Prune Replant Issues:

Insights from Almond & Peach Experience

Greg Browne

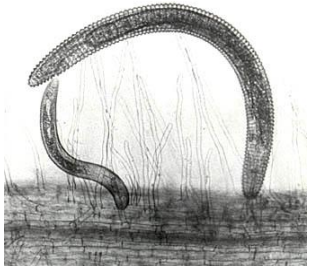
Prune Day
Red Bluff, CA
20 February 2015

Almond Board of California
USDA Pacific Area-Wide Prog. for MB Altern.
California Dept. of Pesticide Reg.
UC Cooperative Extension

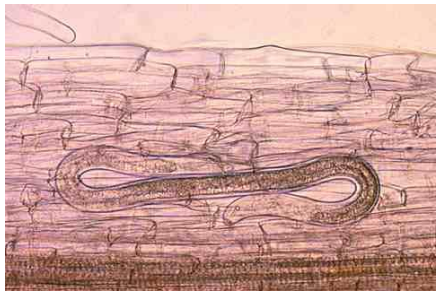
Photo: California Agriculture

Replant problems of *Prunus* species

- **Plant-parasitic nematodes** (ring, lesion, root knot), approx. 35% of almond and fresh stone fruit acreage, 60% of cling peach acreage infested (McKenry)
- **Replant disease (RD)** Microbe-induced growth suppression; commonly occurs in *Prunus* after *Prunus;* severity varies greatly
- **Aggressive pathogens, pests** (e.g., *Phytophthora*, *Armillaria*, *Verticillium*, Ten-Lined June Beetle)
- **Abiotic factors** (physical, chemical conditions related to previous production)



Ring nematode



Lesion nematode

Plant parasitic nematodes

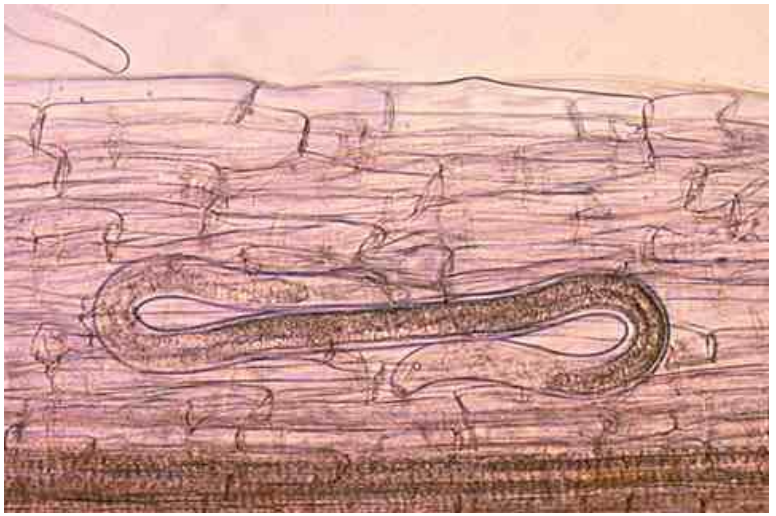
Healthy tree

RD-affected tree

Replant disease

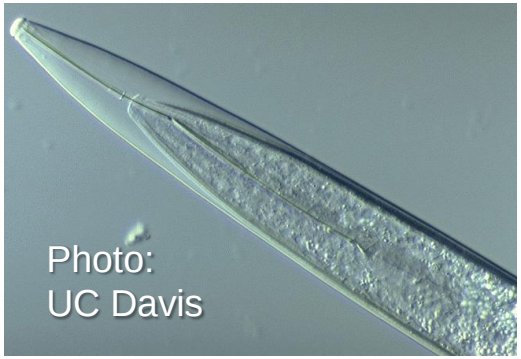
Thoughts on plant-parasitic nematodes, "the replant problem we know"…

- **Economic impact, direct and indirect, can be great over life of orchard**
- **We can sample for them:**
  - Best timing: **pre-push** and **post-push / pre-plant**
  - Best depth range **0.3 to 3-ft depth**
  - Best to **represent variation** in soil texture and block histories
- **Preplant fumigation with 1,3-D** (in Telone II or Telone C35) is prudent when facing known plant-parasitic nematodes
- **Rootstock resistance important** to weigh in management decisions

