

An aerial photograph of a forest. The majority of the trees are green, but there are several distinct clusters of red trees scattered throughout the landscape. The terrain appears to be slightly hilly or uneven.

Using Cover Crop as a Partial Carbon Source for Anaerobic Soil Disinfestation (ASD)

*UCCE Annual Santa Maria Strawberry and Vegetable Meeting
November 28, 2017*

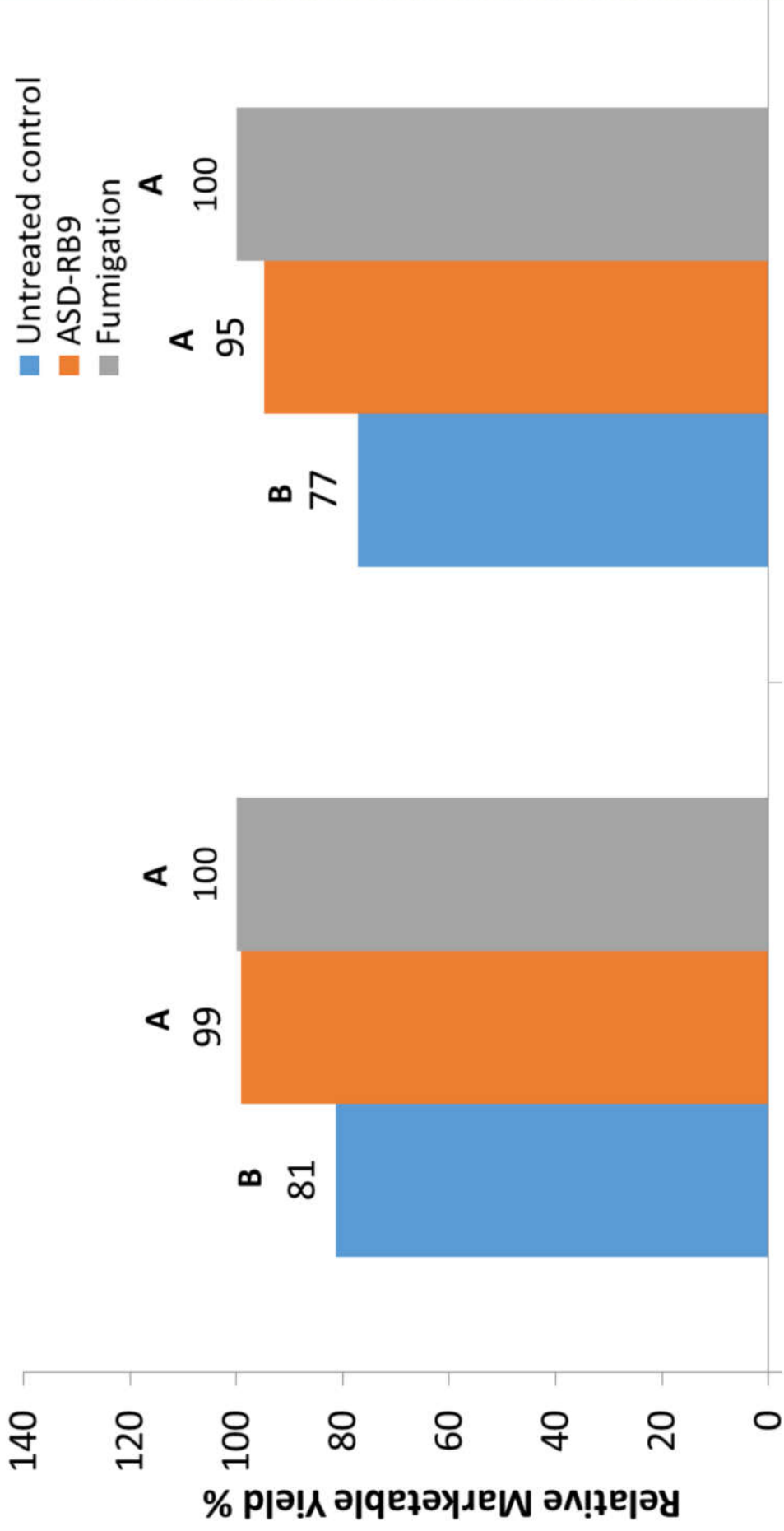
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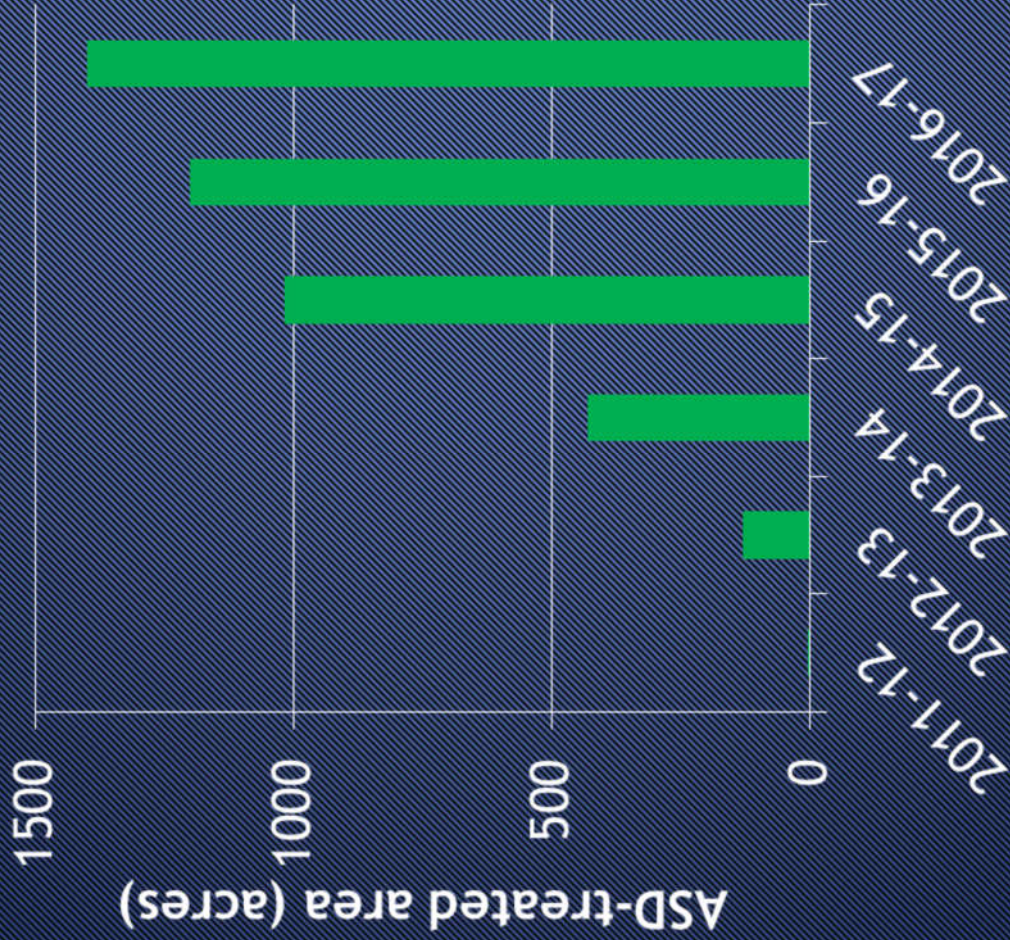
ASD provides comparable fruit yield with fumigant

Relative Marketable Fruit Yield of ASD with Rice Bran 9 tons/acre
(Average of 10-11 Replicated Field Trials across CA, 2010-2015)

