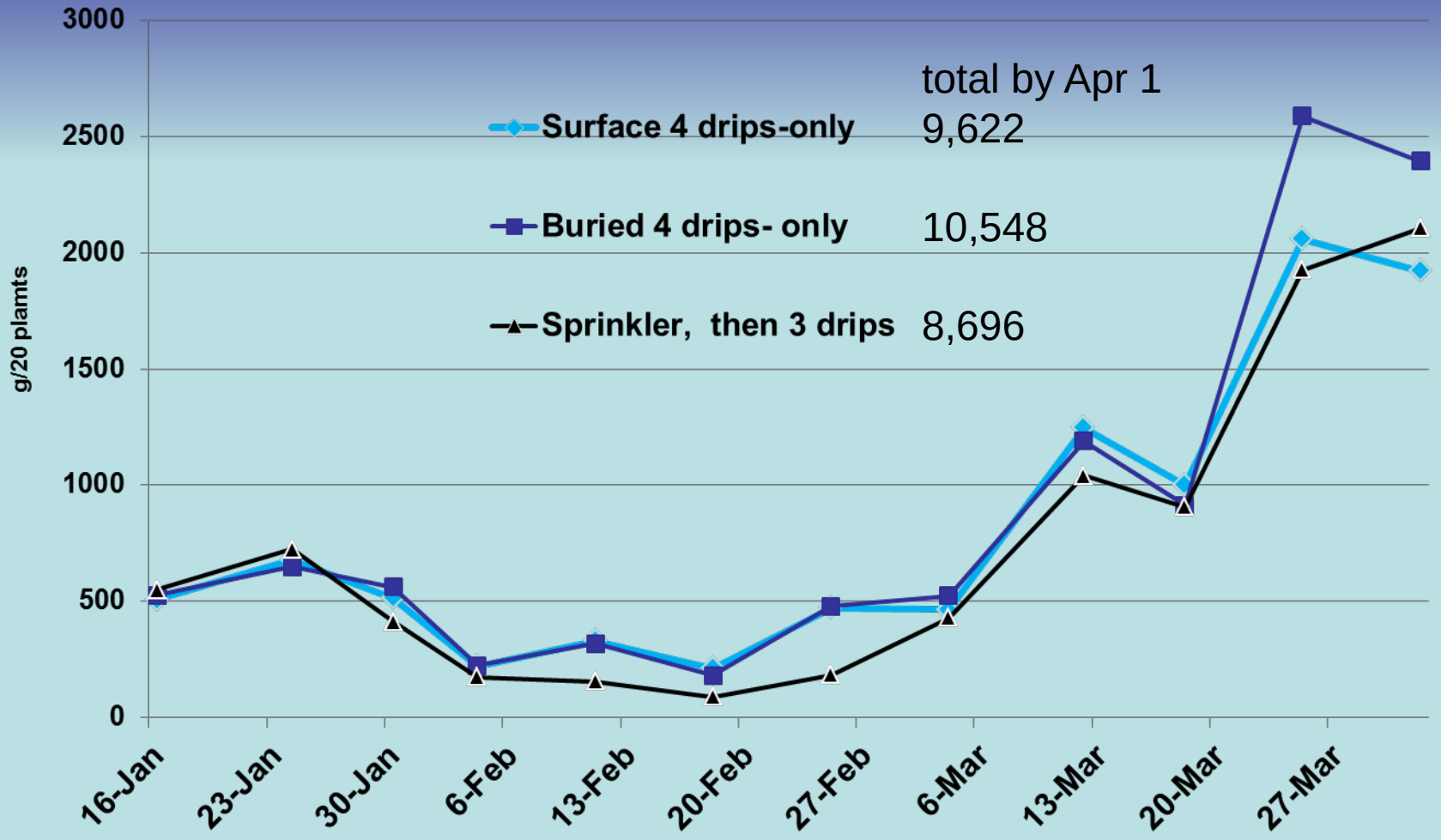
Nov 26, 2014 canopy size

Surface 4 lines (22% smaller)