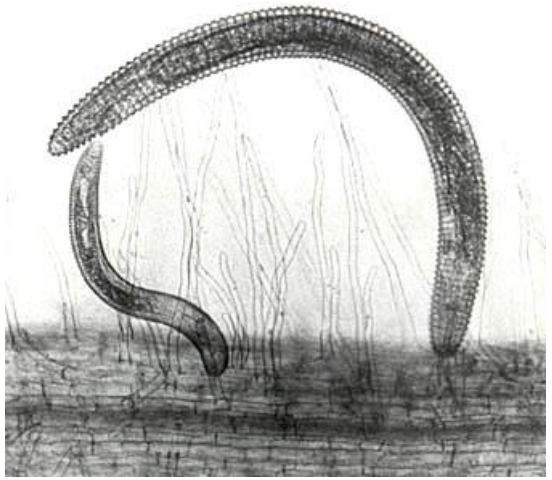


Root lesion nematode

Dagger nematode

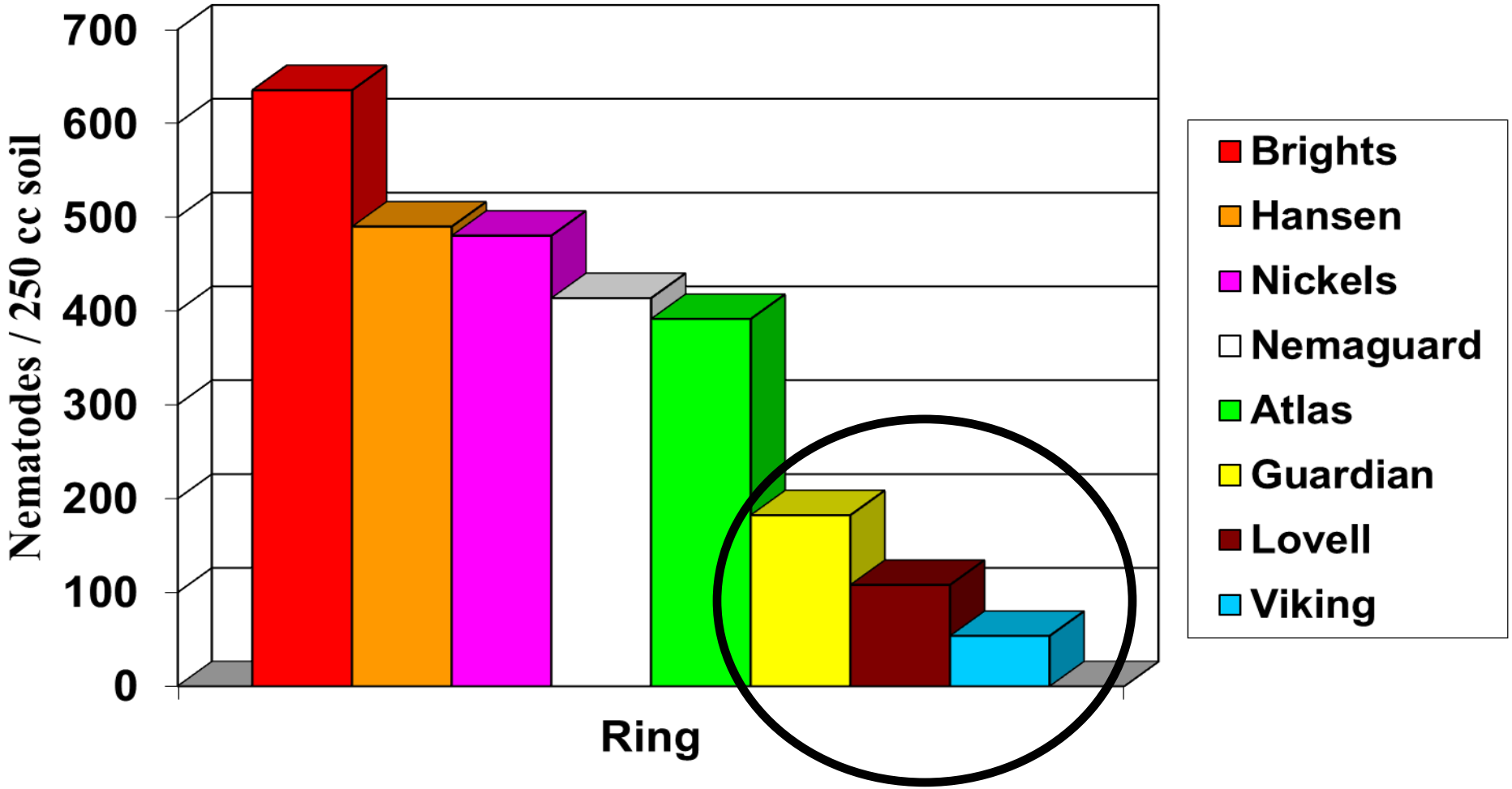


Ring nematode



Soil Numbers of pathogenic nematodes as influenced by almond rootstock
Escalon, CA. January, 2005

DATA OF ROGER DUNCAN. UCCE



Replant disease, “the other replant problem”...

Chico, 2001

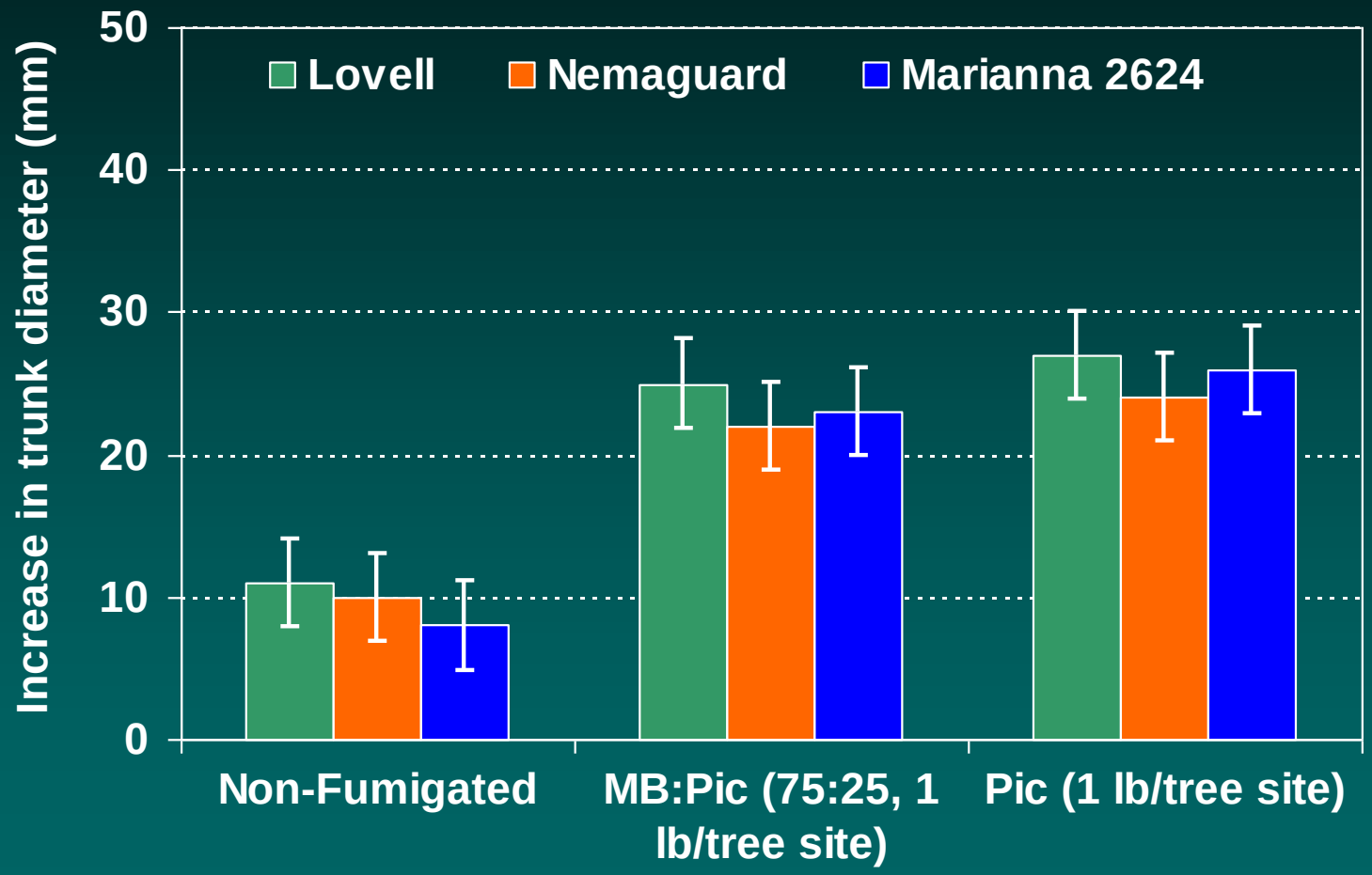
Replant Disease, “the other replant problem”…

