

Anaerobic Soil Disinfestation (ASD)

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ASD:

- Developed as ecological alternative to methyl bromide fumigation in Netherlands and Japan (Blok et al., 2000; Doug et al., 2004; Shinmura and Sakamoto, 1998; Shinmura, 2000 , 2004)
- Can be used where solarization or flooding is not feasible
- In Japan, it is used by hundreds of farmers in greenhouse production (small scale), In Holland: too cold – loose production season

ASD: Target Pests and Crops

Soil-borne pathogens

- *Verticillium dahliae*^{1,2}
- *Fusarium oxysporum*^{1,2}
- *Fusarium redolens*²
- *Ralstonia solanacearum*²
- *Rhizoctonia solani*¹

Nematodes

- *Meloidogyne incognita*¹
- *Pratylenchus fallax*²

Weeds

- *Nutsedge*³

Crops tested

- Welsh onion²
- Tomatoes²
- Strawberries²
- Eggplant^{2, 3}
- Spinach²
- Peppers³
- Maple¹
- Catalpa¹

¹: Dutch studies ²: Japanese studies ³: Florida studies

Anaerobic Soil Disinfestation =
C-source + water + plastic mulch

Costs of organic materials for anaerobic soil disinfection

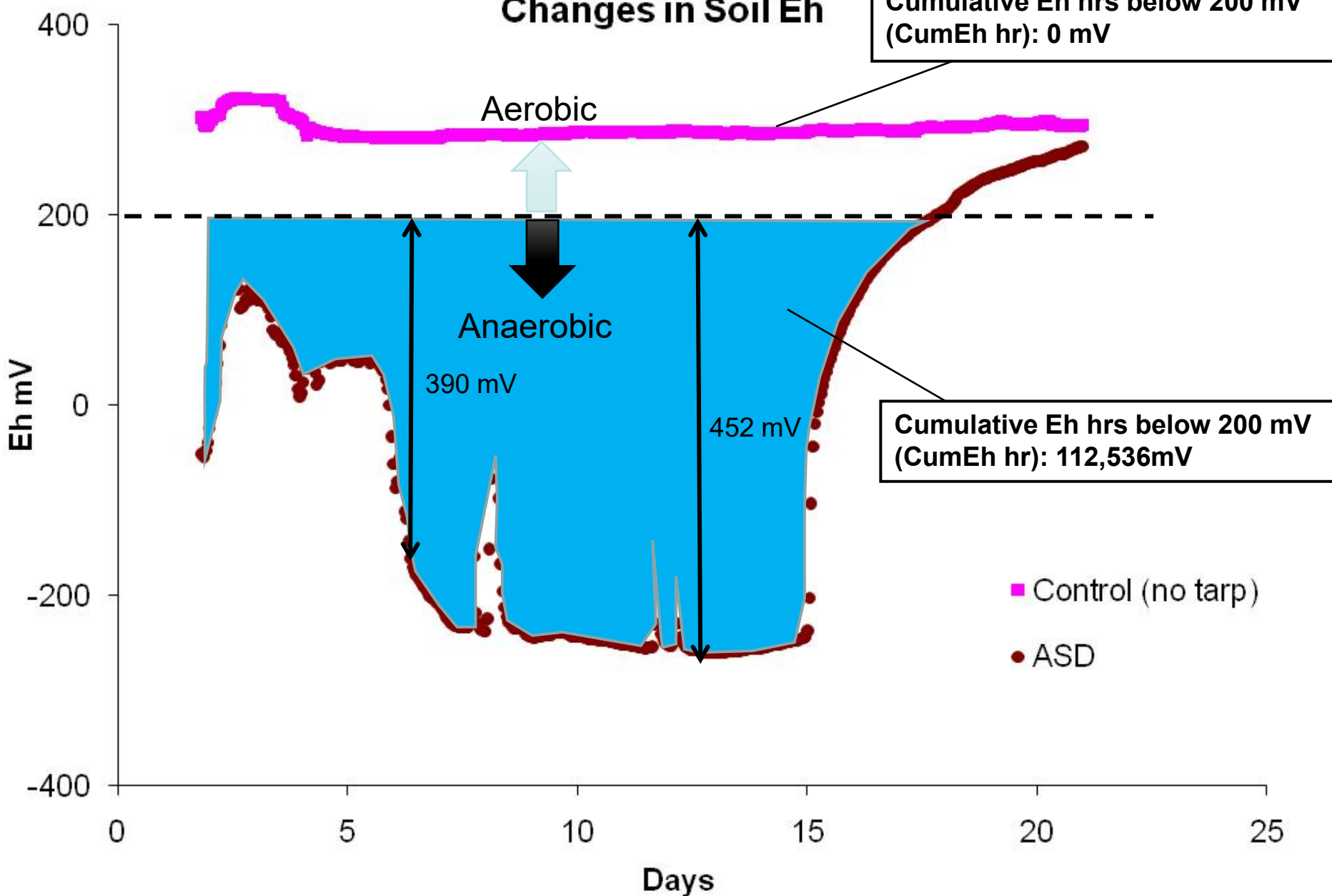
Organic material	Local price \$/ton	Amount tons/acre	Cost \$/acre
Rice bran (CA)*	\$120	4.5 – 9.0	\$540 - 980
Mustard cake (CA)	\$1,600	1	\$1,600
Molasses (FL)	\$115	5.4	\$617
Onion waste	FREE	Too high	Delivery+spread
Cover crop seeds (FL, TN)	~\$1/lbs	33 - 78 lbs/acre	\$33 -78
MeBr/Pic fumigation	-	-	\$2,500-3,000

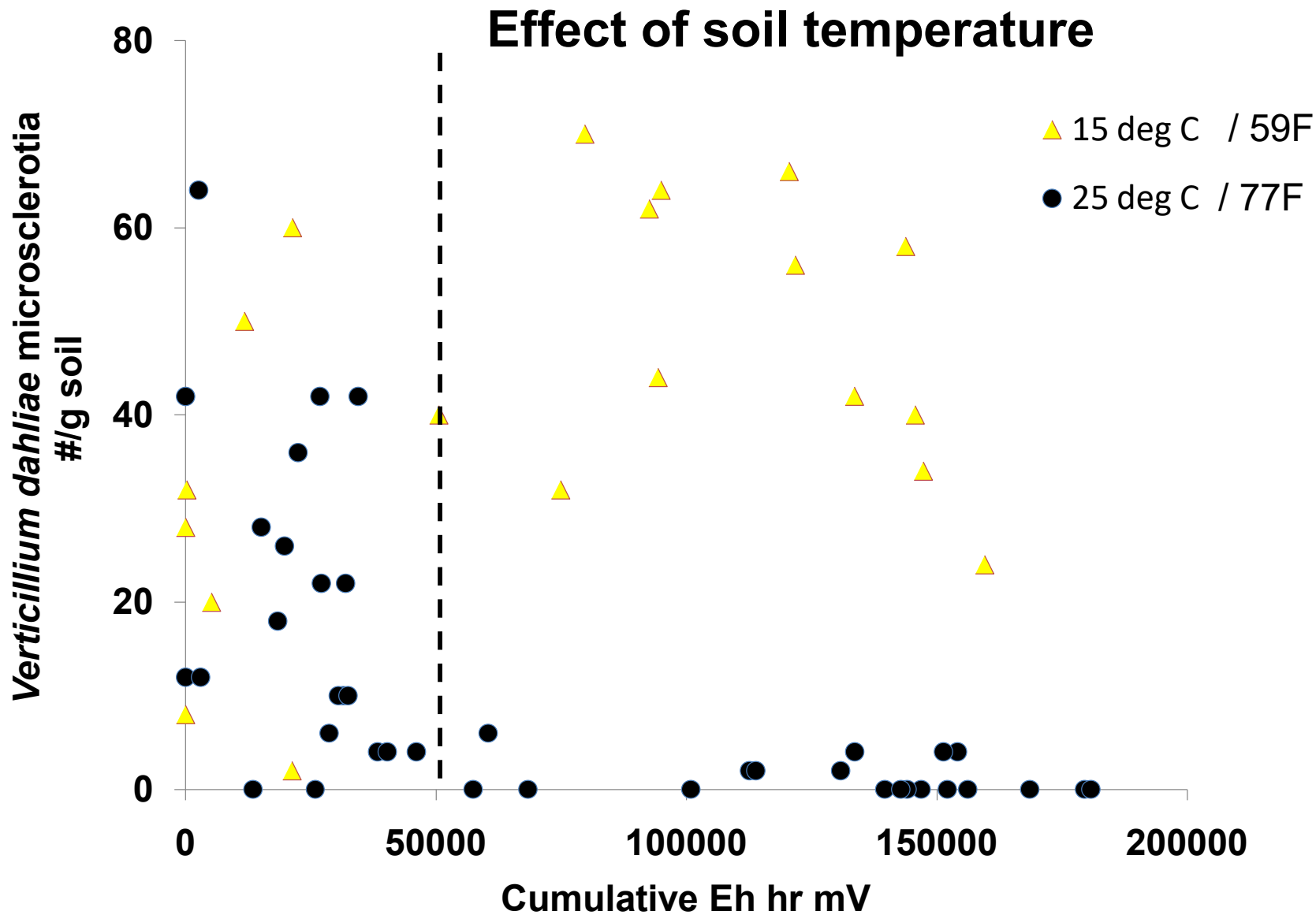
* Approximately 75,000 tons of rice bran is available annually in CA.