Buried 4 lines

= Sprinkler

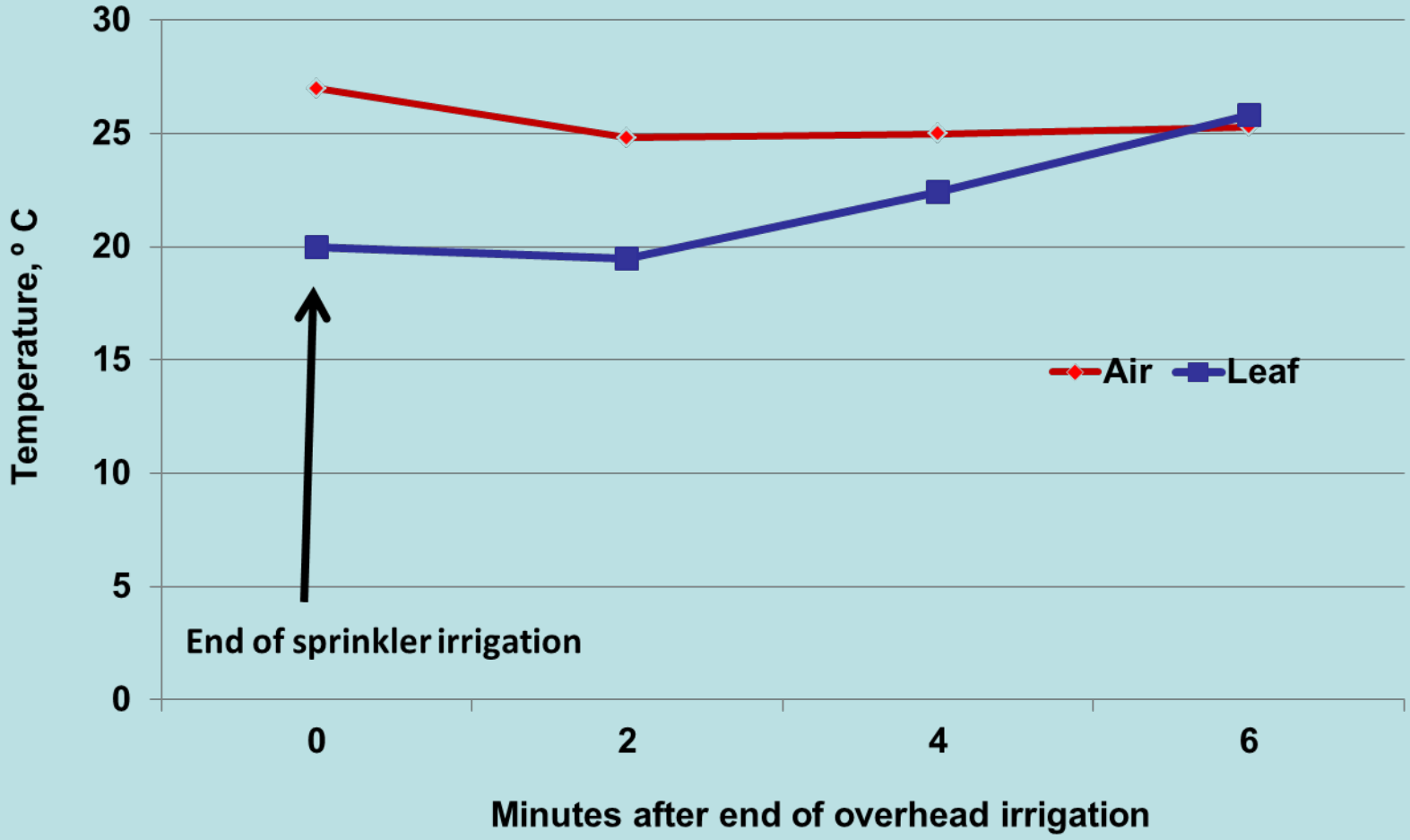
Marketable fruit yield , Oxnard

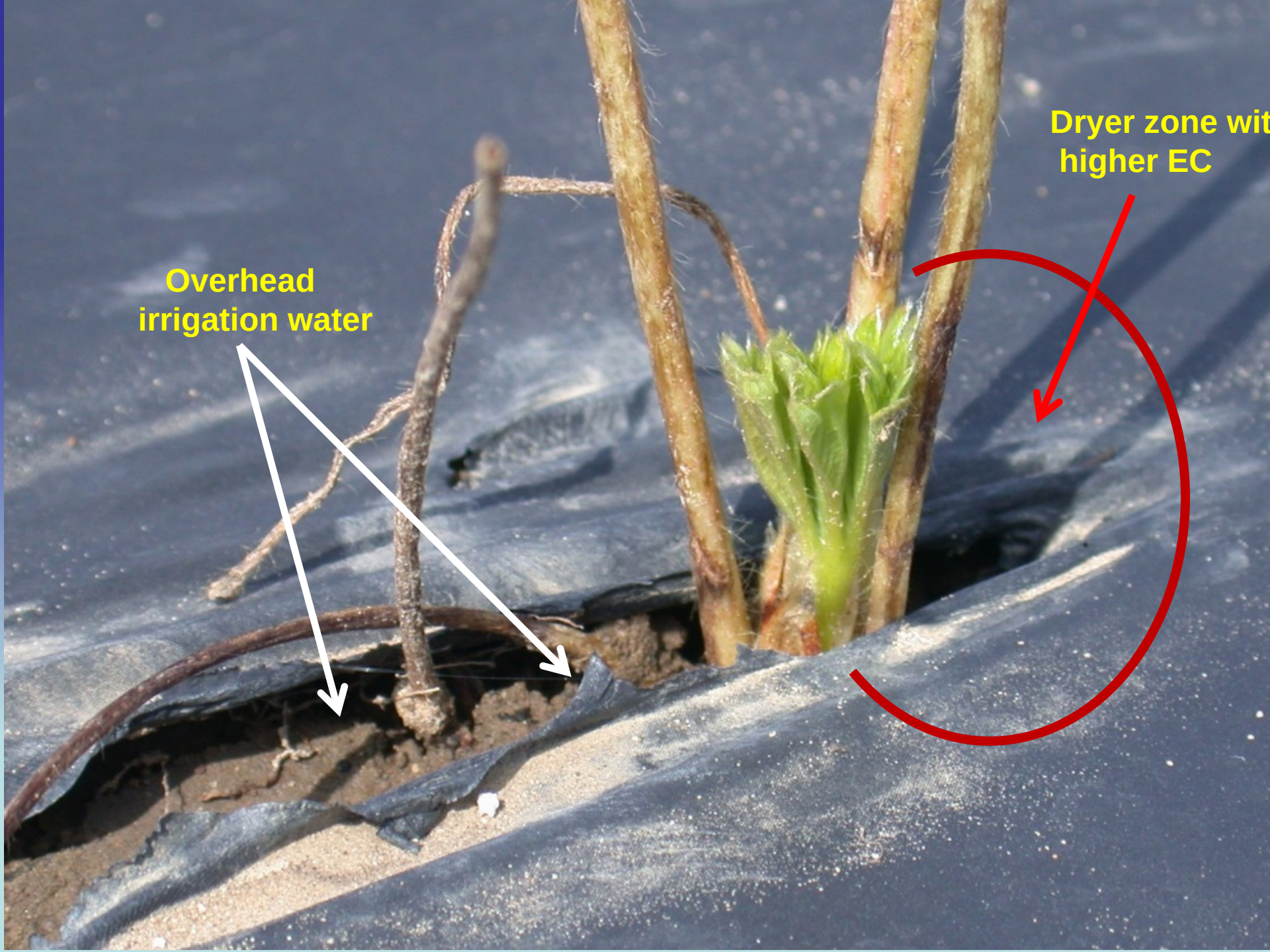


Water use/acre by Nov 12 (before removal of sprinklers):

- **4-DRIP block:** 11, 200 gal (by drip) + 4, 060 gal (2 sprinkler runs during Santa Ana conditions, 1st week of Nov) = **15,260 gal**
- **SPRINKLER block: 47, 250 gal** (collected by cans)

Plant temperature during Santa Ana winds




Overhead
irrigation water
Dryer zone wit
higher EC

Santa Maria:
2 or 4 drip lines with reduced or regular sprinkler irrigation

Plant size or biomass: **Similar, except smaller plants in 4 lines+regular sprinkler**

Bulk soil EC and moisture in root zone: Similar

		0-12" Apr 9th		
	loam	loam	sandy loam-loam	sandy loam
	4 lines reduced	**4 lines regular**	**2 lines regular**	**2 lines reduced**
EC sat paste dS/m	4.16	3.83	4.82	3.72
Chloride, meq/L	2.82	3.23	4.12	2.89
Sodium, meq/L	9.1	9	10	8
Sulfate, meq/L	41	35	38	28
Potassium, meq/L	1.6	1.6	1.7	1.9