Durham, 2002.

Repeated sampling indicated no role of plant-parasitic nematodes in RD at sites chosen for trials near Chico, Durham, and Parlier, CA

Effect of fumigant x rootstock, Durham

Trees planted Feb 2003, measured 9 Dec 2003, Orchard 1



Impact of RD as determined by pre-plant fumigation…

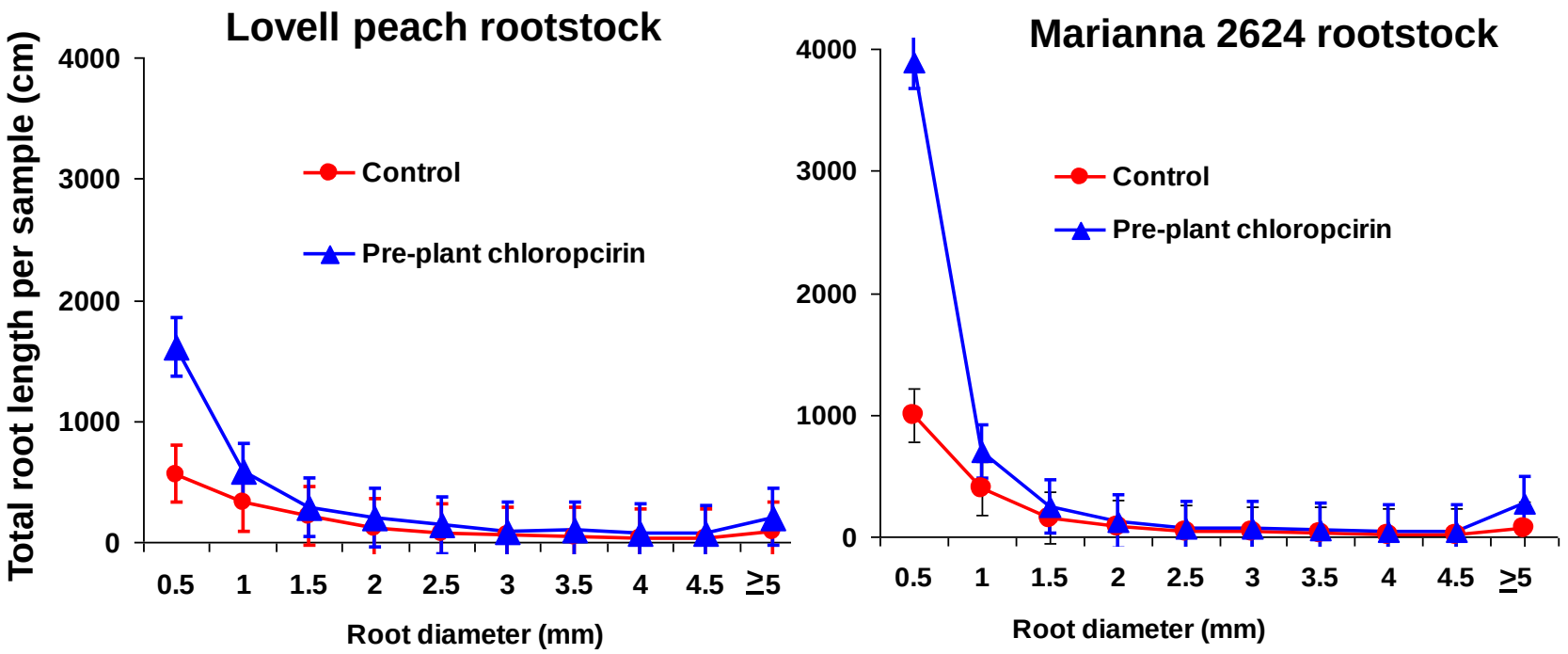
Durham, 2004

Healthy tree, CP-fumigated plot

RD-affected tree, Non-treated plot

Impact of RD on first-year root development, almond…

Durham, 2004; root length densities determined by soil and root excavation, digital imaging, and WinRHIZO software.