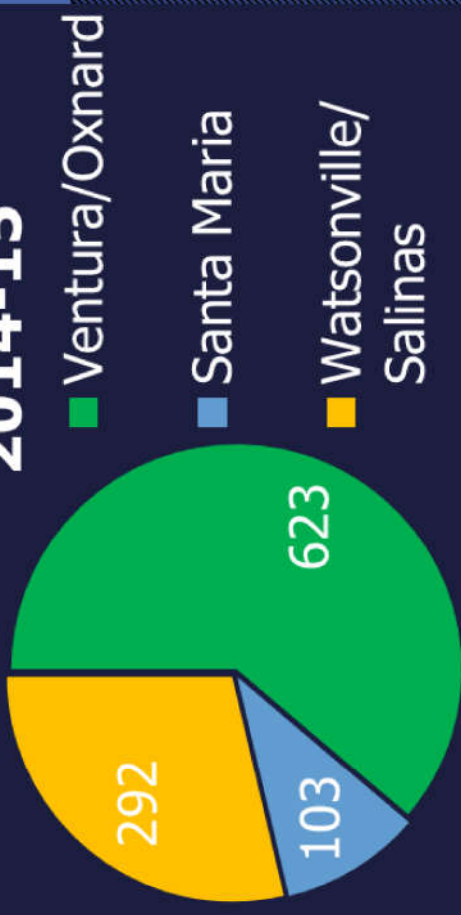


10 trials incl. Verticillium, Rhizoctonia, 11 trials incl. Verticillium, Rhizoctonia, Pythium and Macrosporangium+Fusarium-
infested sites
Fusarium-infested sites

ASD-treated strawberry fields in California



2014-15



- 80% organic sites
- 20% conventional sites

4 Frequently Asked ASD Questions by Growers

1. Reducing cost? Different C-sources?
2. Effect of ASD on 3 major soil-borne pathogens for CA strawberries?
3. Reducing water use?
4. N release from rice bran? Residual effect?

Outline

1. ASD trials using cover crop as a partial C-source; A replicated trial and 2 demonstration trials
2. ASD cover crop trial to control *Fusarium oxysporum* f. sp. *fragariae* (F.o.f.)
3. Flat-ASD vs. Bed-ASD
4. N management consideration under ASD

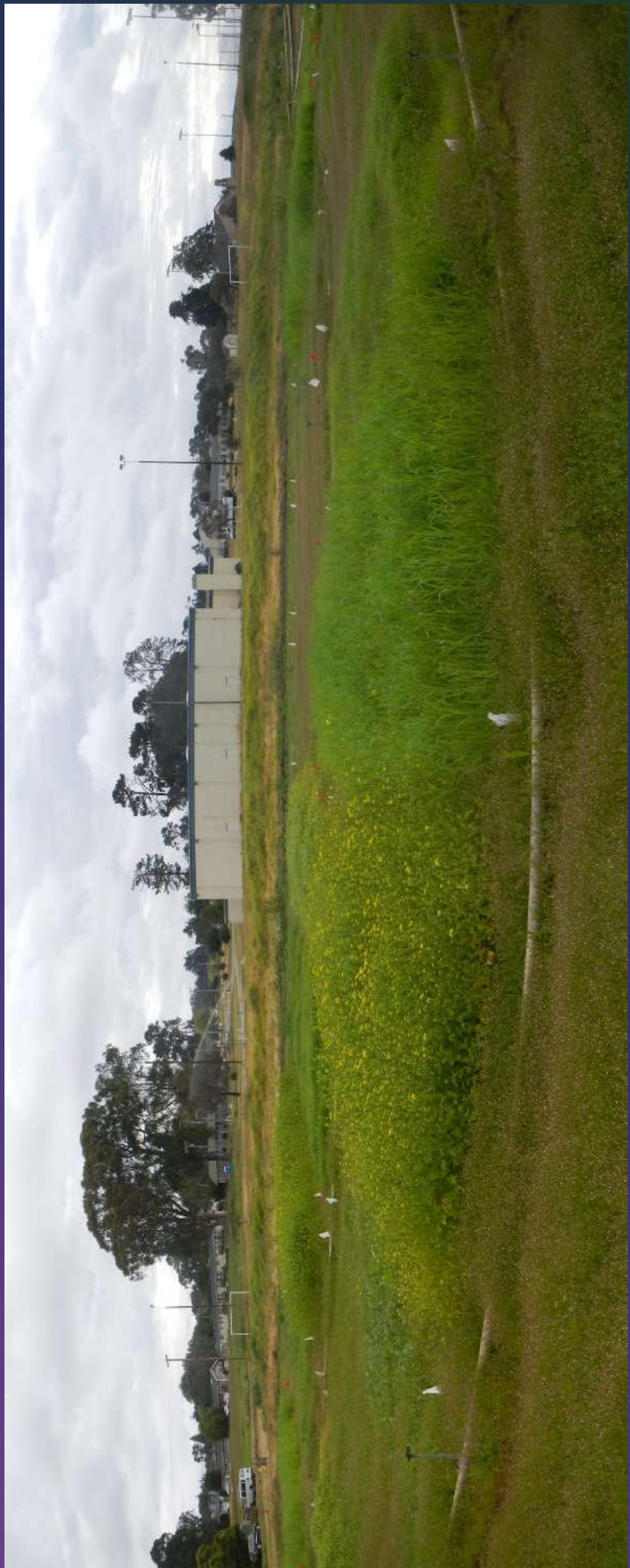
Summer cover crop ASD trial (MBA, Watsonville)

Goals:

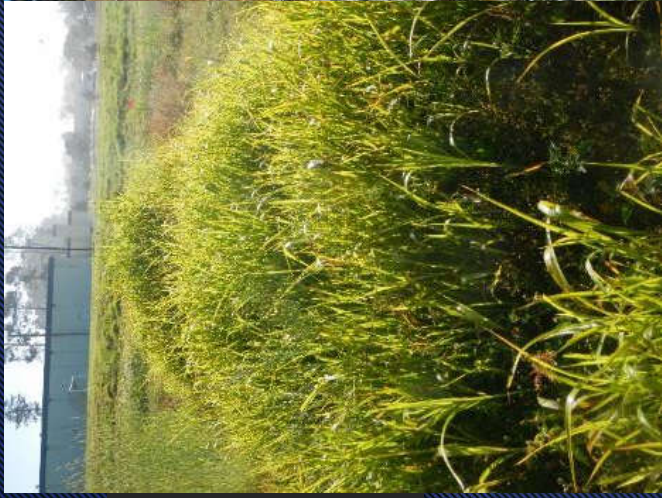
- Find good summer cover crops for ASD in coastal CA
- Revisiting F.o.f. control threshold under ASD
(> 300 hrs above 86 °F at 8" soil depth, Yonemoto et al, 2007)

Approaches:

- Piper Sudan grass, Triticale, FL104 rye, Italian rye, Mustard (Ida Gold), Open pollinated broccoli, Rice bran 9 t/ac, No cover crop. RCBD, 4 reps, 32 plots
- Cover crop: May 3 - July 17, 2017
- CC dry biomass + rice bran = 9 tons/ac for ASD (July-Aug)
- Burial/retrieval method: 3 naturally infested F.o.f. inocula per plot