ASD: Mechanisms

- Accumulation of toxic products under anaerobic decomposition (e.g. organic acids, volatiles)
- Biocontrol by anaerobic microorganisms
- ~~Low pH~~
- Lack of oxygen
- Combination of all of these

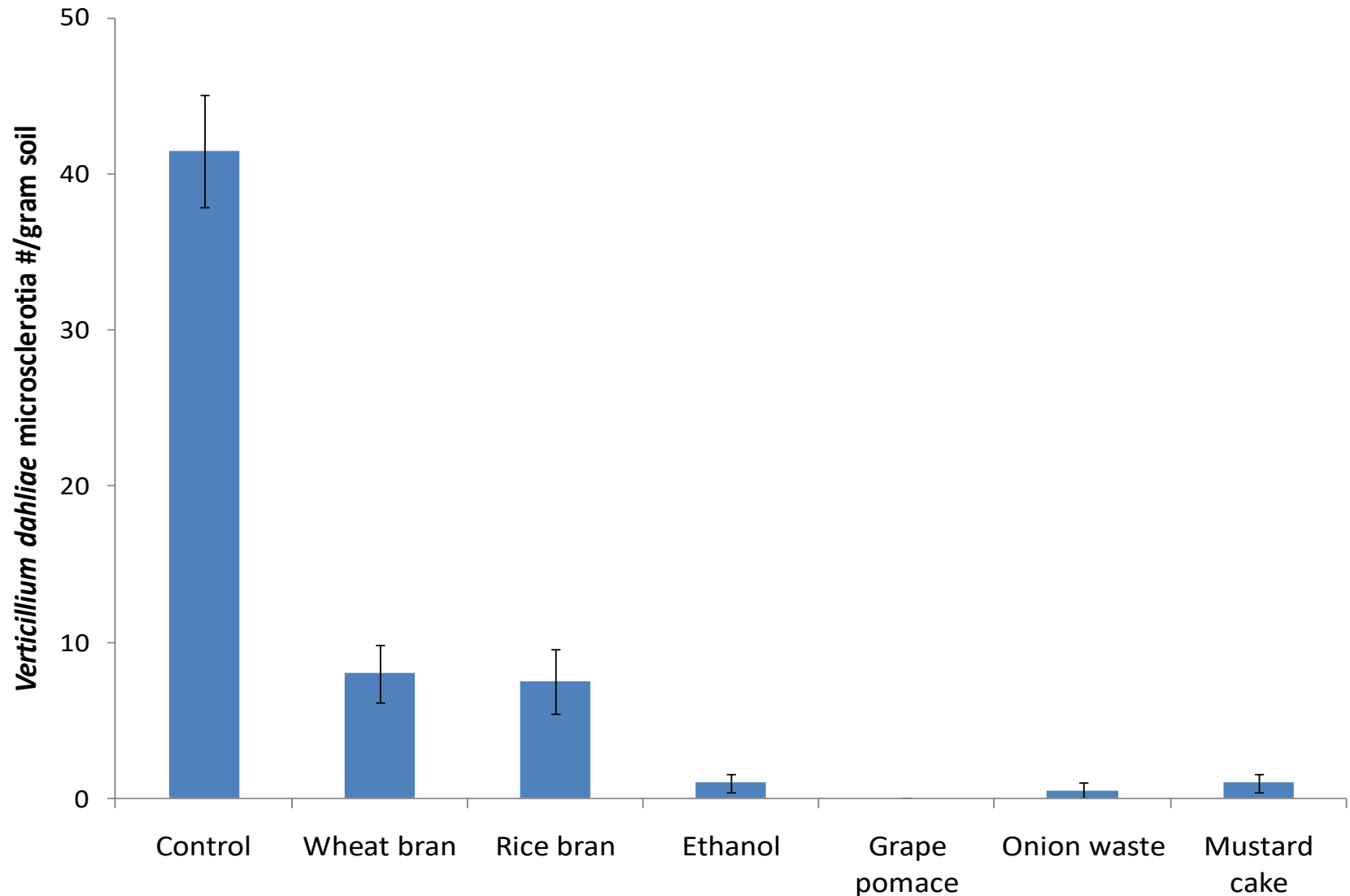
Changes in Soil Eh





Correlation between *Verticillium dahliae* population after three weeks of ASD treatment and cumulative Eh hr below 200 mV during the entire incubation period at 25 °C and 15°C (pot experiment).