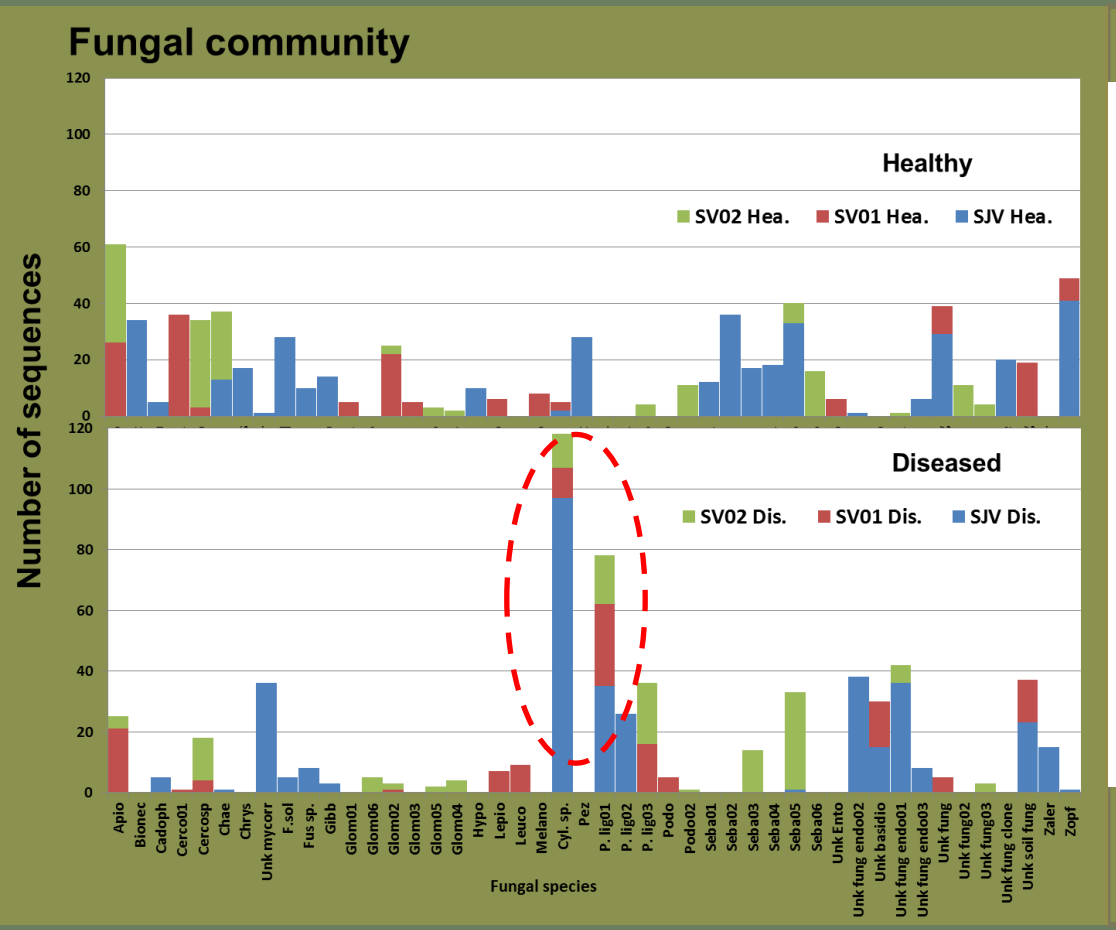


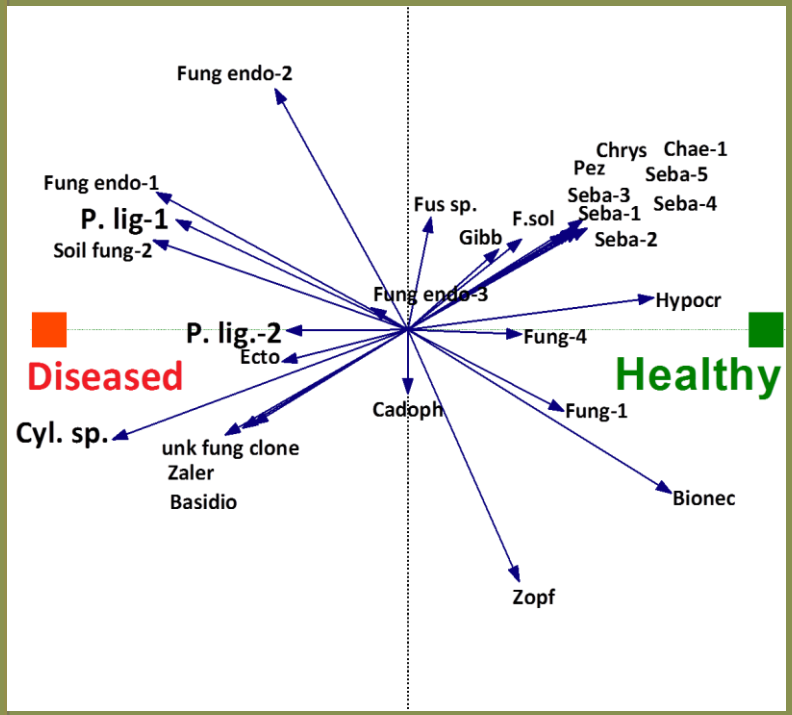
Replant disease, Firebaugh, 2007

Replant disease, Madera, 2008

Replant disease, Parlier, 2008