10 April ’14

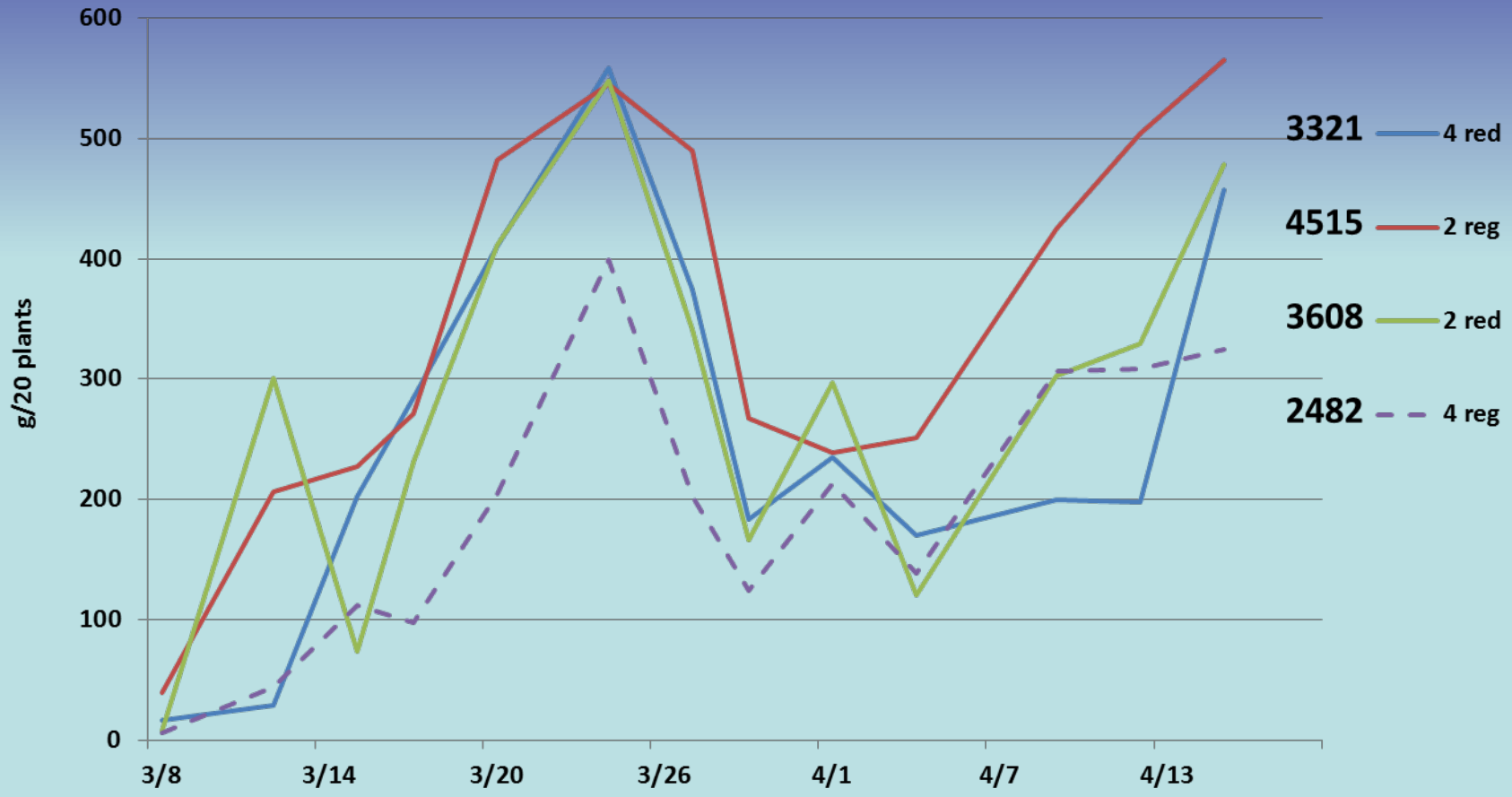
4 lines reduced

4 lines regular

2 lines reduced

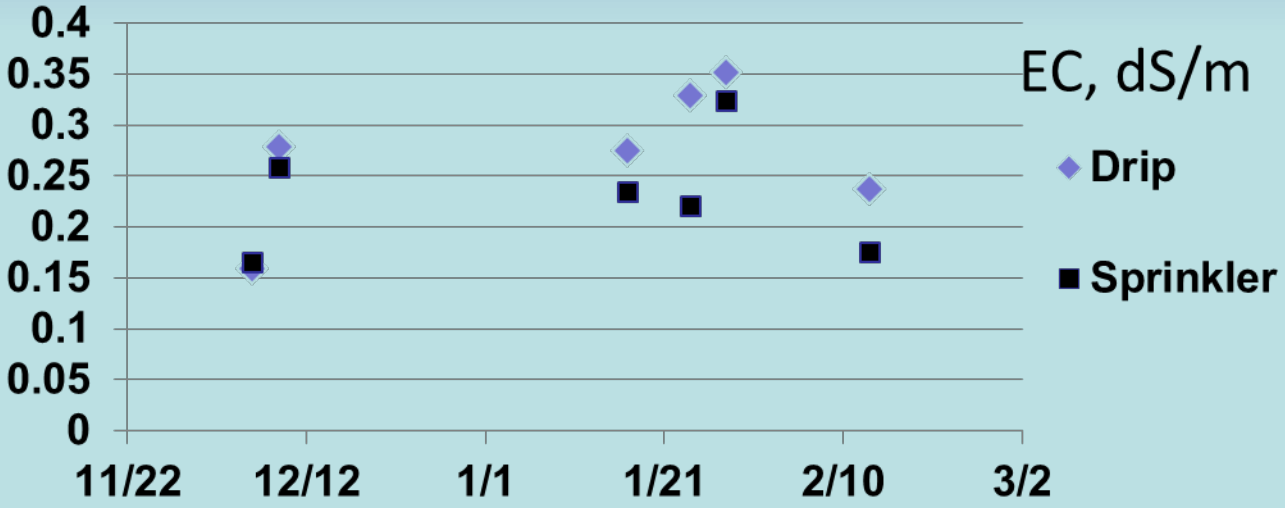