Different C sources effectively reduce *V. Dahliae* microsclerotia – pot studies



**Experiments
in Santa Cruz and Monterey
Counties**



10/10/2008



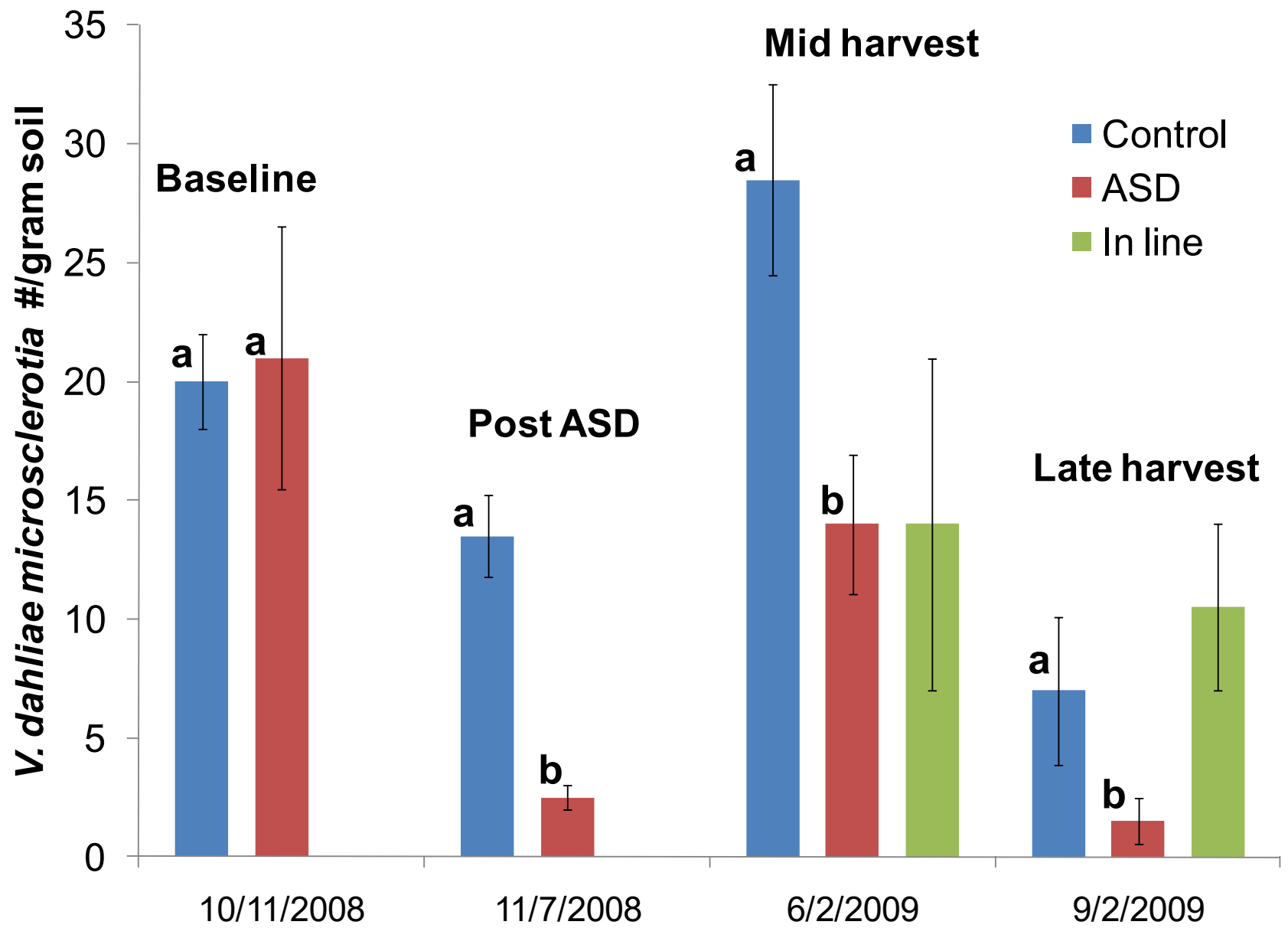
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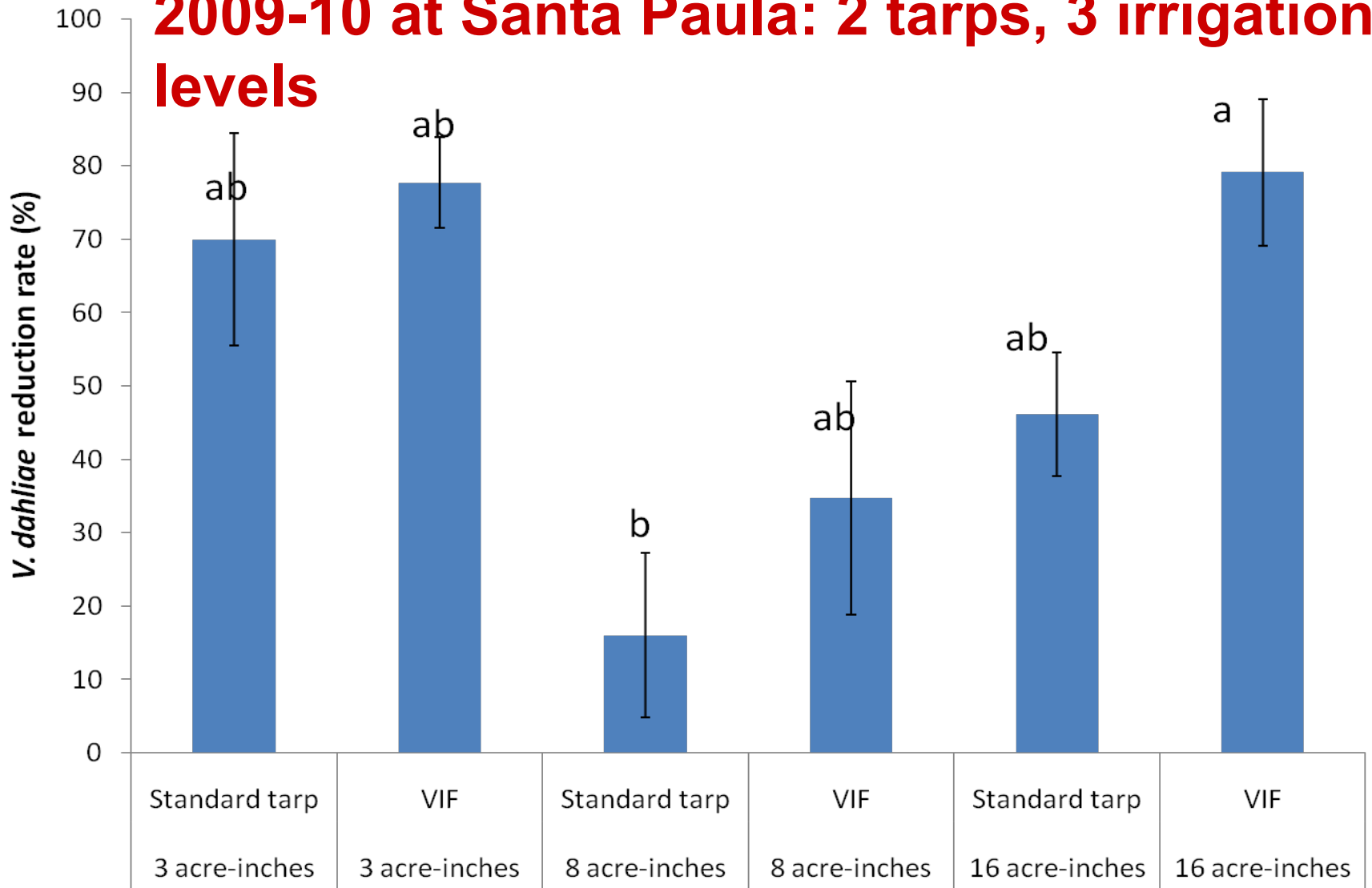
11/7/2008



Effect of ASD on native *Verticillium dahliae* population in soils Salinas (2008/9).

Experiments in Ventura County

2009-10 at Santa Paula: 2 tarps, 3 irrigation levels



Effect of ASD on reduction rate of native *Verticillium dahliae* in soils in Ventura trial (2009). Baseline *V. dahliae* population in the soil at each treatment varied from 15 to 45 microsclerotia/gram soil.

2010-11 at Santa Paula:

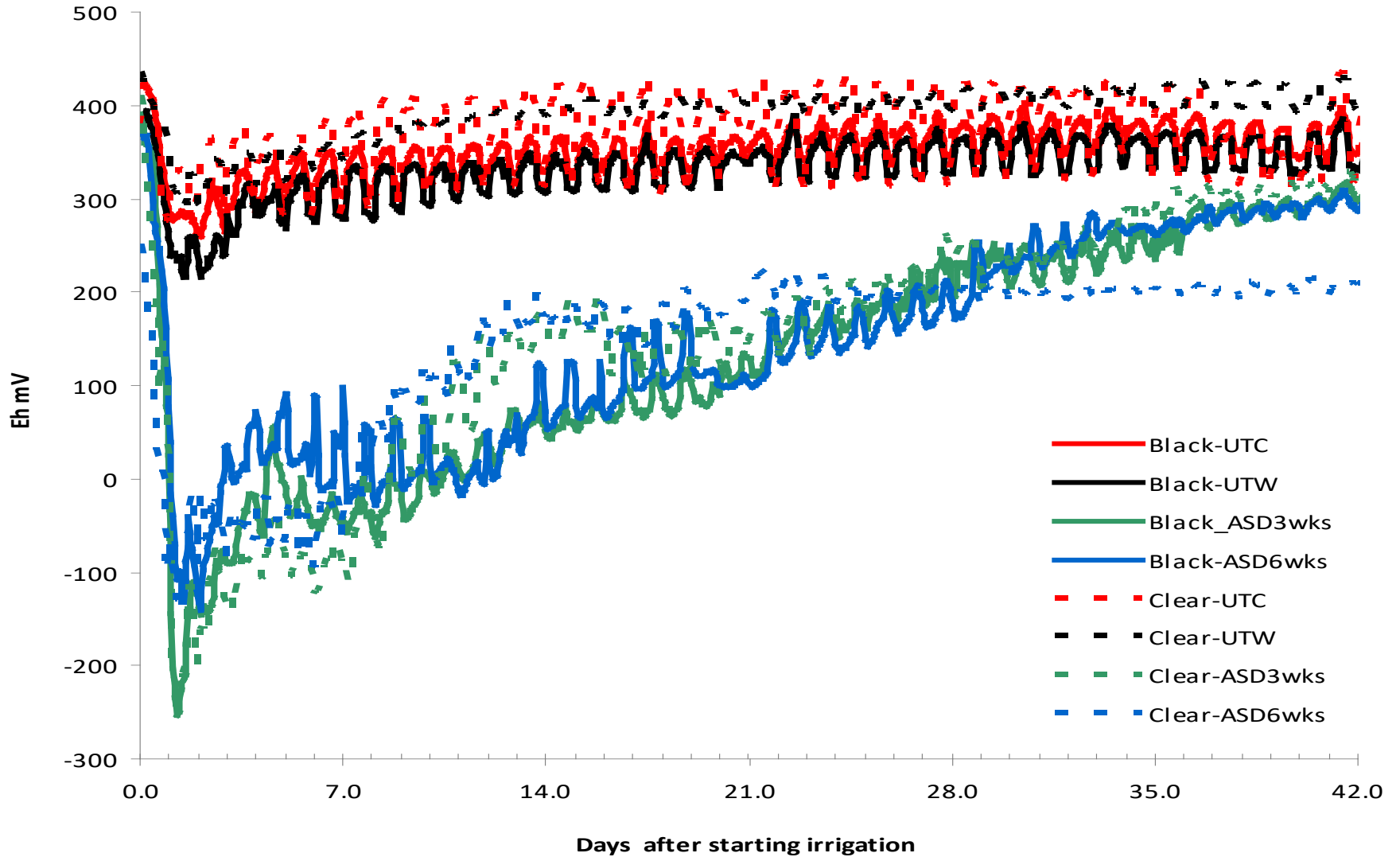
- UC Hansen Agricultural Center, Santa Paula.
- **Silty clay loam** soil with native *V. dahliae*: **15 microsclerotia/gram soil**
- Randomized block split plot design with 4 reps.
Main plot: type of tarp (standard black 1.5 mil, and clear 1.25 mil)
Sub plot: Untreated check (UTC), UTC + water, ASD 3 weeks (8/18 – 9/09), and ASD 6 weeks (8/18 – 9/30)
- **C source**: Rice bran 9 tons/acre in all ASD plots.
- **Irrigation**: 3 ac-inches except UTC plots.