Replant Disease: Sorting through the haystack of potential causes…



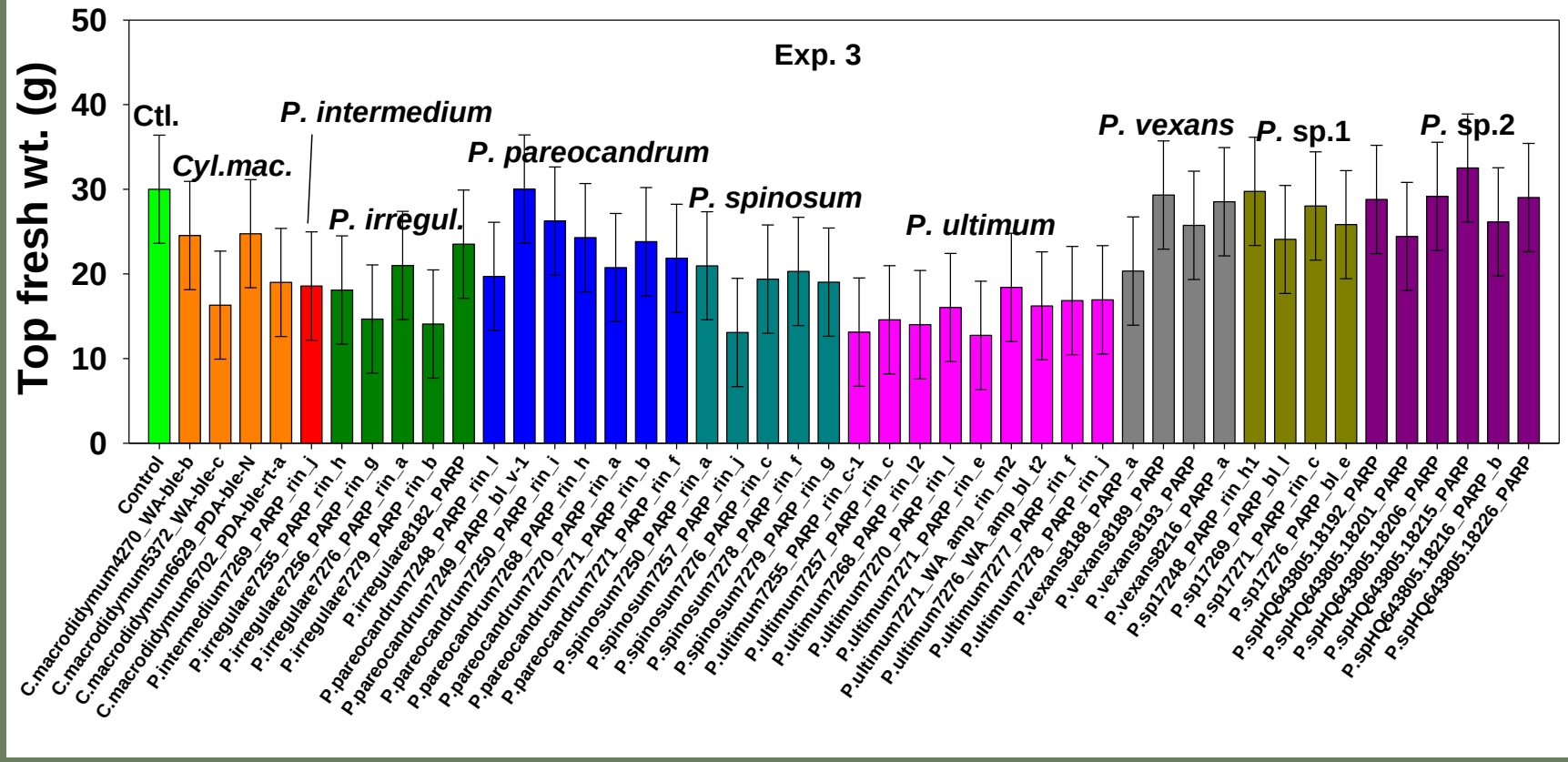


Ordination analysis

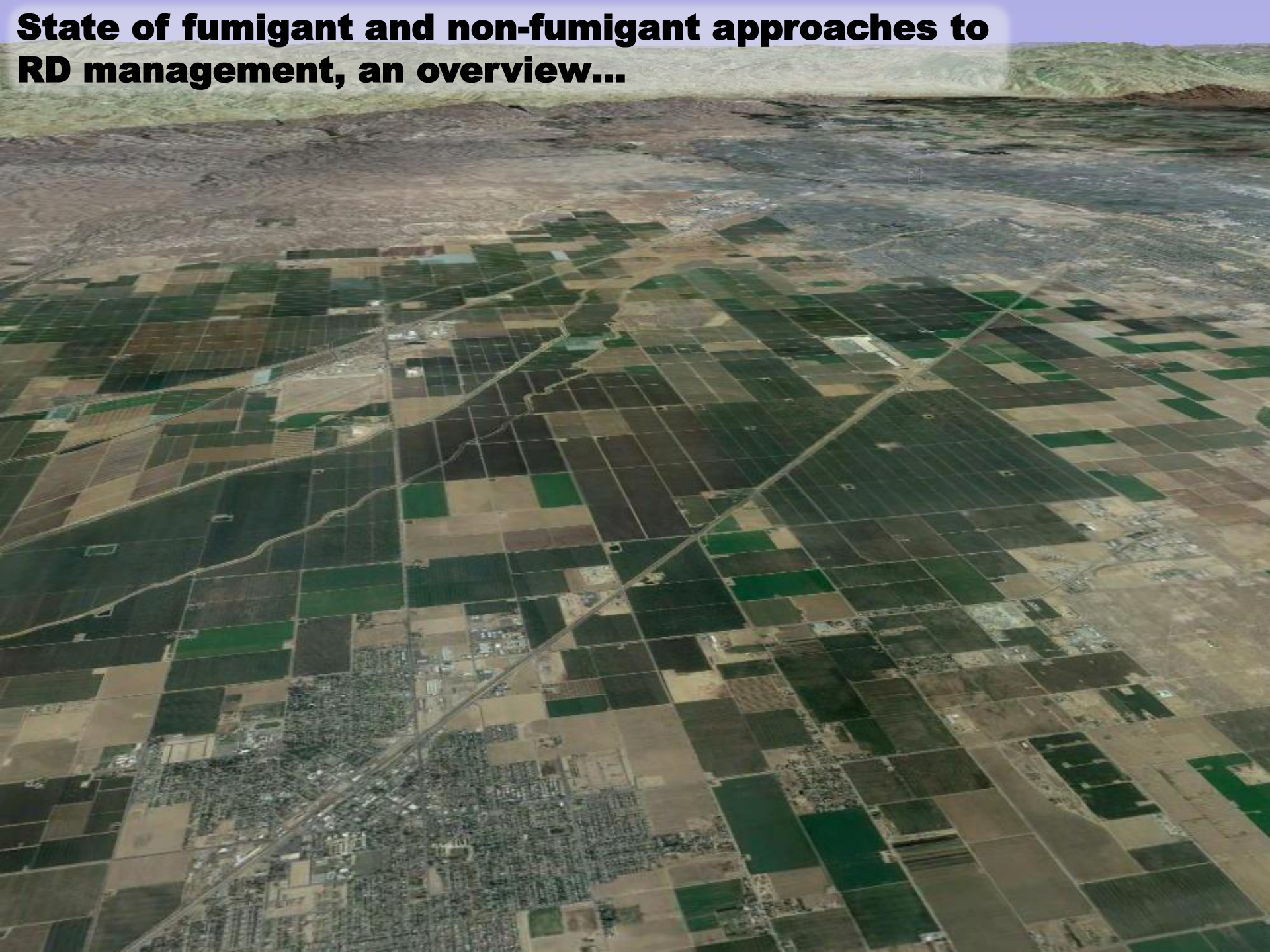
Contributors to RD: *Cylindrocarpon* and *Pythium* species