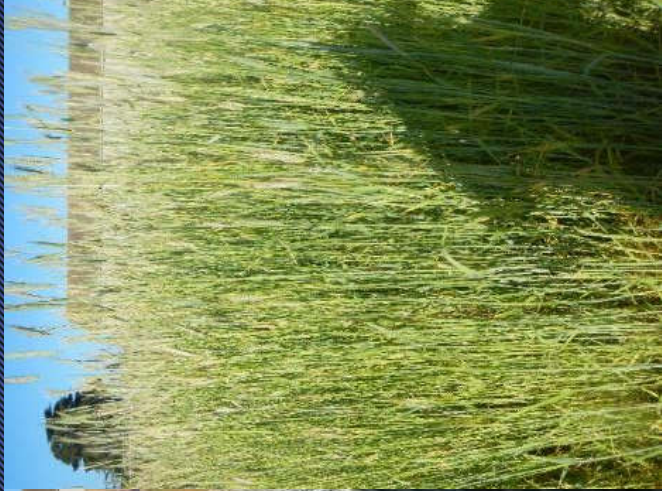
Summer cover crop ASD trial MBA, Watsonville (June 8, 2017)



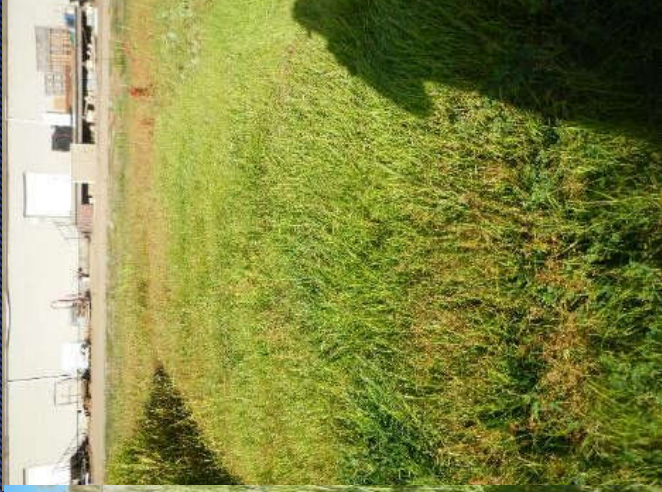
Piper Sudan grass



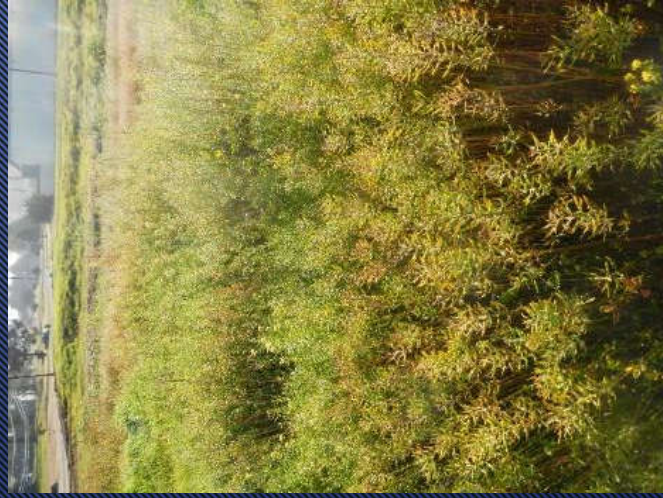
Triticale



FL104 rye



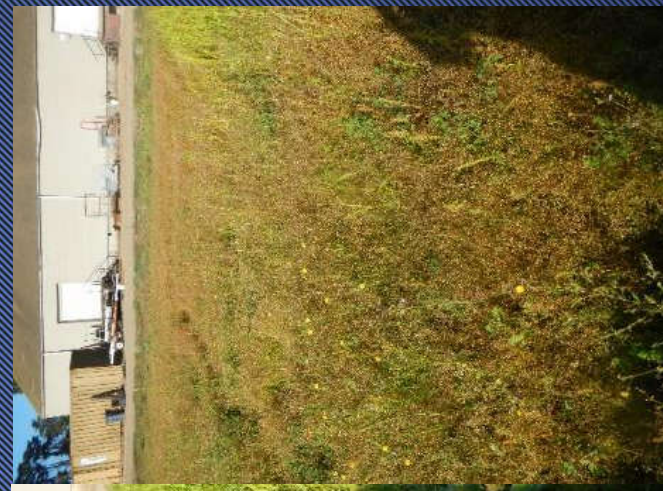
Italian rye



Mustard (Ida Gold)



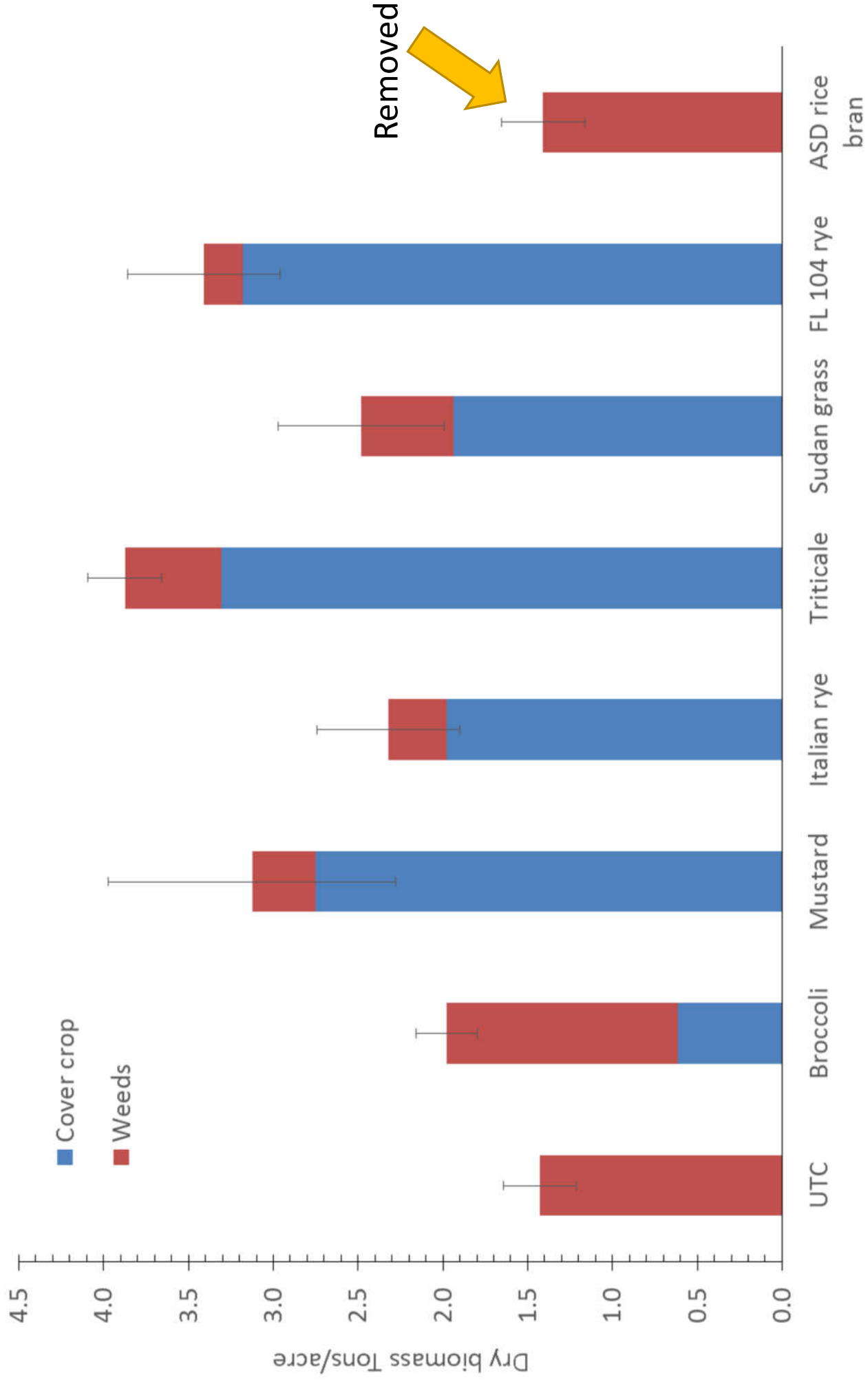
Open pollinated broccoli



No cover crop

**Summer
cover crop
ASD trial at
MBA,
Watsonville
(July 17, 2017)**

Dry Biomass (ASD-CC trial, MBA)