Incorporation of rice bran to beds





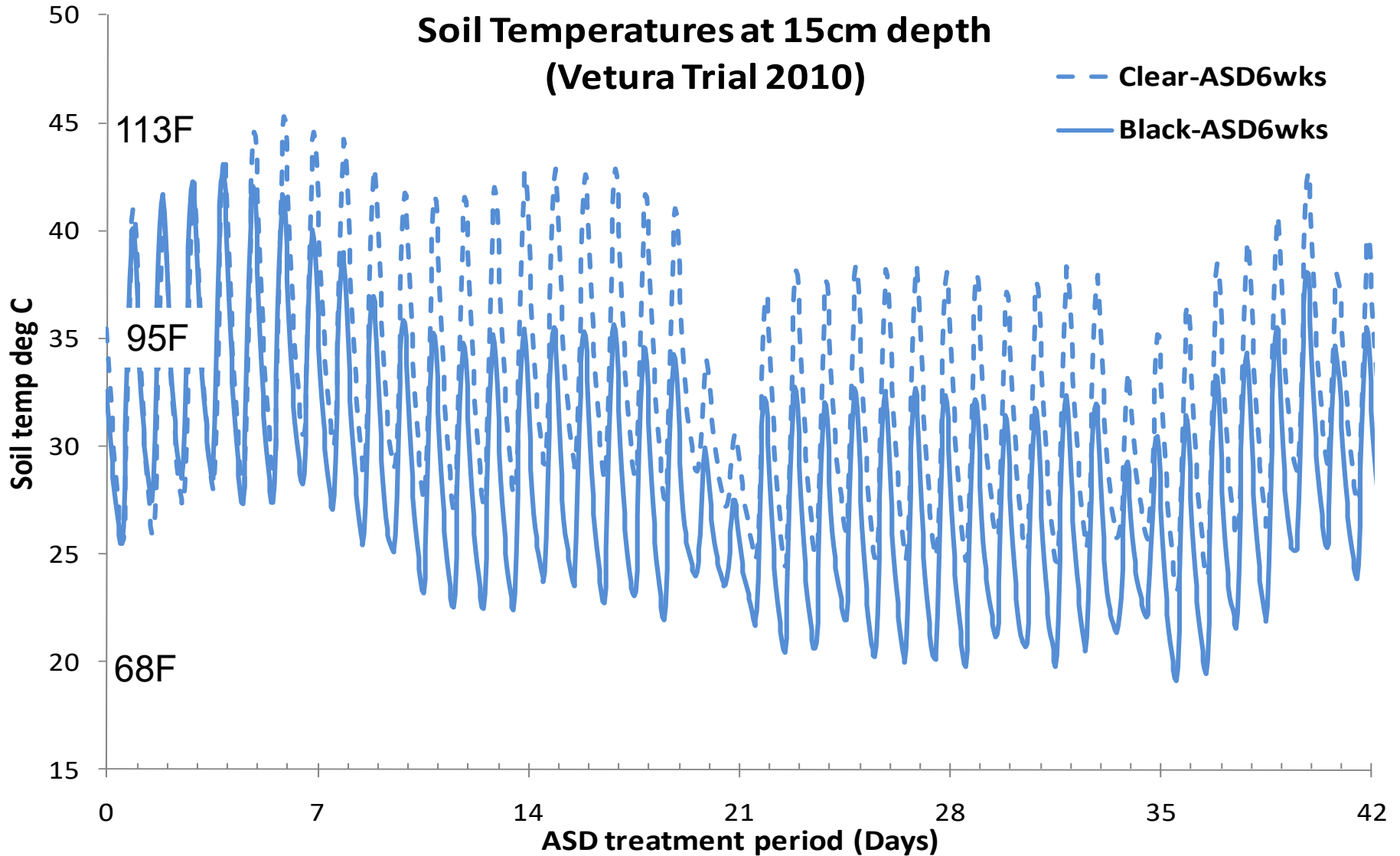
ASD ORP 2010



Soil Temperature

Soil Temperatures at 15cm depth
(Vetura Trial 2010)