Ck *Cyl. macrodidymum*

Ck *Pythium ultimum*

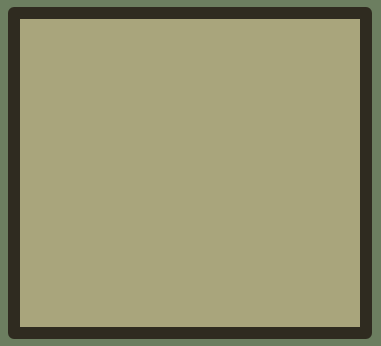


State of fumigant and non-fumigant approaches to RD management, an overview…

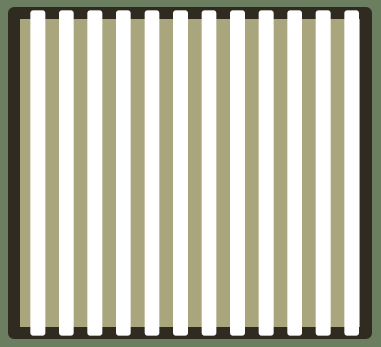


Soil fumigation considerations

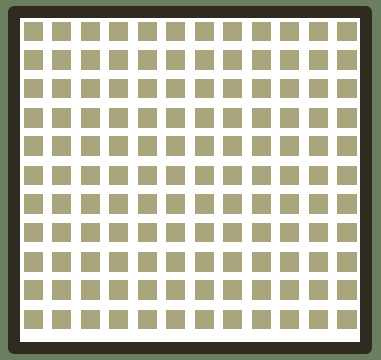
Broadcast
100% coverage

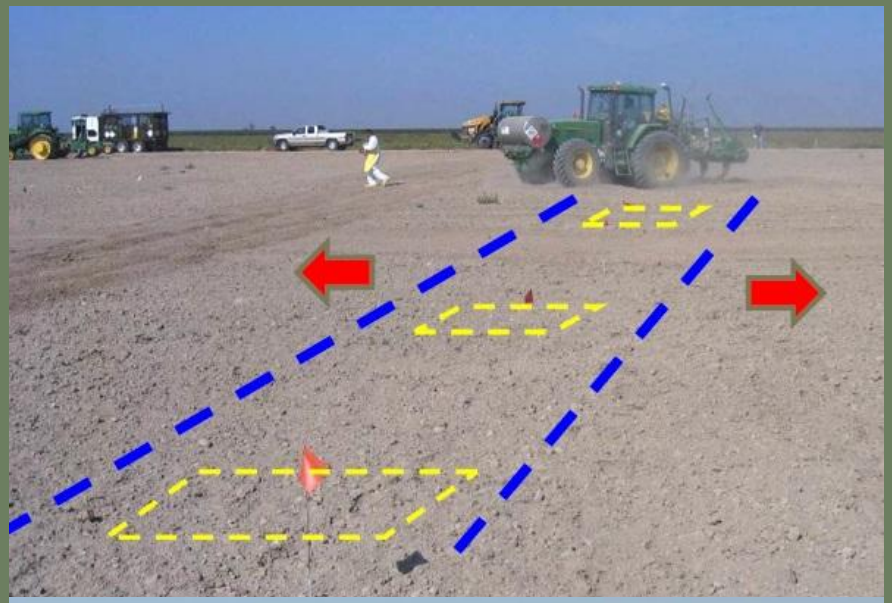


Strip
50% coverage

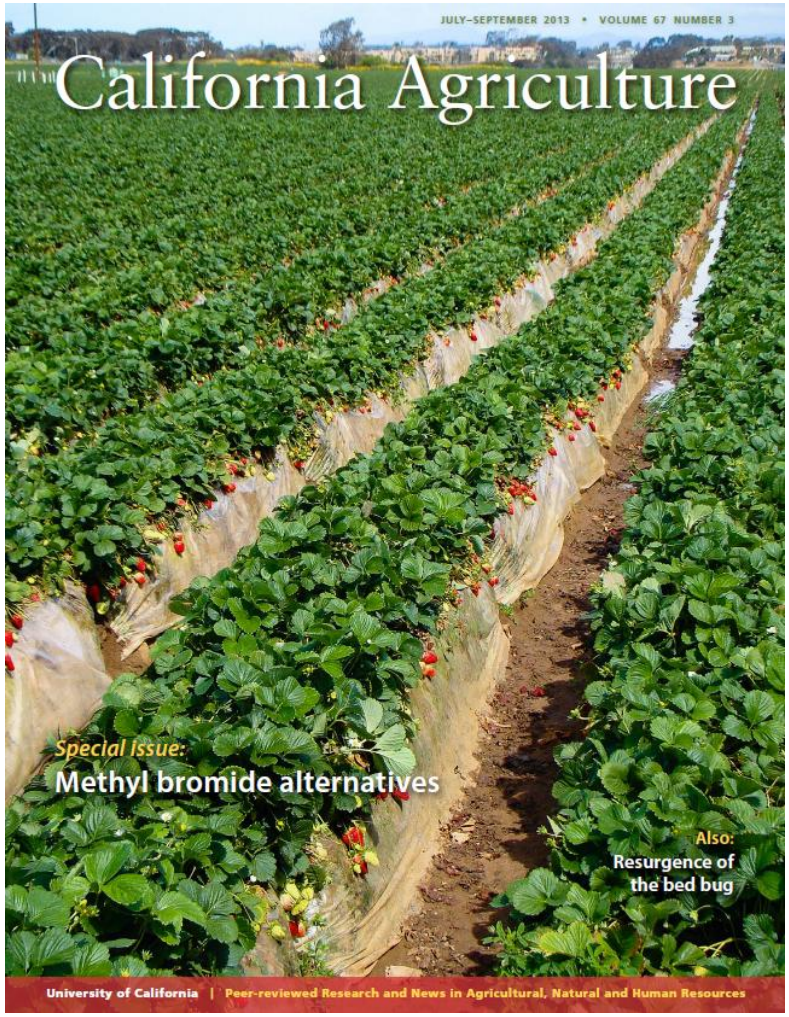


GPS-Grid
<20% coverage





Summaries of Prunus replant studies available online: http://californiaagriculture.ucanr.edu