Cover Crop-Based Summer Flat ASD Treatment (July-Aug 2017)



1. Mowing cover crops



2. Adding rice bran



3. Chiseling and rototilling



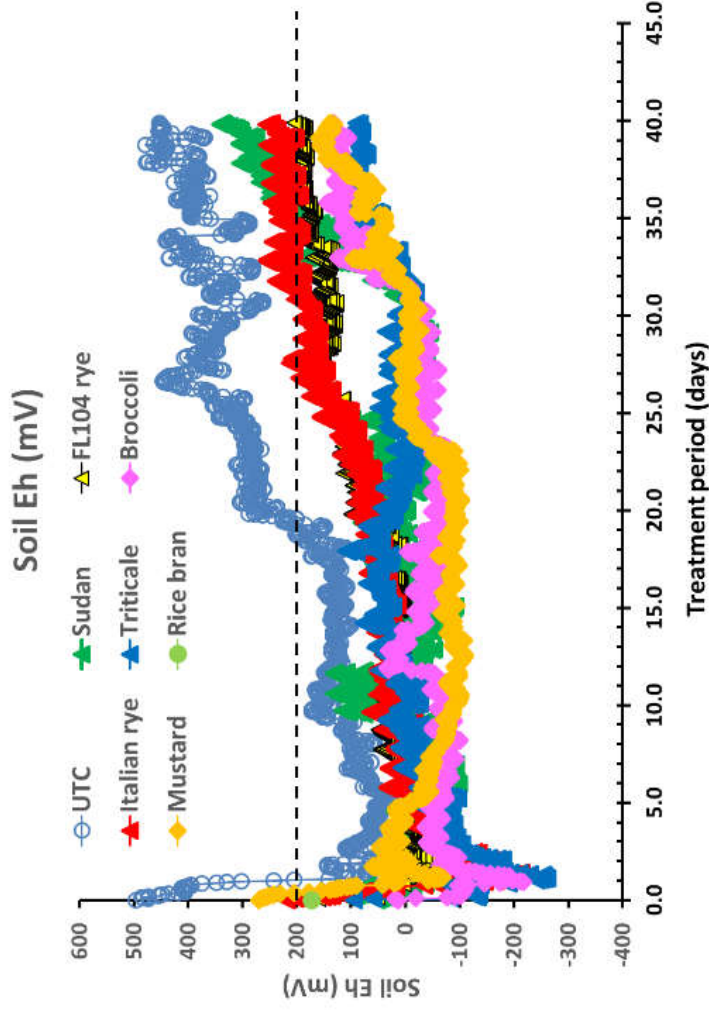
4. Applying clear TIF and drip tapes



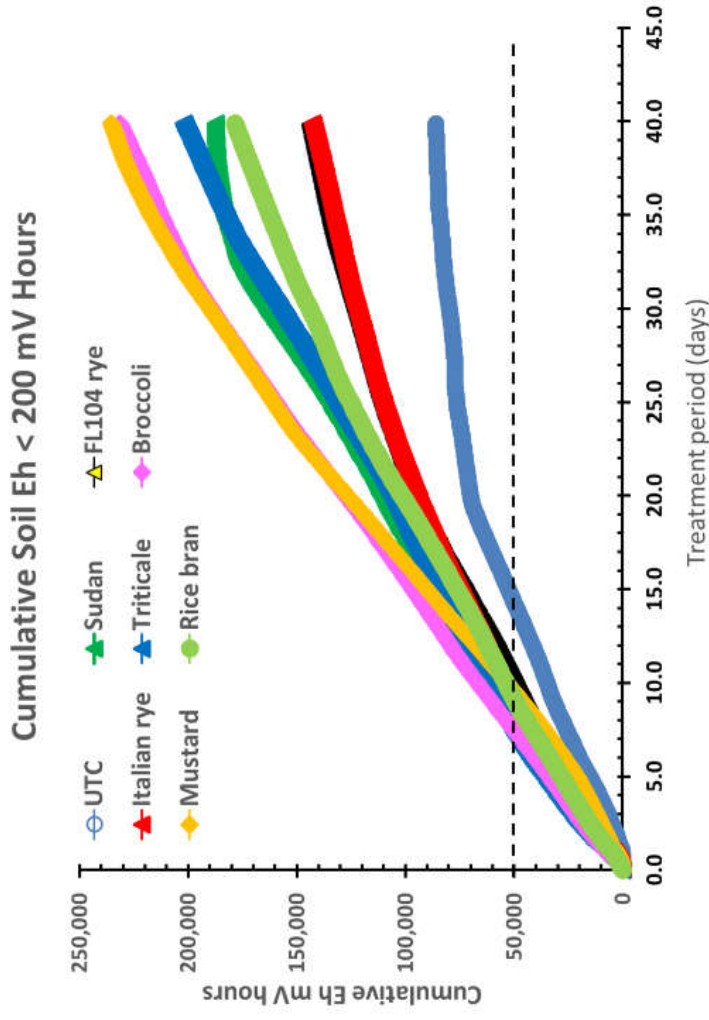
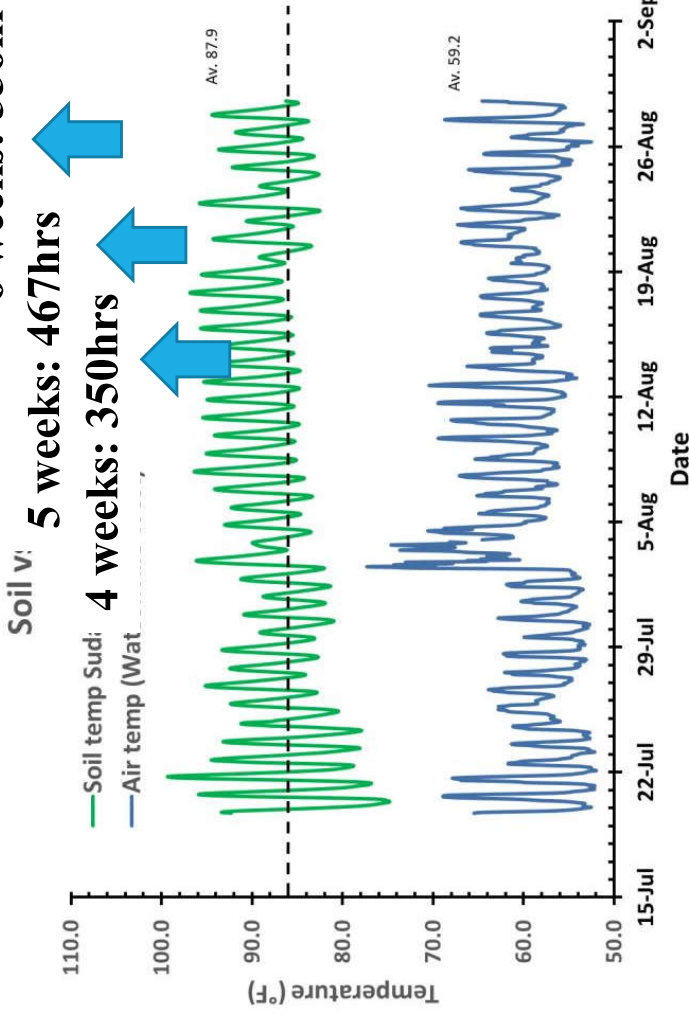
5. Drip irrigation (1.5 ac-inches)