Clear-ASD6wks
Black-ASD6wks



Nov 22, 2010

ASD 3WK, black

Standard, black



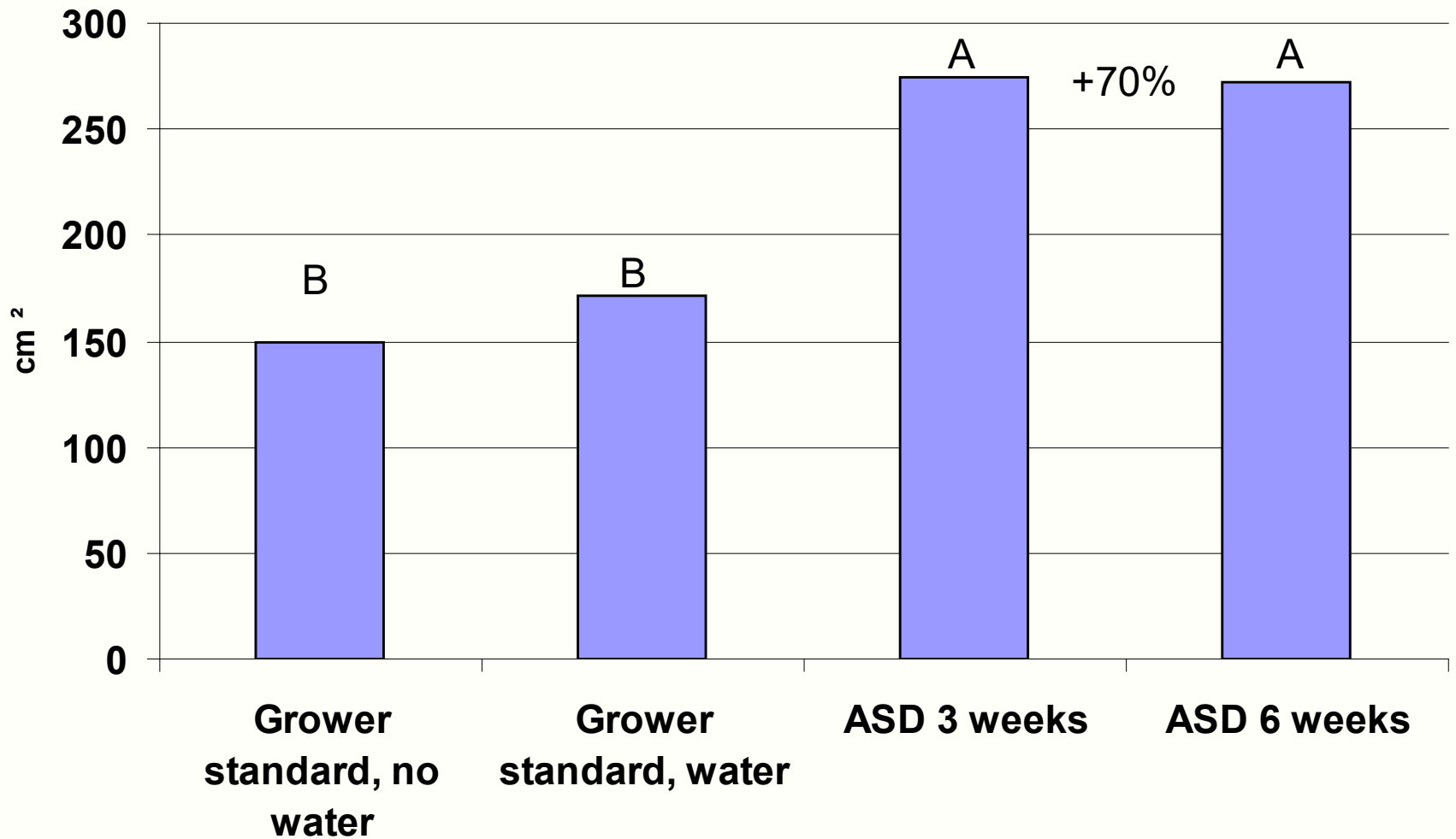
Nov 22, 2010

ASD 3WK, clear

Standard, clear



Canopy size, Nov 22, 2010



Feb 12

ASD 3WK, clear



Standard, clear



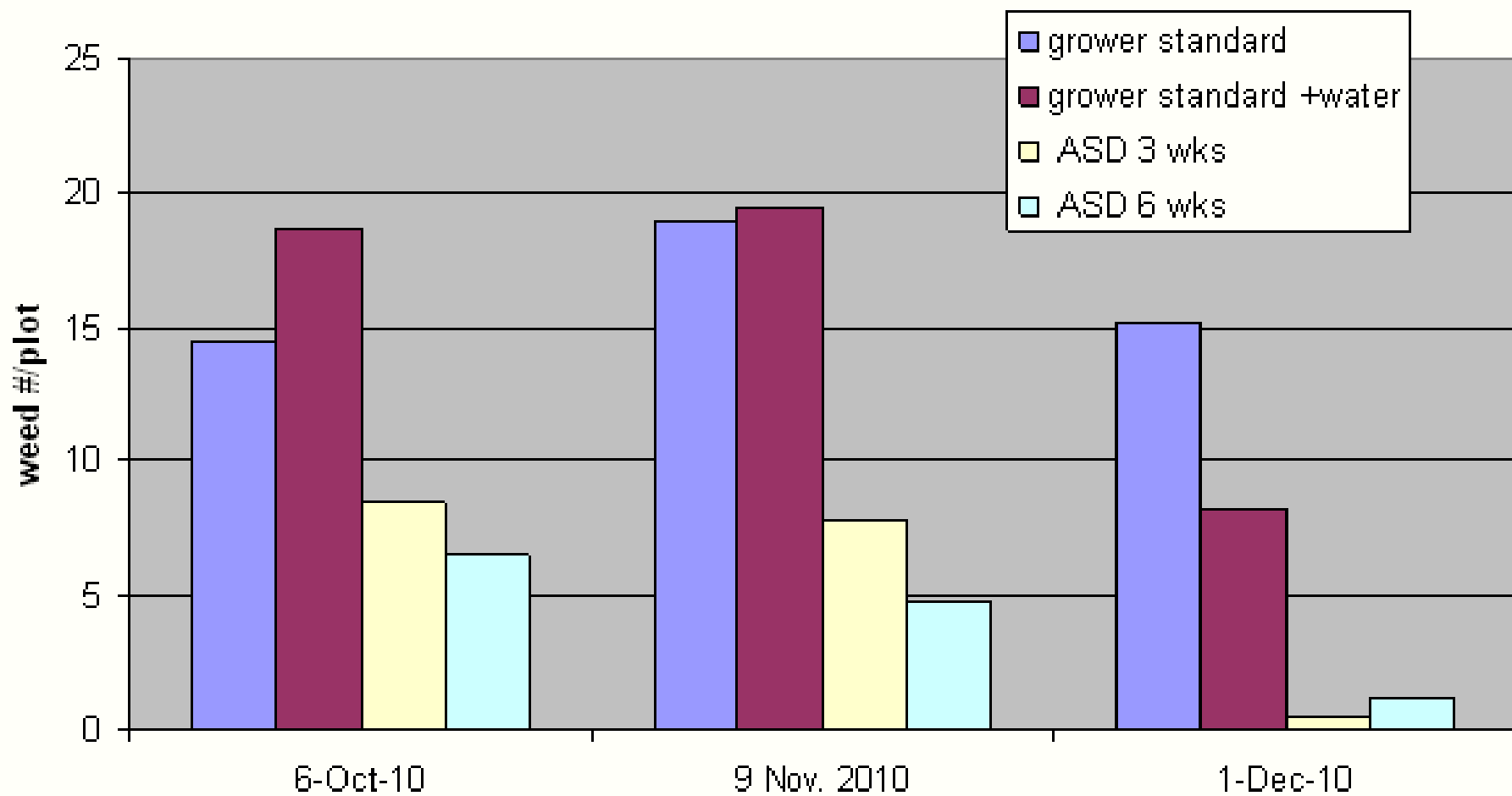
Feb 12

ASD 3WK, black

Standard, black