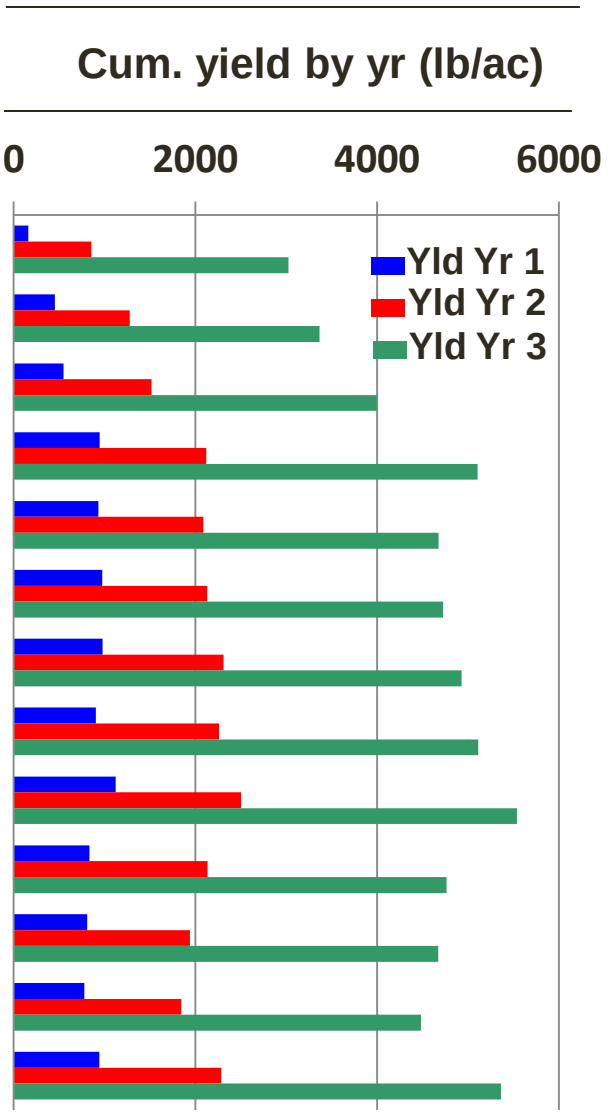


Please email me at gtbrowne@ucdavis.edu for help with or discussion of PAW-MBA results

Replant disease, Madera Co., 2007

Almond replant trial, Firebaugh, CA; treatments, costs, yields

Fumigant	Treated area	Fumigant rate lb / trt. ac.	Fumigant rate lb / or. ac.	Cost of trt. ($/ac.)
Control	None	0	0	0
Methyl br.	Row strip (45%)	400	180	1962
Telone II	Row strip (38%)	340	129	393
Midas	Row strip (38%)	0	152	na
Chloropicrin	Row strip (38%)	400	152	871
Chloropicrin	Row strip (38%)	300	114	677
Chloropicrin	Row strip (38%)	200	76	482
Telone C35	Row strip (38%)	550	209	882
Pic-Chlor 60	Row strip (38%)	550	209	829
Pic-Chlor 60	Row strip (38%)	400	152	667
Chloropicrin	Tree spot (17%)	400	68	441
Telone C35	Tree spot (17%)	550	94	447
Telone C35	Full coverage (100%)	550	550	2169