2 lines regular

Santa Maria: fruit yields



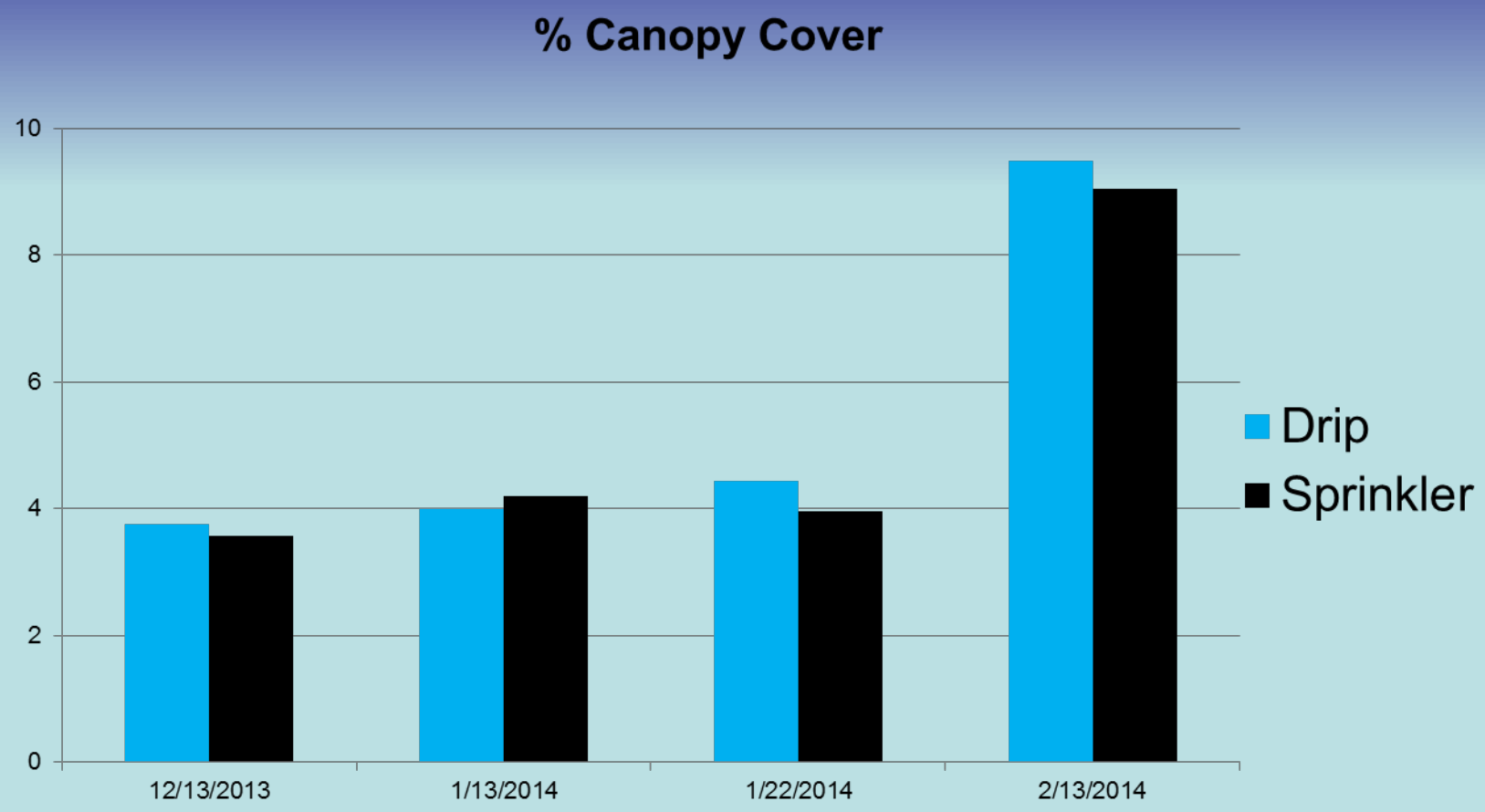
Watsonville:
2 drip-only vs sprinkler + drip