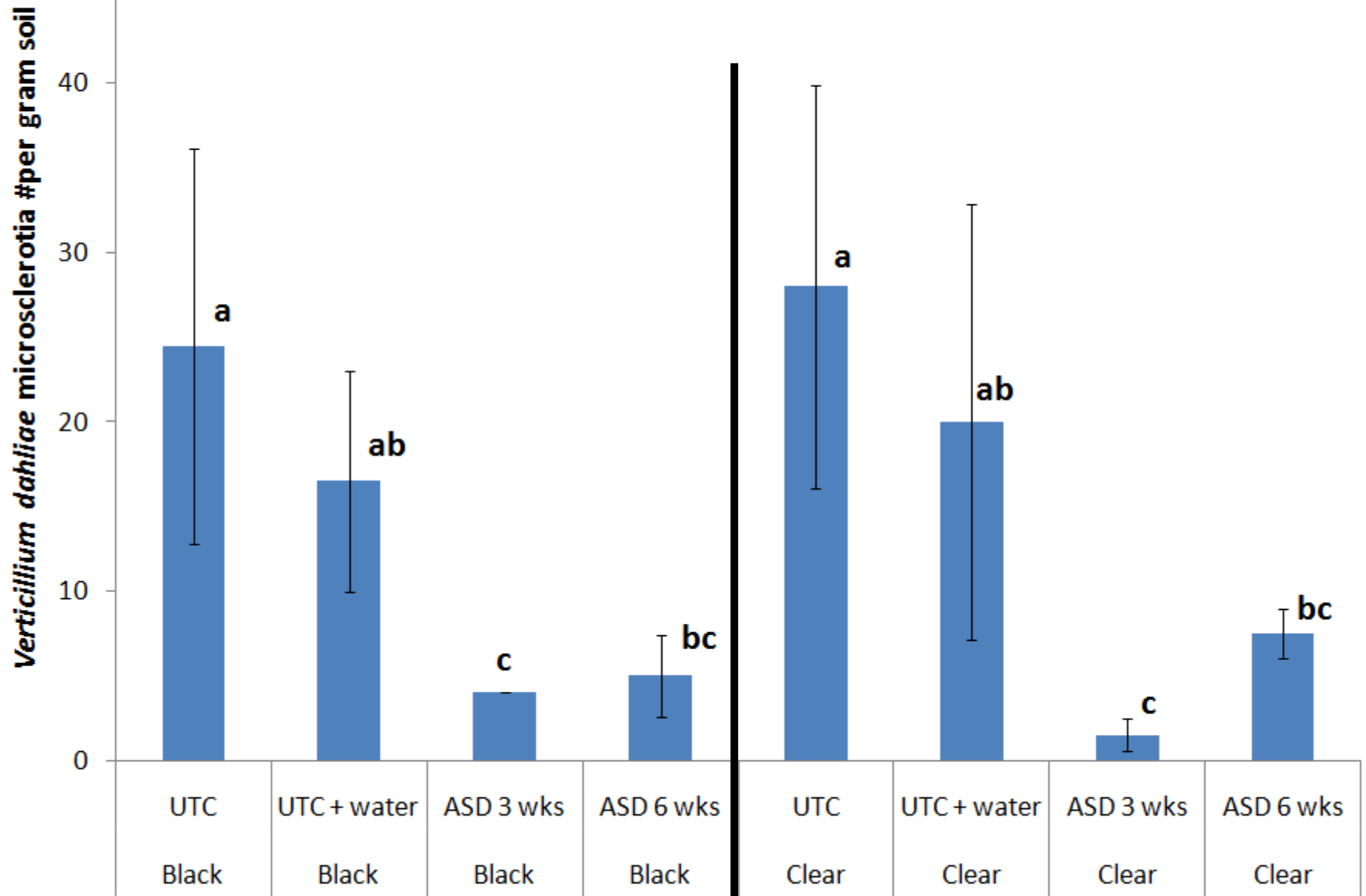


Weed densities

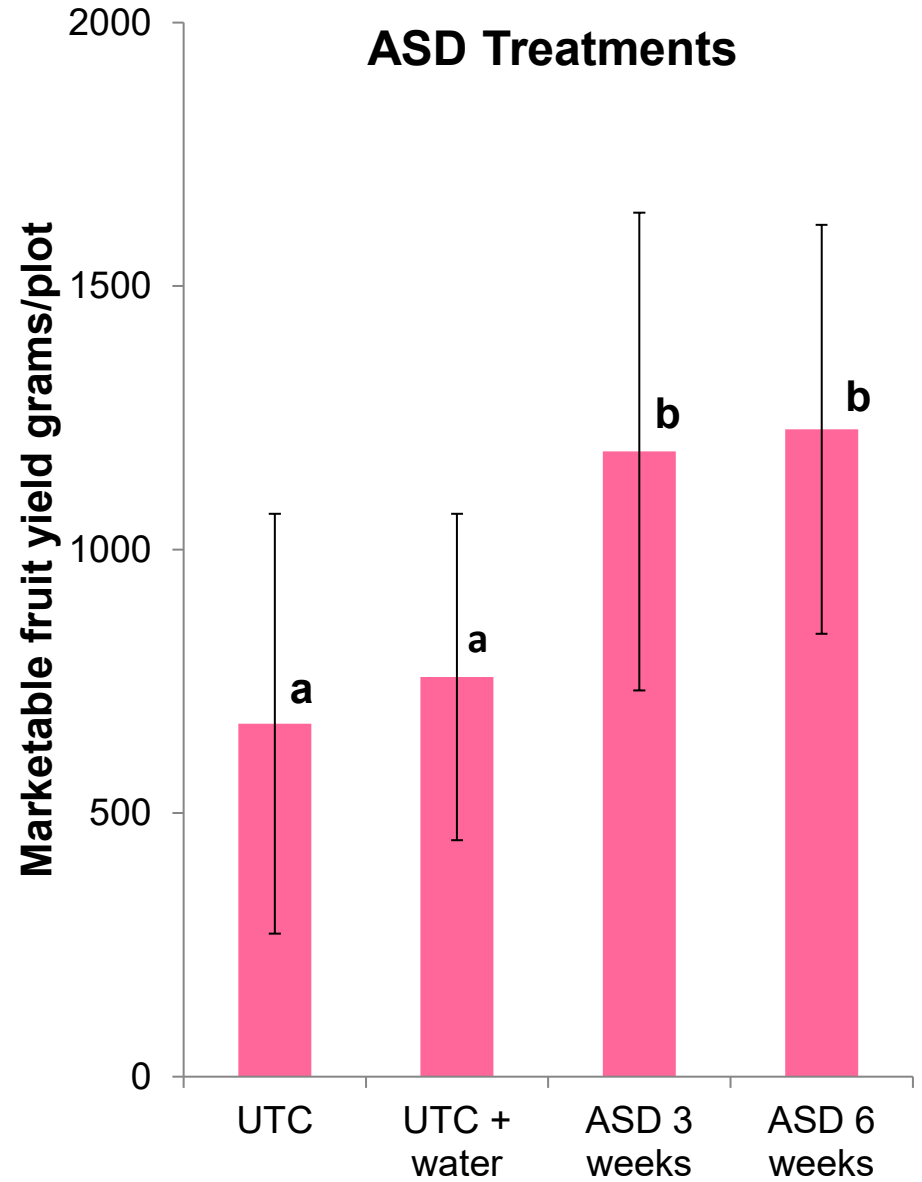
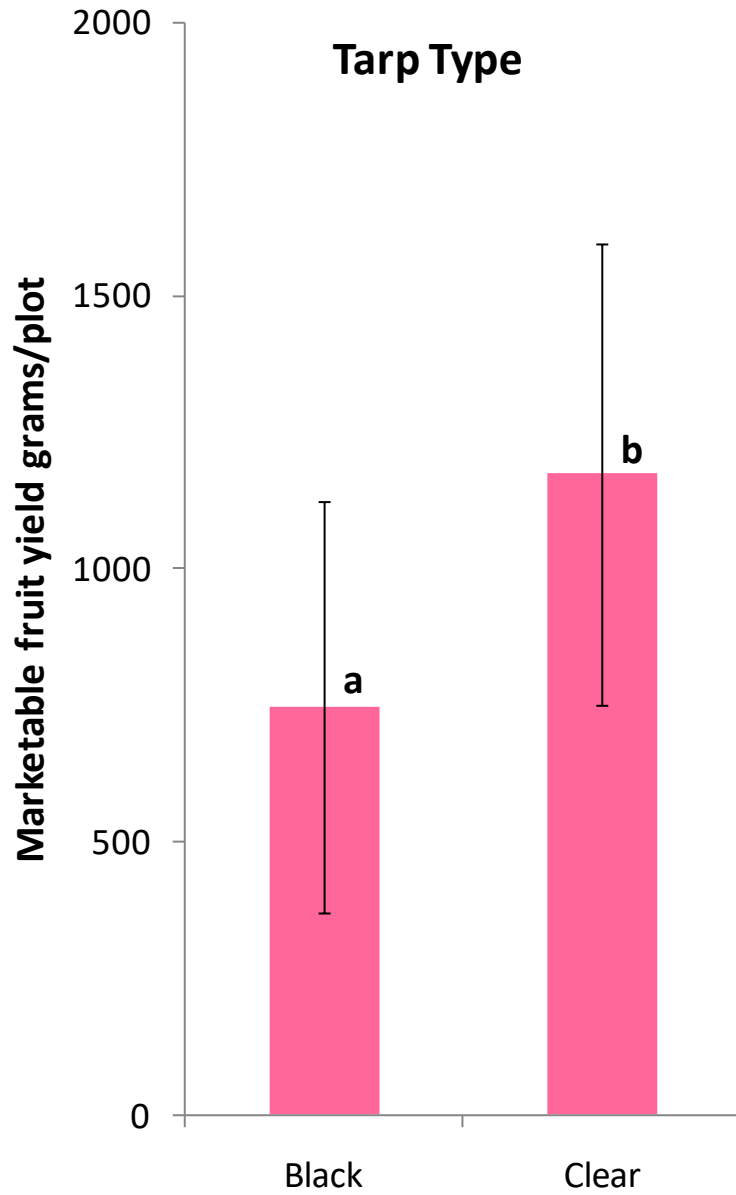


Significant reduction: ASDs < untreated standards

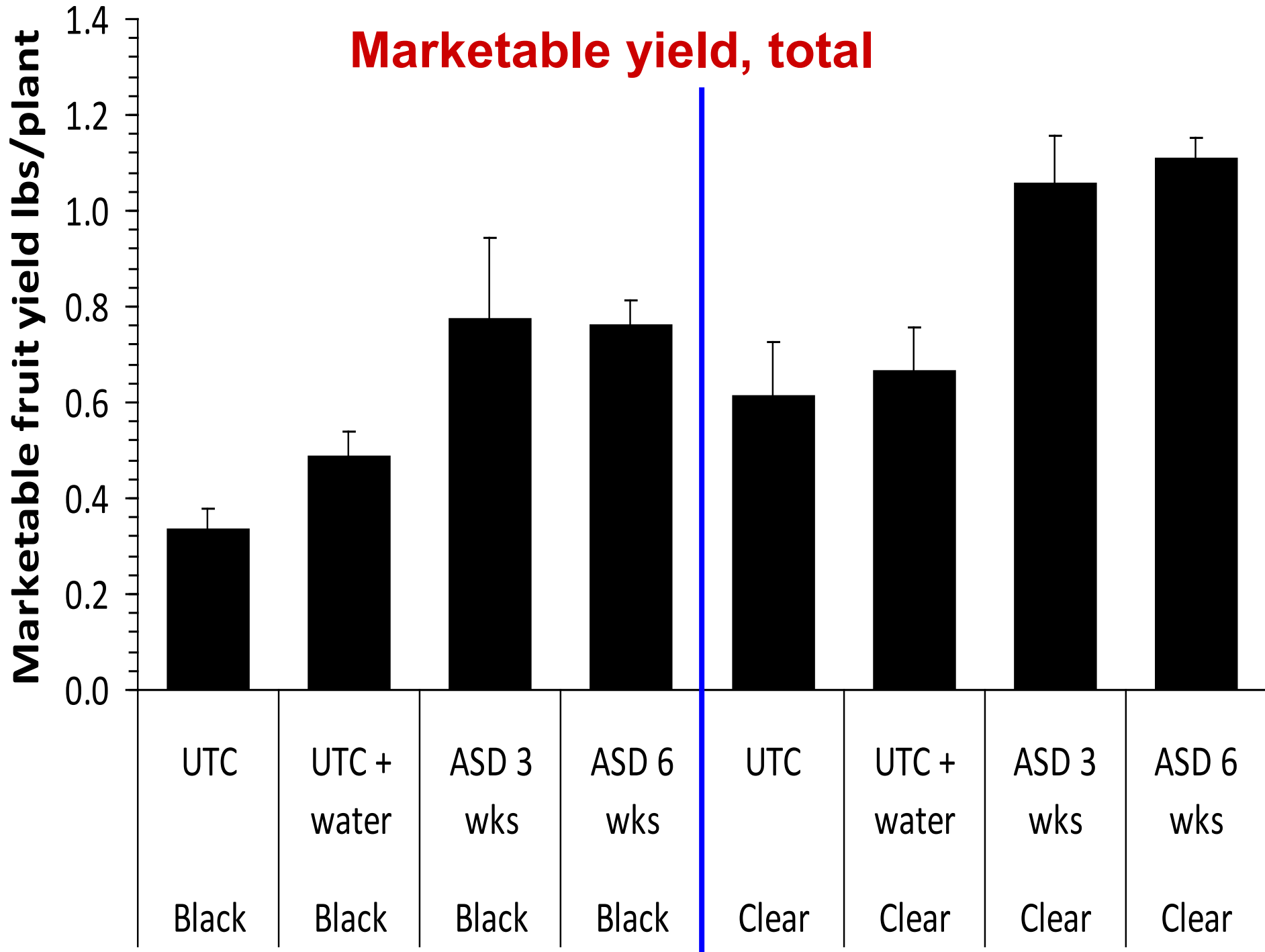
Verticillium dahliae population in topsoil
(Ventura, CA. Sep. 2010. Mean \pm SD)