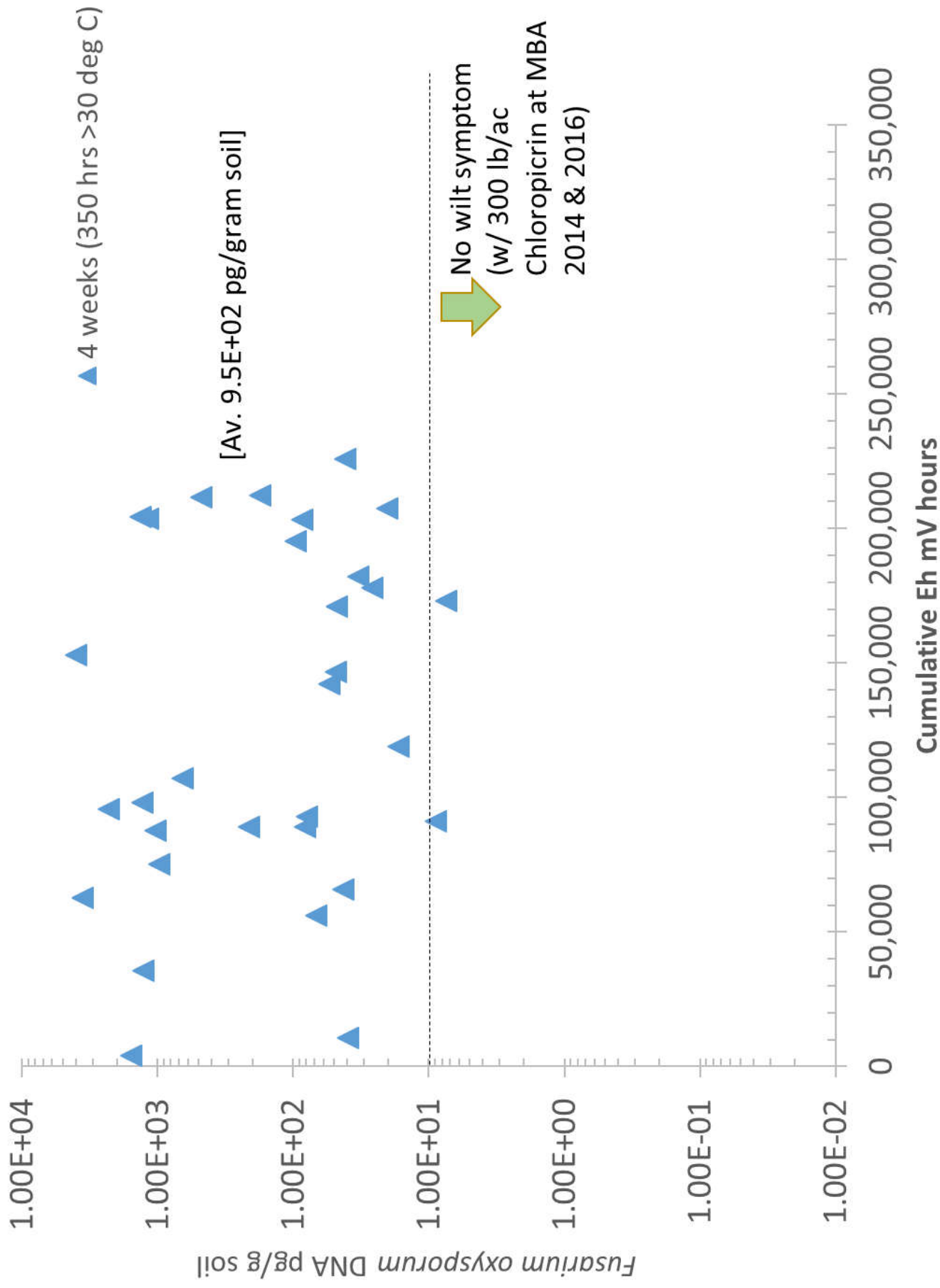
6. Summer flat ASD w/ clear TIF (July 19 – August 28, 2017)