- Water savings: 21%
- Plant biomass: similar, but more roots in drip-only
- Electrical conductivity:

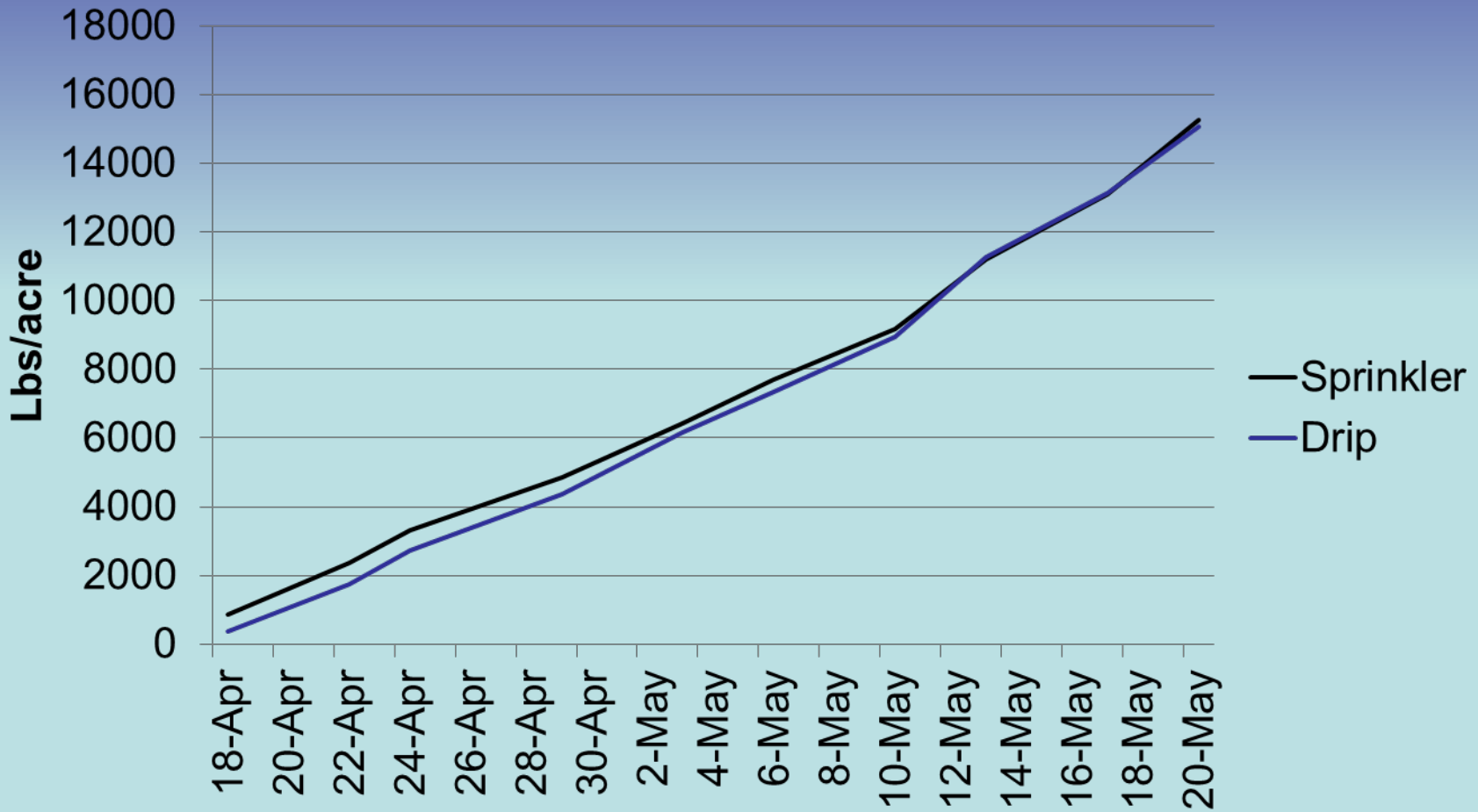


- Soil Moisture: similar

Watsonville:



Watsonville:
cumulative fruit yield



Summary

- Additional drip lines hydrate root zones and leach salts effectively (may leach N)
- Conserve water and prevent runoff with no negative effect on yield
- Sprinklers needed but amount of overhead water can be minimized
- Fumigant distribution can be improved with additional drip lines

What else can we do with Anaerobic Soil Disinfestation?