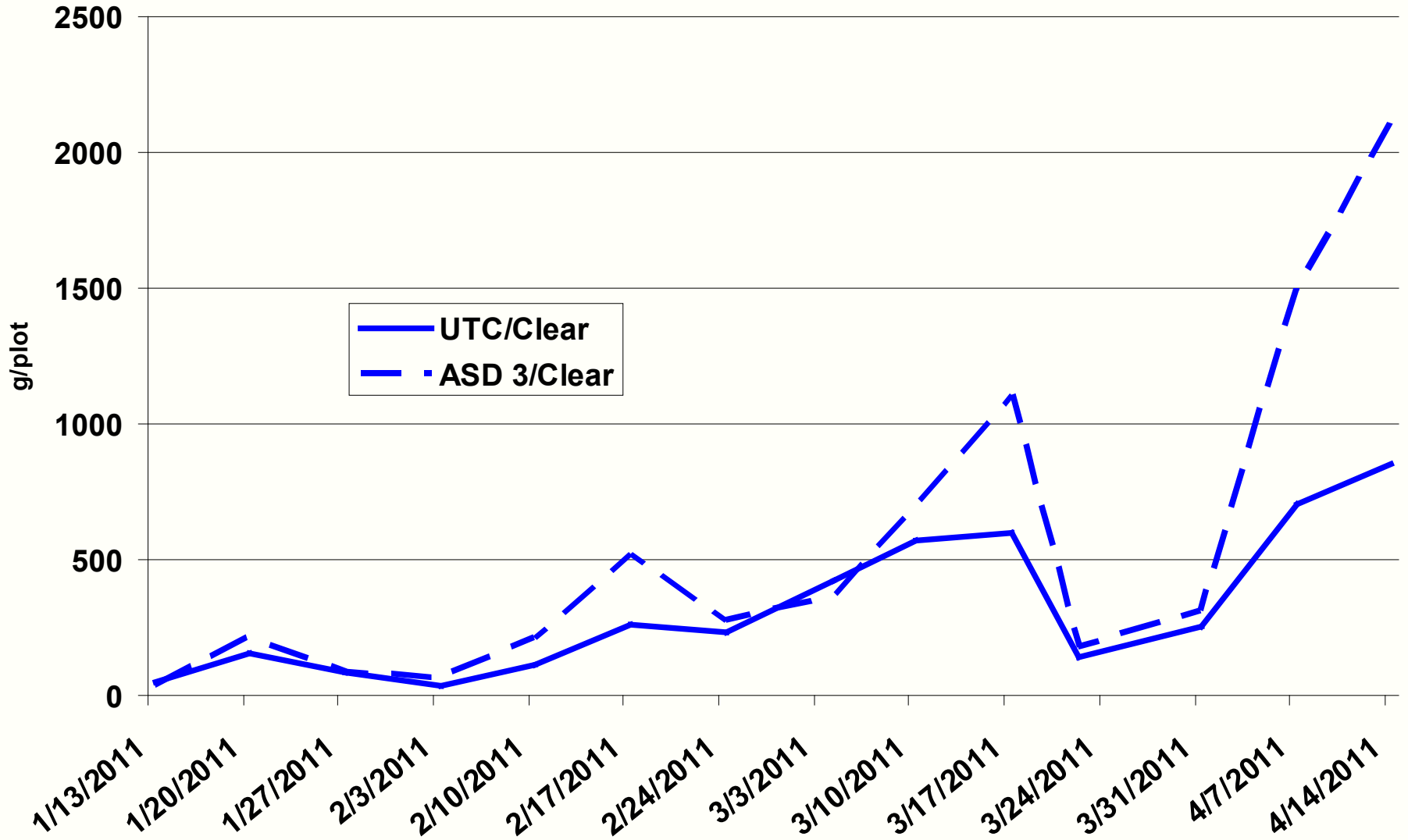
Early Marketable Yield (Ventura, CA. Jan – Feb 2011. Mean \pm SD)