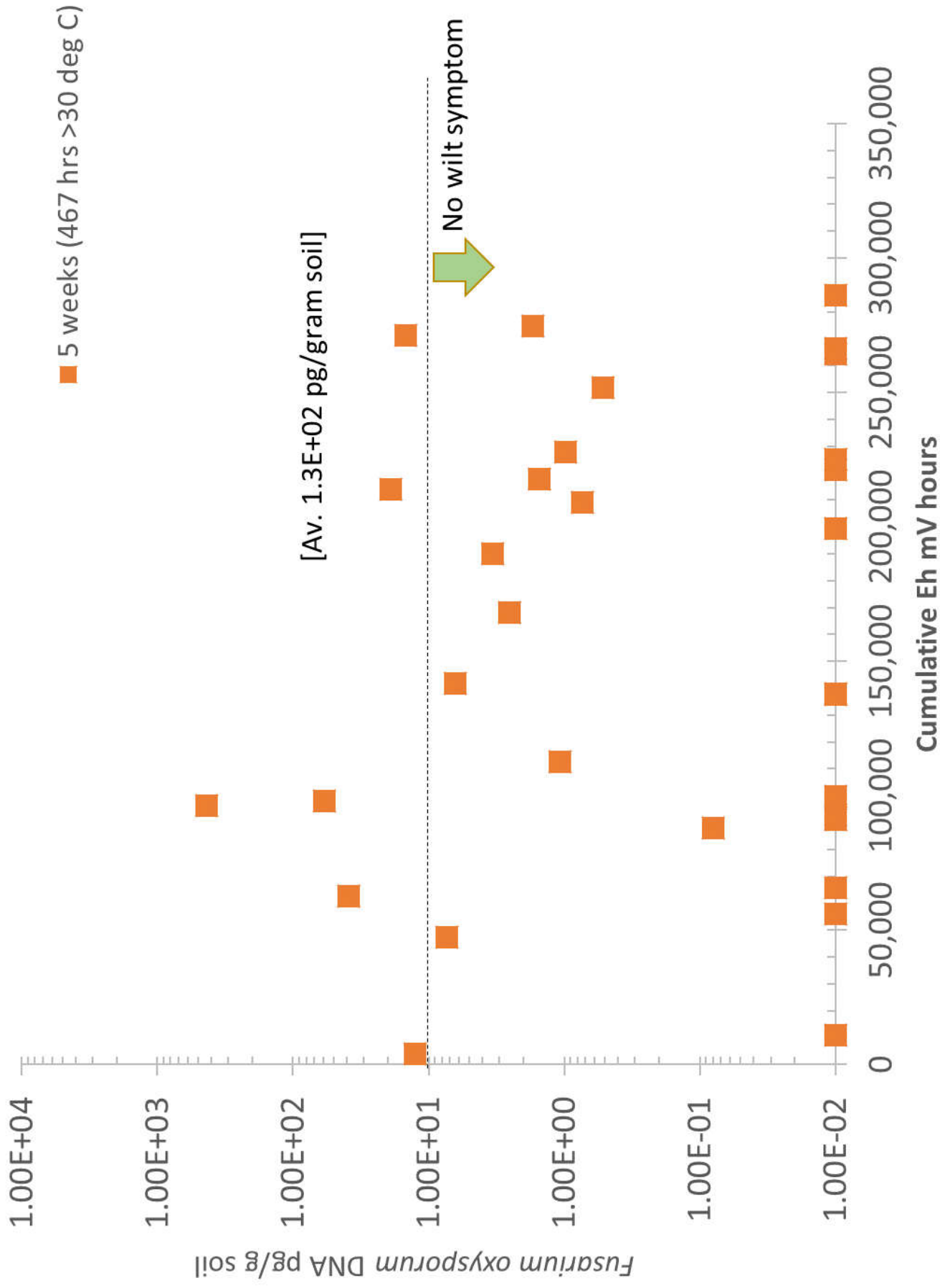
6 weeks: 556hrs



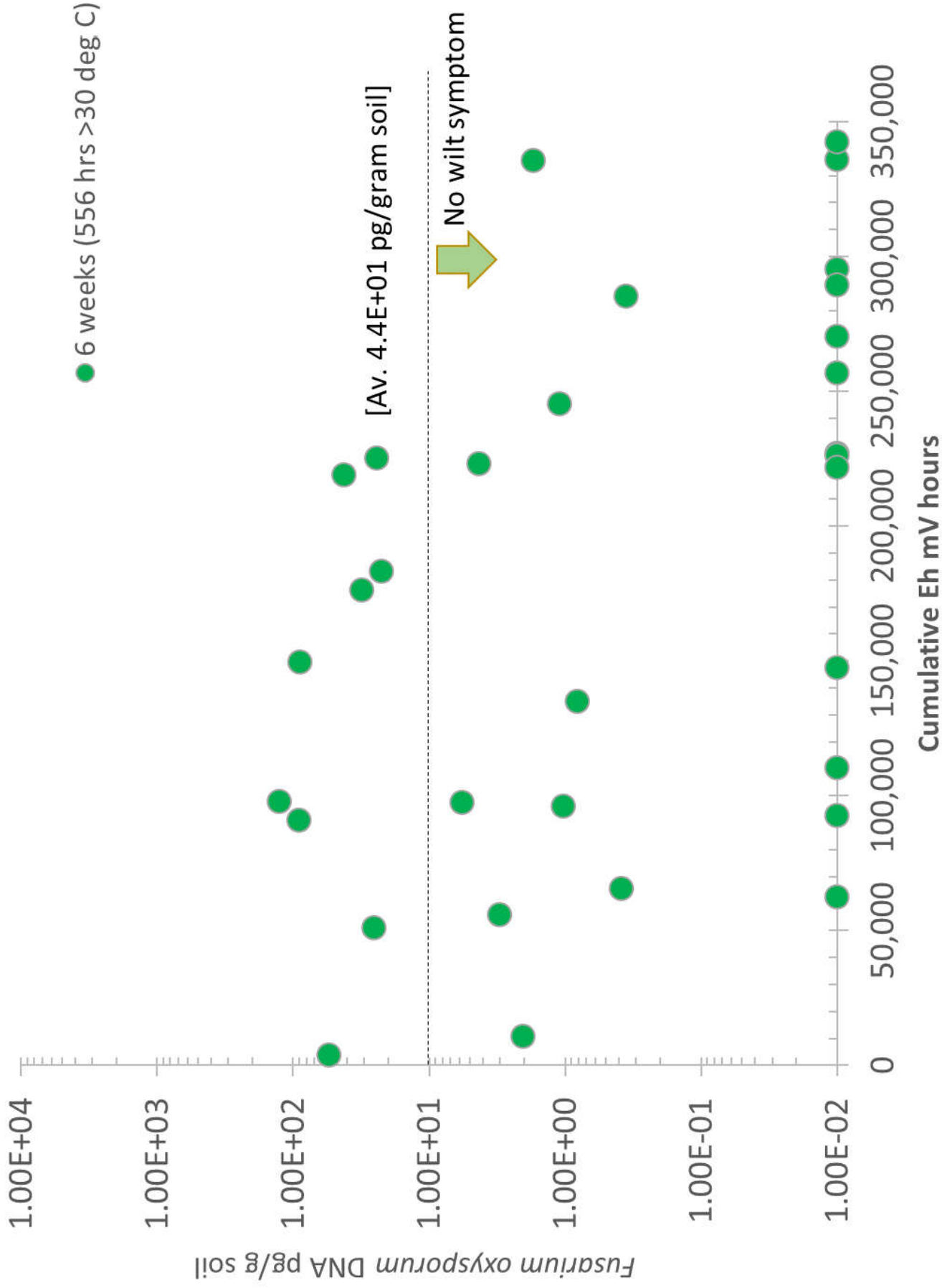
- Strong anaerobic condition at all CC + RB treatments
- > 300 hours of cumulative soil temperature > 86 °F at 4.5” depth
- Fusarium inocula retrieved at 4, 5, and 6 weeks of ASD treatment from each plot



Fusarium oxysporum population after varying cover crop-based ASD treatments (4 weeks. MBA, summer 2017)

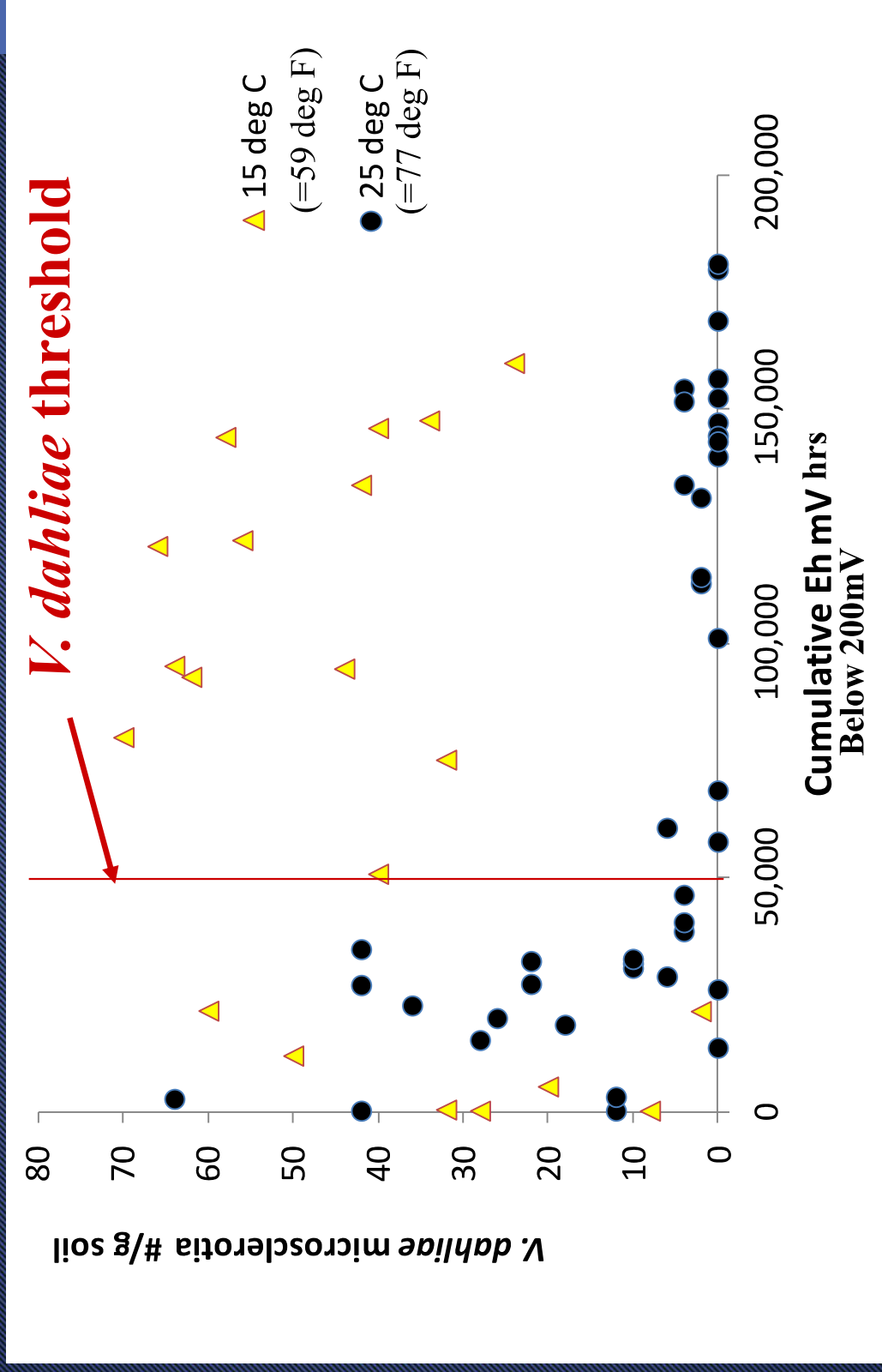


Fusarium oxysporum population after varying cover crop-based ASD treatments (5 weeks. MBA, summer 2017)