Oleg Daugovish, Anna Howell, Bill Rutan, Steve Koike (UC-ANR), Joji Muramoto and Carol Shennan (UCSC)

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

For C-source:

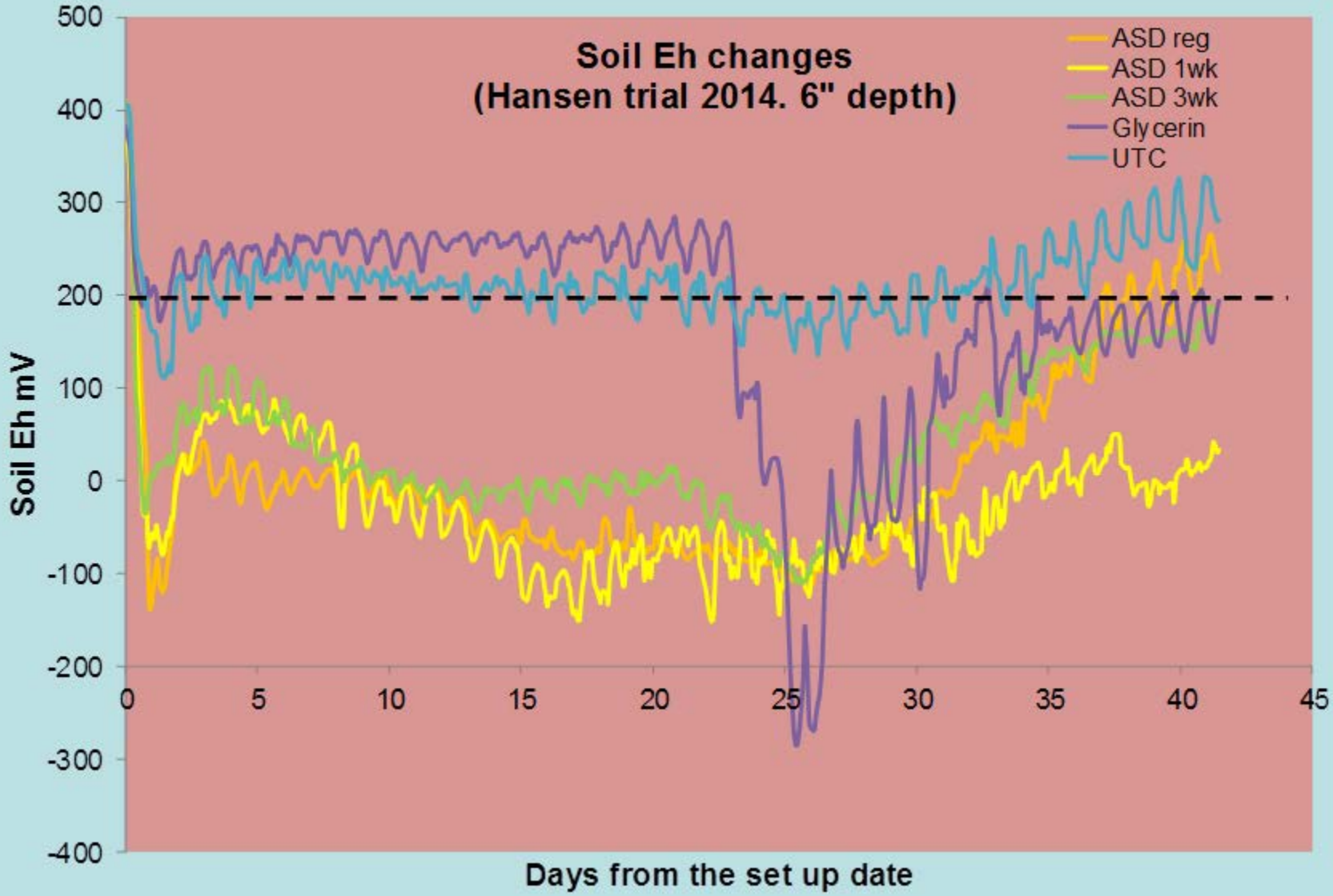
- Rice bran applied to beds: at least 25% less needed
- Apply Glycerin at 4% by volume via drip

For water:

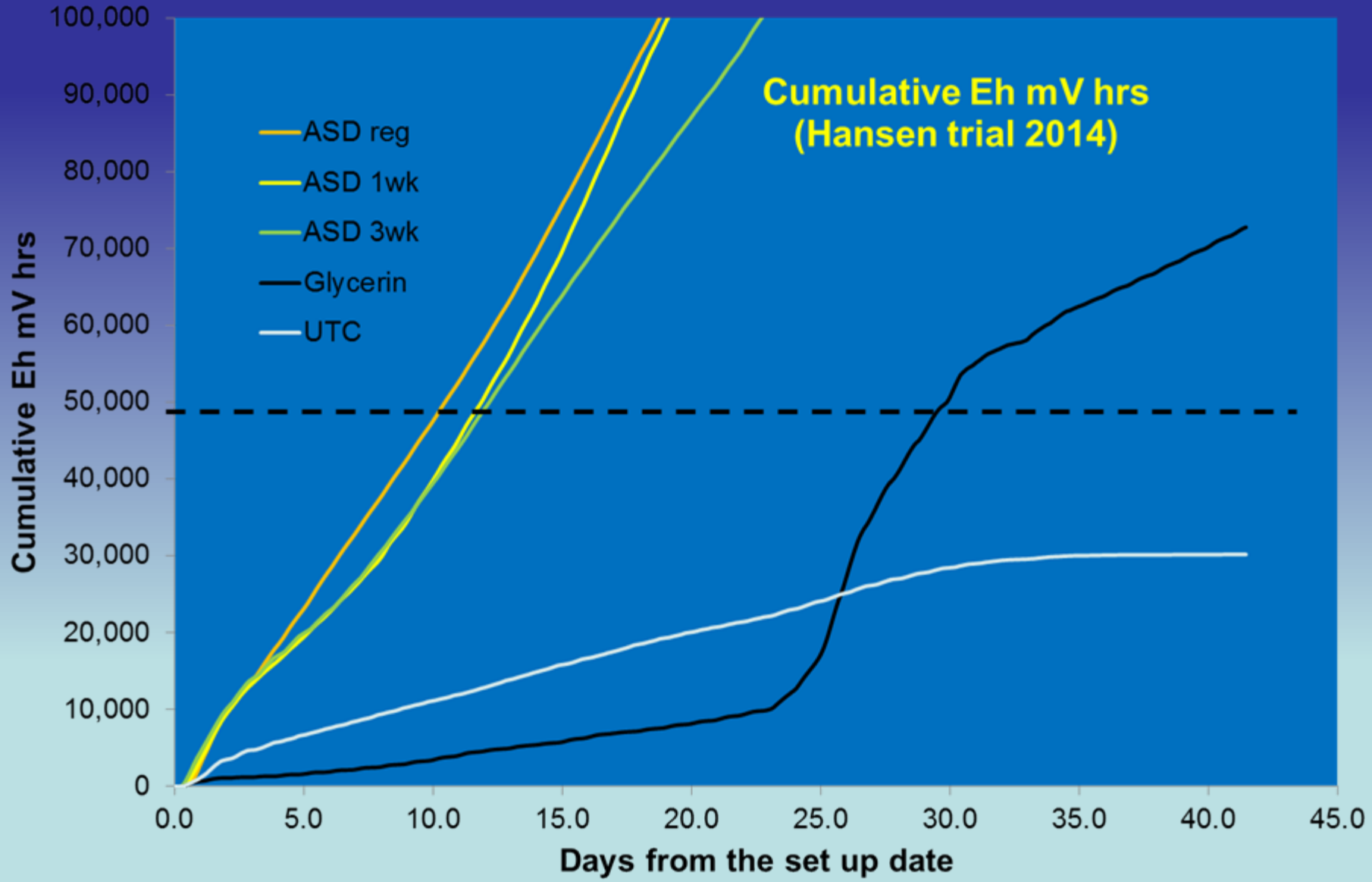
- Delay drip irrigation 1 wk after bedding
- Apply no water after bedding
- Drip-irrigate immediately