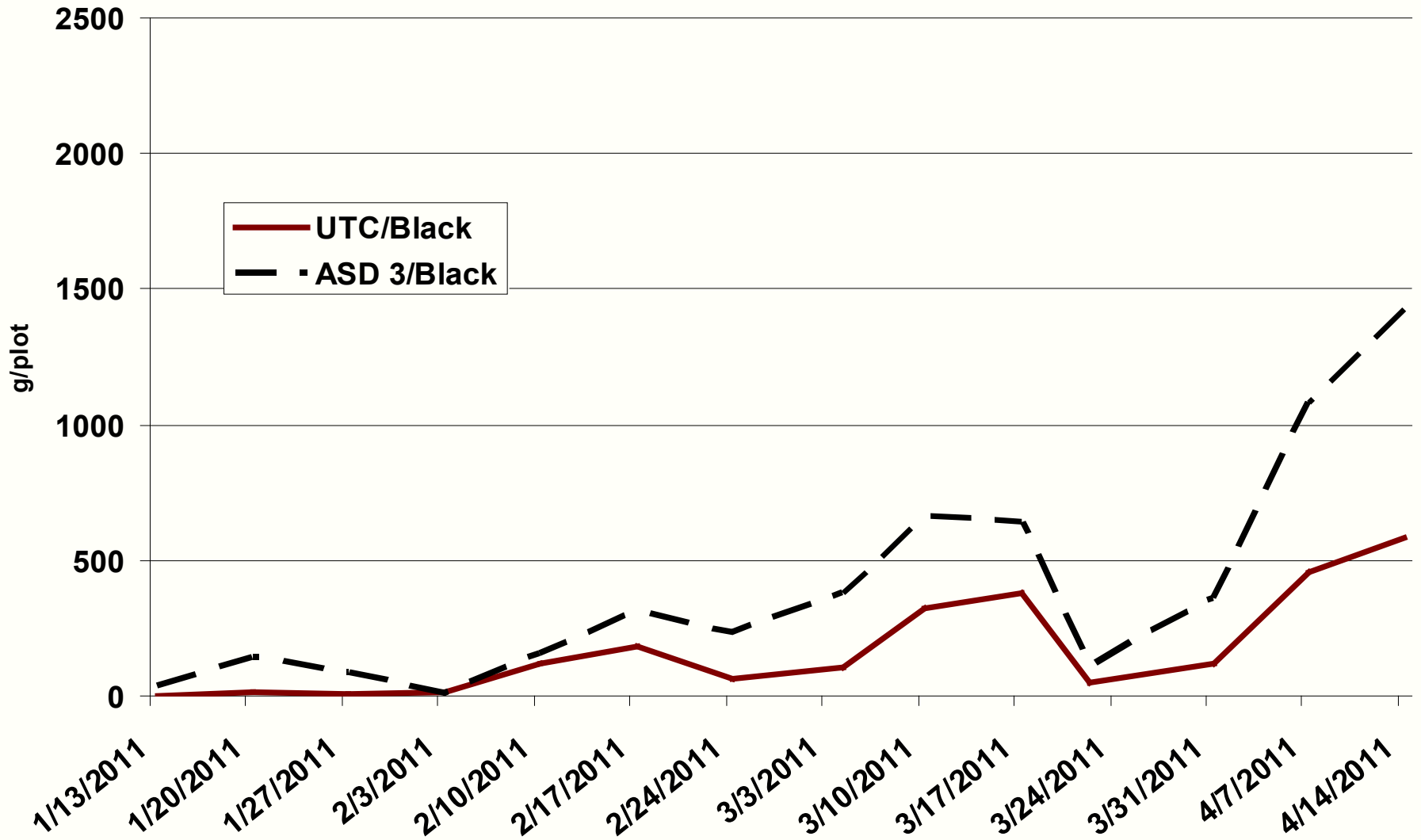
Marketable yield, total



Marketable yield, clear mulch



Marketable yield, clear mulch



Verticillium dahliae symptoms



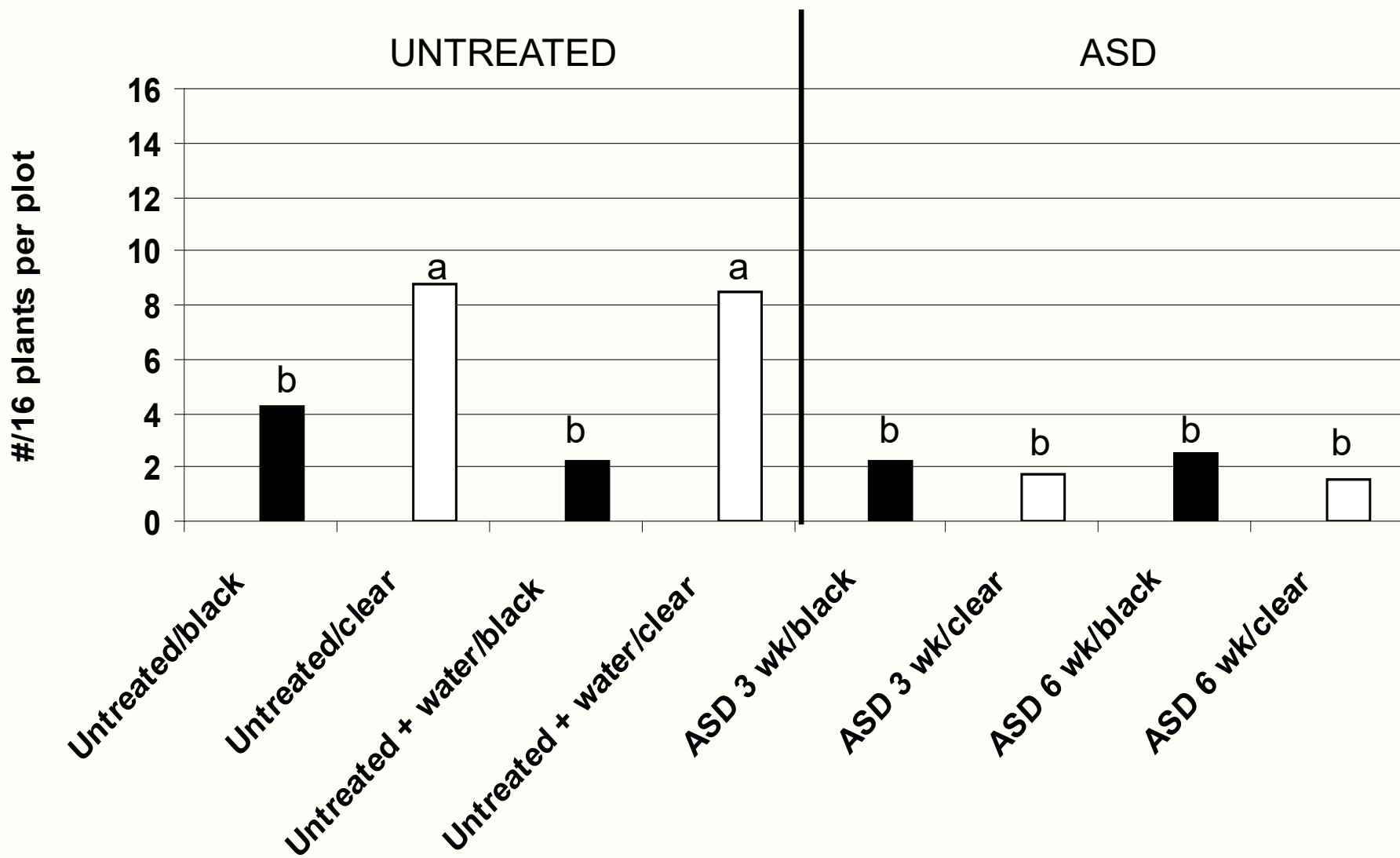
April 19, 2011

ASD 3 wks/clear

Untreated/clear



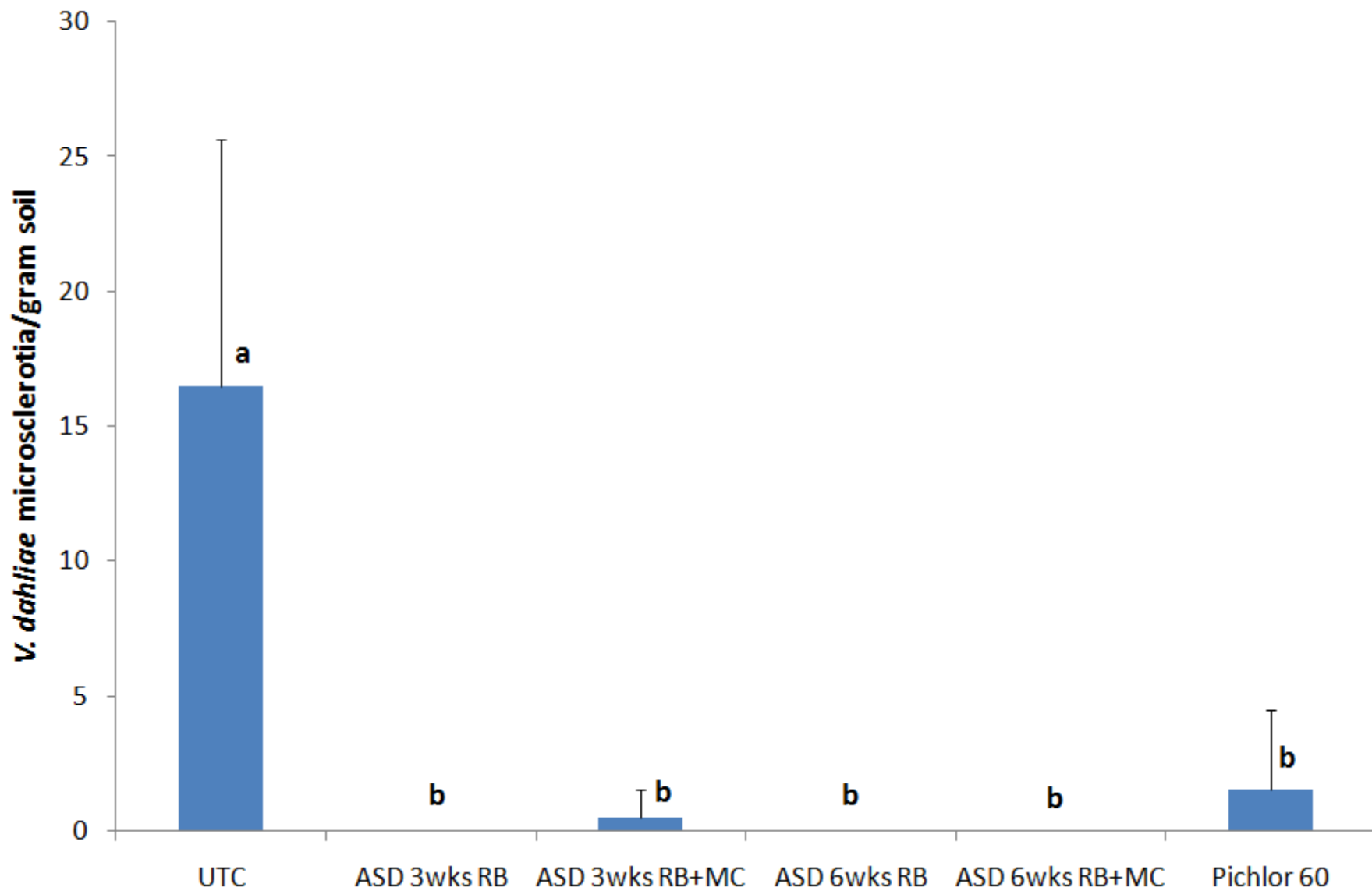
Plants with *V.dahliae* symptoms, Apr 1. 2011



Other trials underway

- Castroville – clay loam, native soil *V. dahliae* – 11 microsclerotia/g soil
 - C source – 9 t/ac rice bran, 8 t/ac rice bran + 1 t/ac mustard cake
 - two dates – Sept and Oct
 - two tarping lengths – 3 weeks and 6 weeks
 - Compare ASD against Pichlor 60 and untreated control
- Watsonville - sandy loam, native soil *V. dahliae* – non detective
 - C source – 9 t/ac rice bran, 8 t/ac rice bran + 1 t/ac mustard cake
 - Compare ASD against steam, Pichlor 60 and untreated control

**Native *Verticillium dahliae* population in Soil after ASD Treatment
(Castroville, CA. Sep. 2010. Mean + SD)**



For effective ASD

- 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

Acknowledgements

- Hector Gutierrez (Tri-Cal /Otillo Farms)
- USDA and CSC
- UCCE Master Gardeners

This is a collaborative work: UCSC, UCCE, U. Florida/USDA-Ft. Pierce FL, U. Tennessee.

Webinar available at:

<http://www.extension.org/pages/33656/a-novel-strategy-for-soil-borne-disease-management:-anaerobic-soil-disinfestation-asd-webinar>

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