Fusarium oxysporum population after varying cover crop-based ASD treatments (6 weeks. MBA, summer 2017)

Both anaerobic condition and temperature are important for disease control in ASD



Cumulative mV hrs with Eh below 200mV - threshold for *V. dahliae* control at ~50,000 (25 °C)

(Shennan et al., 2017)

Summary

- Triticale, FL104 rye, and mustard (Ida Gold) had the highest biomass as summer cover crops in Watsonville, CA
- All types of cover crops tested were able to create a strong anaerobic condition when rice bran was added to make the total rate 9 tons/acre
- Economic analysis to be conducted
- Tentatively, more than 450 hours (~5 weeks) above 86 °F appears to be necessary to reduce *Fusarium oxysporum* in soil below the wilt threshold irrespective of anaerobic status
- The experiment will be repeated in the next season

Cover Crop ASD Demo Trial 1 (1 acre, Watsonville, CA)



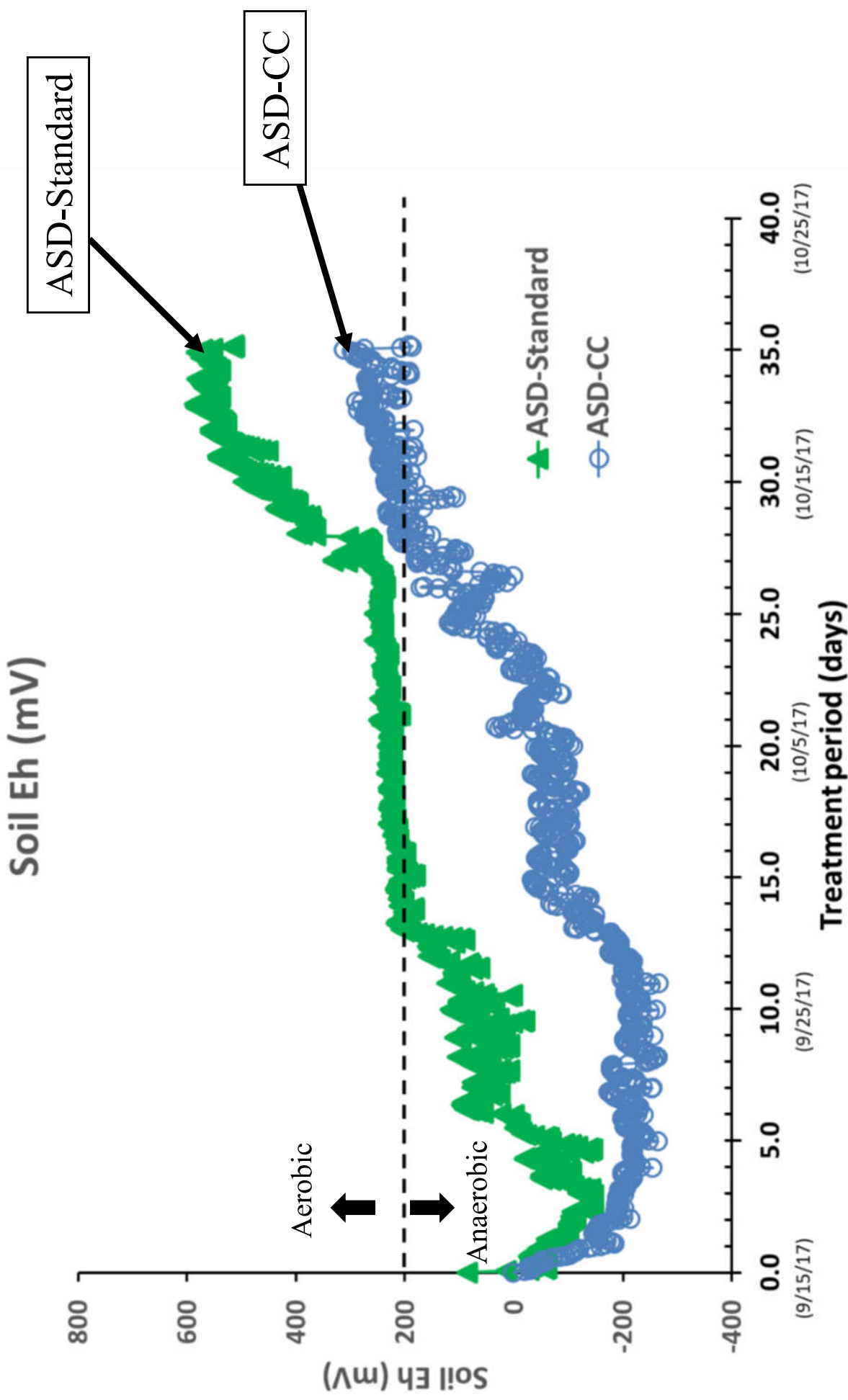
ASD-Std:
Rice bran 13 tons/ac



ASD-CC: Sudan
grass 1.4 tons-d.w./ac
+ rice bran 6 tons/ac

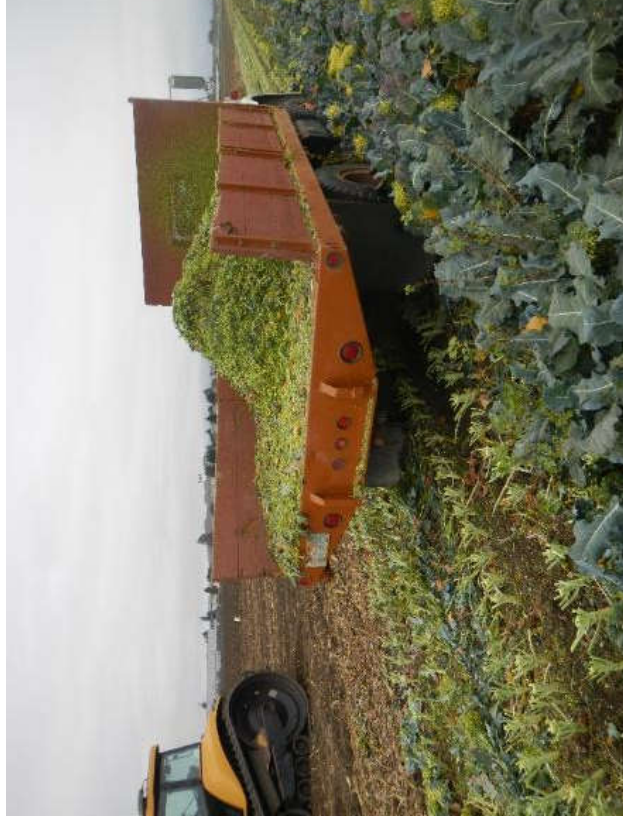


Cover Crop ASD Demo Trial (1 acre, Watsonville, CA)



Use of freshly mowed cover crop with reduced rate of rice bran created a stronger anaerobic condition than the standard ASD

Cover Crop ASD Demo Trial 2 (1 acre, Watsonville, CA)