https://www.youtube.com/watch?v=wR_JdJuRdiI&feature=youtu.be

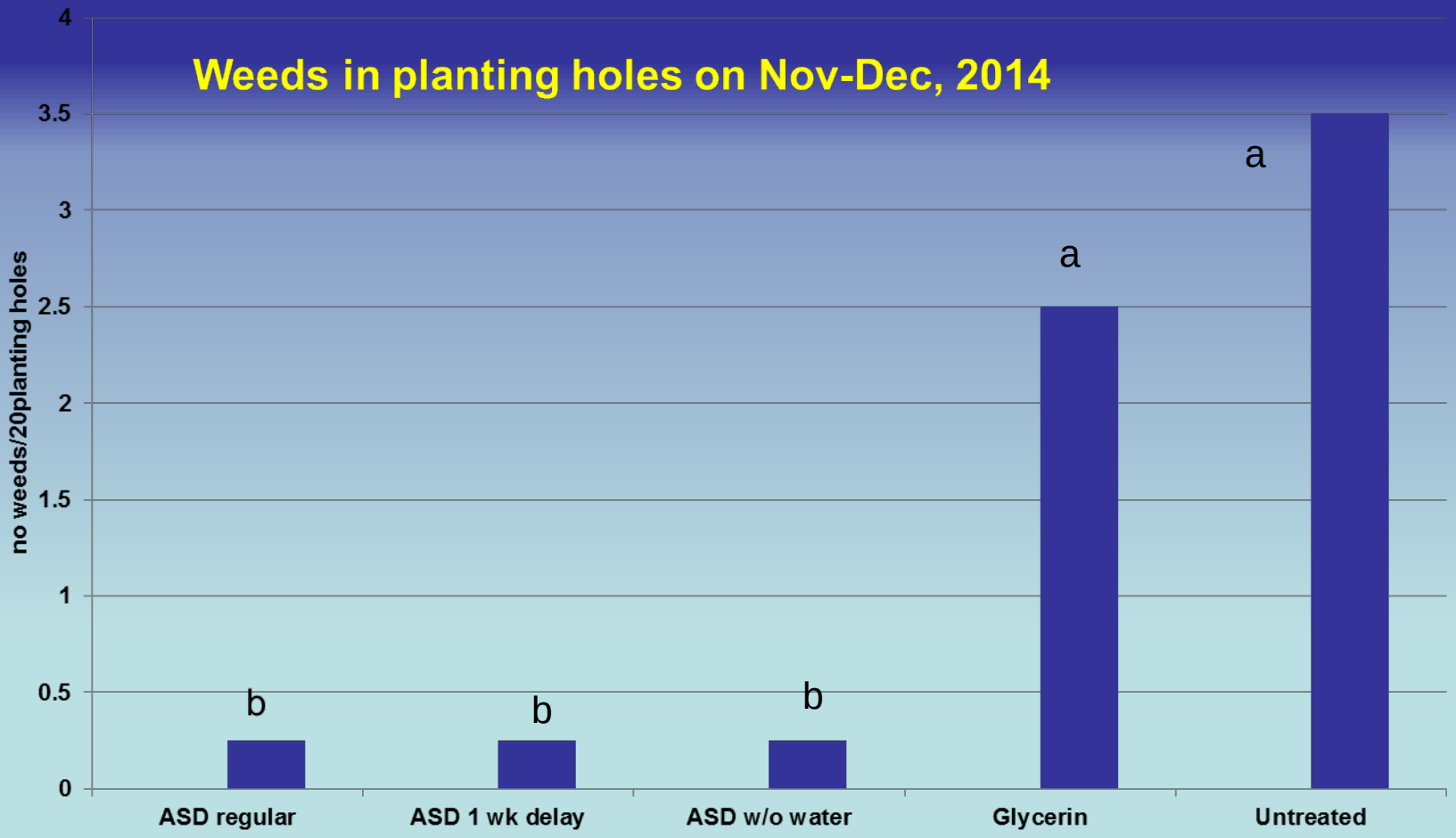
Anaerobic conditions



Anaerobic conditions



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

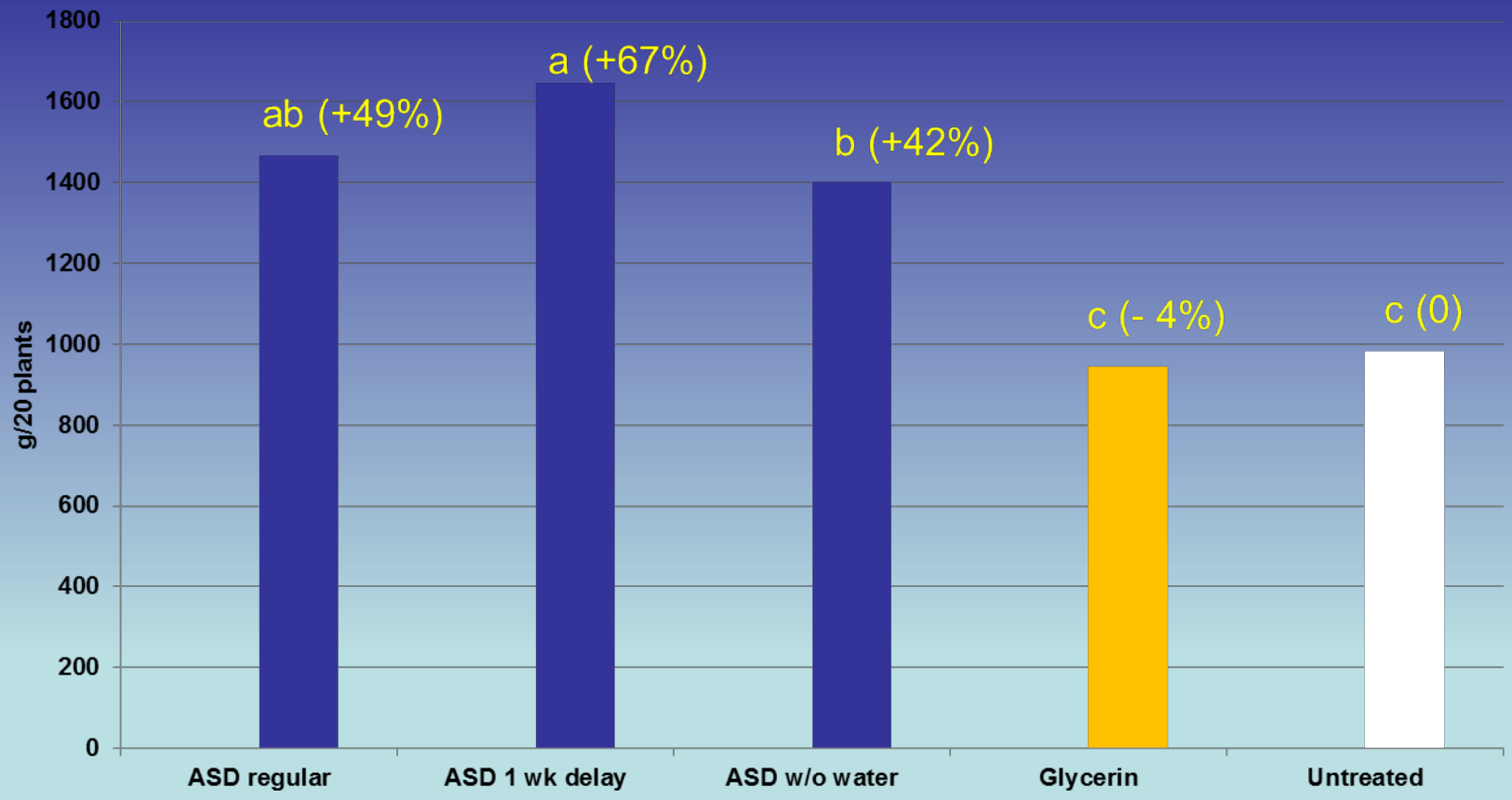
Dec 28, 2014

ASD/9t rice bran

ASD/glycerin

Untreated

Early Fruit yield: Dec-Feb



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- California Strawberry Commission

Walmart

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