Dutch ASD (summer cover crop-based flat treatment)

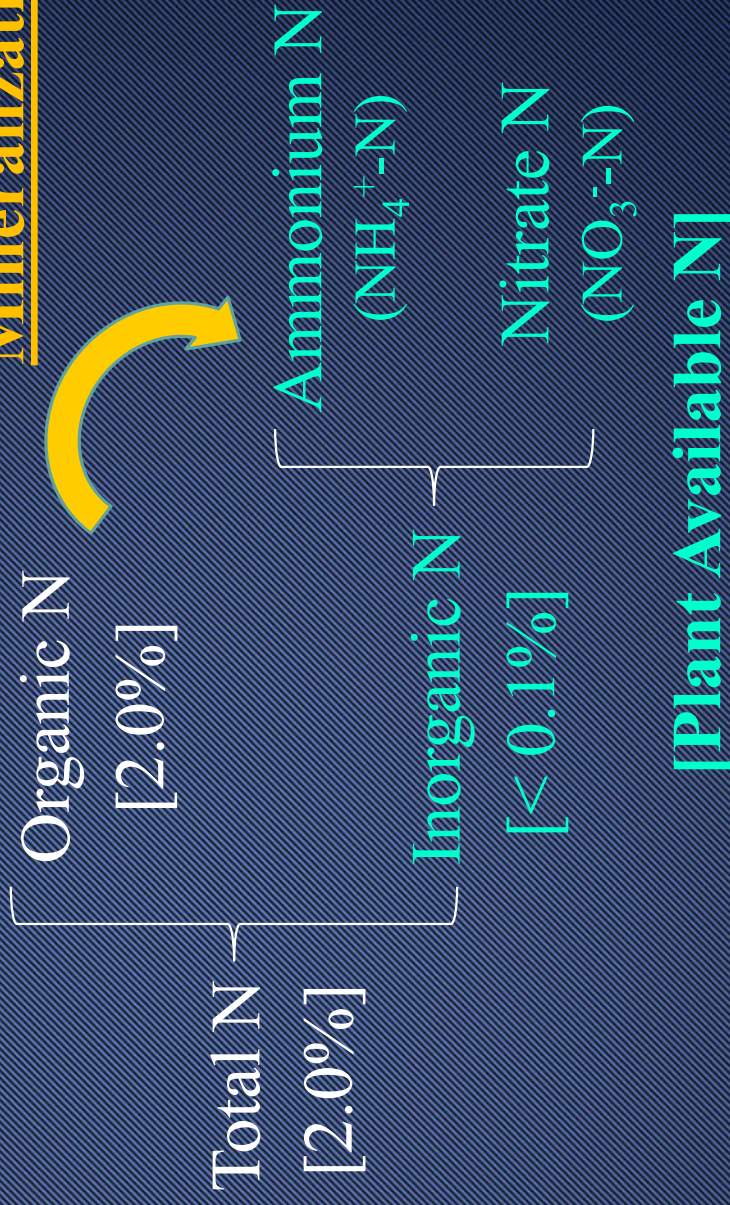
1. Sprinkle before mowing cover crop
 2. Mow and incorporate cover crop, and compact/smooth the soil surface in one path
 3. Lay tarp
- Less soil pore space than beds
 - Water saving potential
 - No drip tapes (lower cost!)
 - Better disease control?
 - Can be used for other C-source incl. liquid C-sources



N Mineralization from Rice Bran

- Rice bran: $\text{N-P}_2\text{O}_5\text{-K}_2\text{O}$: 2-3-1 (C/N: 20)
- N mineralization rate: 20-30% per season (further study in progress)
- 20-30% of TN becomes available to plants per season
- e.g. RB 9 tons/acre:
 $18,000 \text{ lb} \times 0.02 =$
Total N: 360 lb-N/ac
 $360 \times 0.2 = 72$
72-108 lb-N/ac of plant available N

Mineralization*

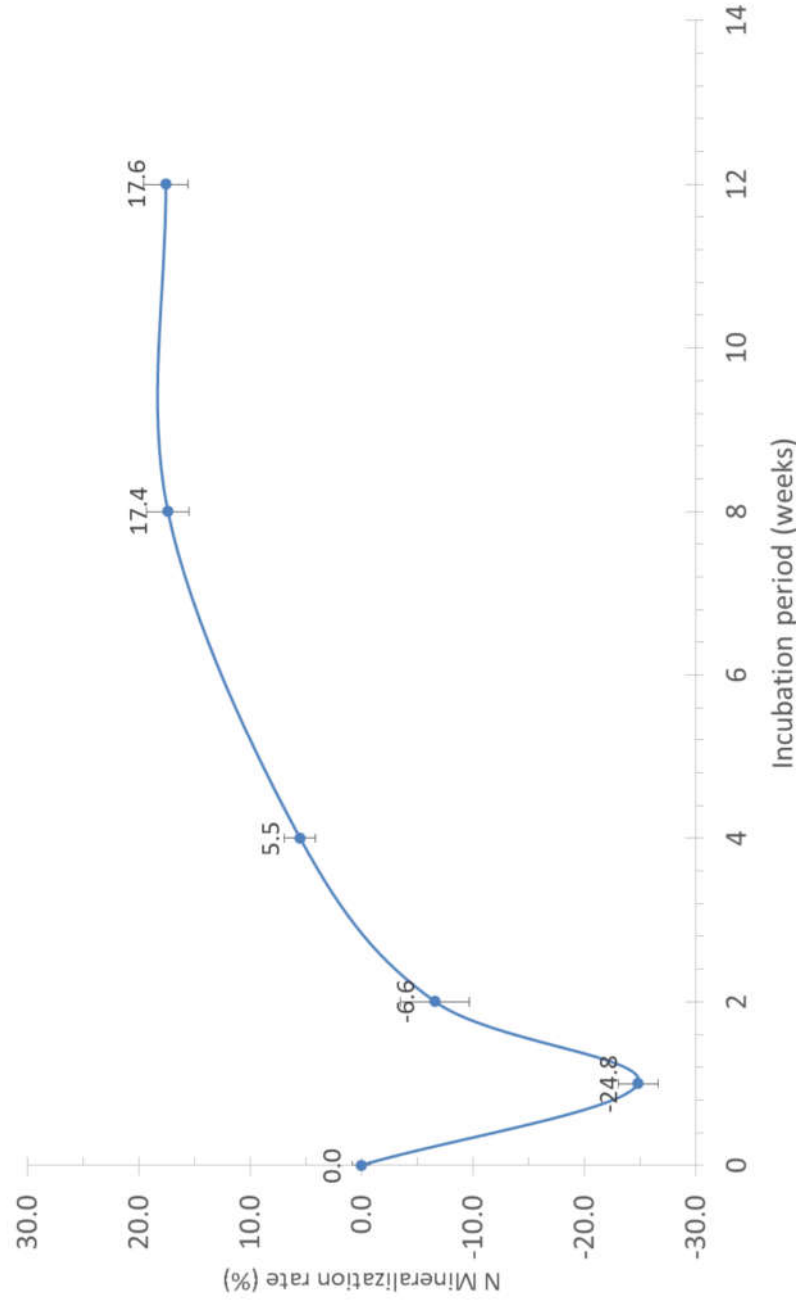


* Biological process

N Mineralization from Rice Bran

- Preliminary data
 - 20% mineralization in 12 weeks
 - Remainder may be decompose slowly
 - Repeated ASD can increase soil N fertility
- For summer planting strawberries in Santa Maria;
 - Lower rate
 - Use of cover crop

Rice bran N mineralization rate
50% water filled pore space (aerobic) at 90 °F/79 °F (day/night)



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Thank you!
Question?

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