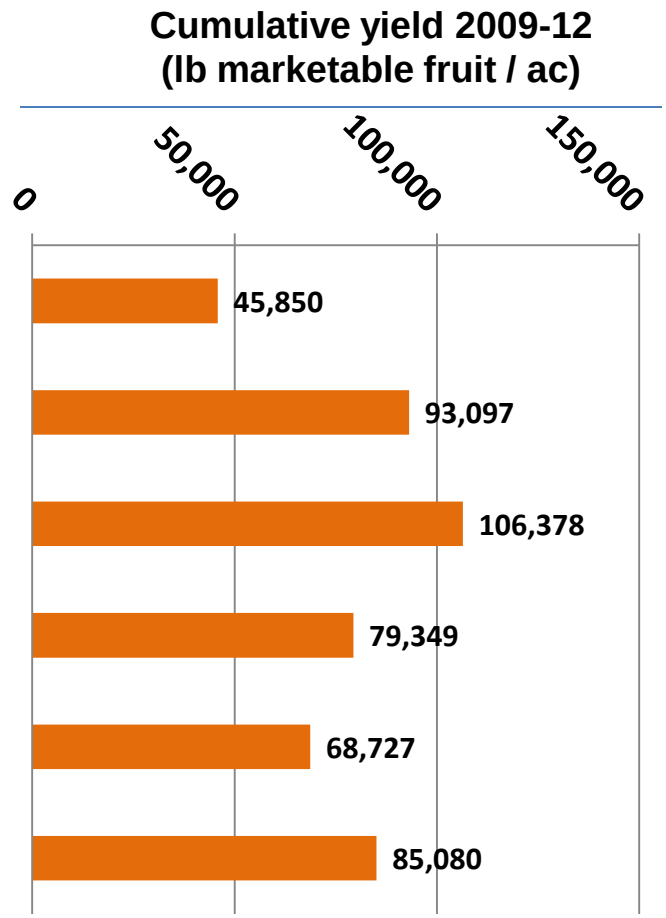


Almond replant trial; Firebaugh, CA

Fumigant	Treated area	Fumigant rate		Cost of trt. ($/ac.)	Cum. net reven. gain ($/ac.)[a]	
		lb / trt. ac.	lb / or. ac.		Yield Yr. 2	Yield Yr. 3
Control	None	0	0	0	0	0
Methyl br.	Row strip (45%)	400	180	1962	(1,120)	(1,279)
Telone II	Row strip (38%)	340	129	393	929	1,552
Midas	Row strip (38%)	0	152	na	na	na
Chloropicrin	Row strip (38%)	400	152	871	1,593	2,433
Chloropicrin	Row strip (38%)	300	114	677	1,870	2,727
Chloropicrin	Row strip (38%)	200	76	482	2,422	3,328
Telone C35	Row strip (38%)	550	209	882	1,926	3,296
Pic-Chlor 60	Row strip (38%)	550	209	829	2,462	4,202
Pic-Chlor 60	Row strip (38%)	400	152	667	1,885	2,814
Chloropicrin	Tree spot (17%)	400	68	441	1,725	2,857
Telone C35	Tree spot (17%)	550	94	447	1,530	2,473
Telone C35	Full coverage (100%)	550	550	2169	688	2,511

Parlier peach replant trial

Treatment[a]		Fumigant rate		Cost of treatment ($ / acre)
Fumigant	Treated area	lb / trt ac	lb / orch ac	
Control	None	0	0	0
Methyl bromide	Row strip (42%)	400	200	2,272
Telone C35	Row strip (50%)	550	231	1,062
Telone C35	Tree spot (13%)	550	69	460
Inline	Tree spot (5%)	550	28	207
Chloropicrin	Tree spot (13%)	400	50	457



Parlier peach replant trial

Treatment[a]		Fumigant rate		Cost of treatment ($ / acre)	Cummulative yield (lb / ac)	Net fruit prices and net revenue gain ($/acre)[b]			
Fumigant	Treated area	lb / trt ac	lb / orch ac			$ 0.24 / lb	$ 0.12 / lb	$ 0.06 / lb	$ 0.03 / lb
Control	None	0	0	0	45,850	0	0	0	0
Methyl bromide	Row strip (42%)	400	200	2,272	93,097	9,067	3,398	563	(854)
Telone C35	Row strip (50%)	550	231	1,062	106,378	13,465	6,201	2,570	754
Telone C35	Tree spot (13%)	550	69	460	79,349	7,580	3,560	1,550	545
Inline	Tree spot (5%)	550	28	207	68,727	5,283	2,538	1,166	480
Chloropicrin	Tree spot (13%)	400	50	457	85,080	8,958	4,251	1,897	720

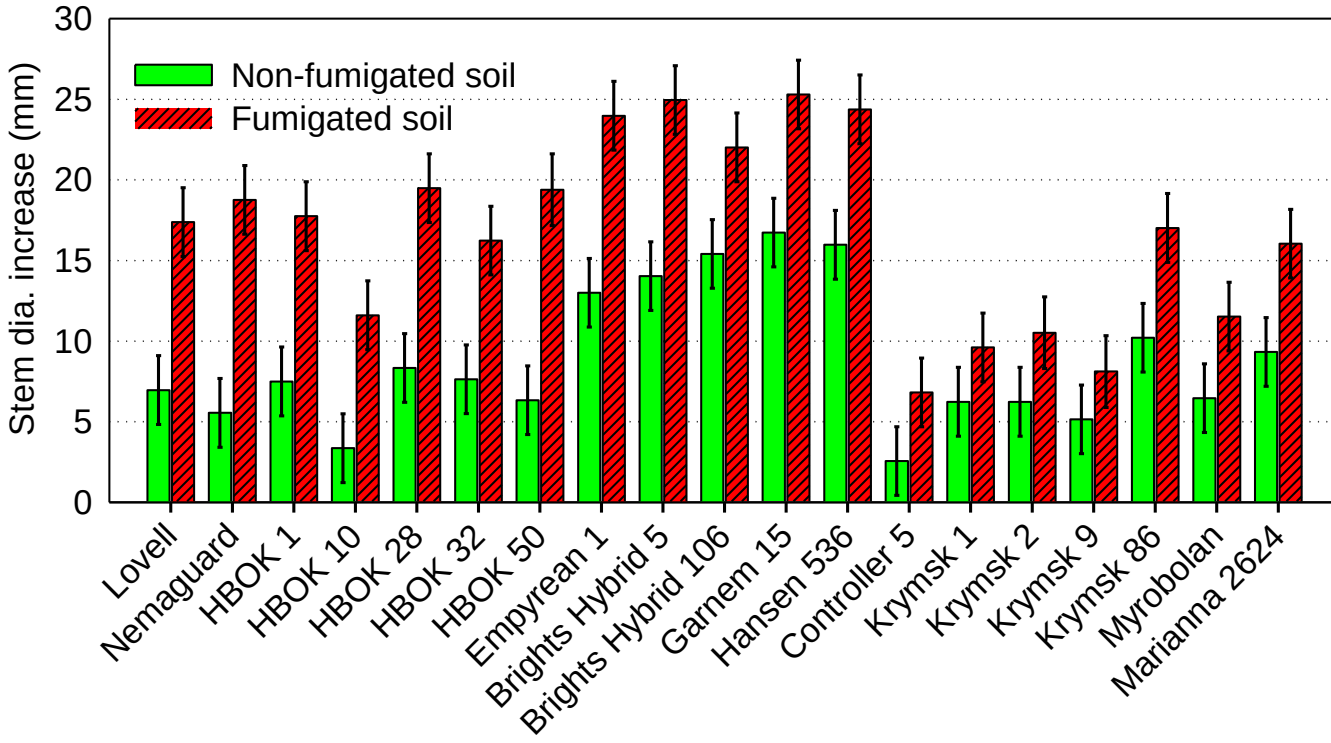
Non-fumigants:

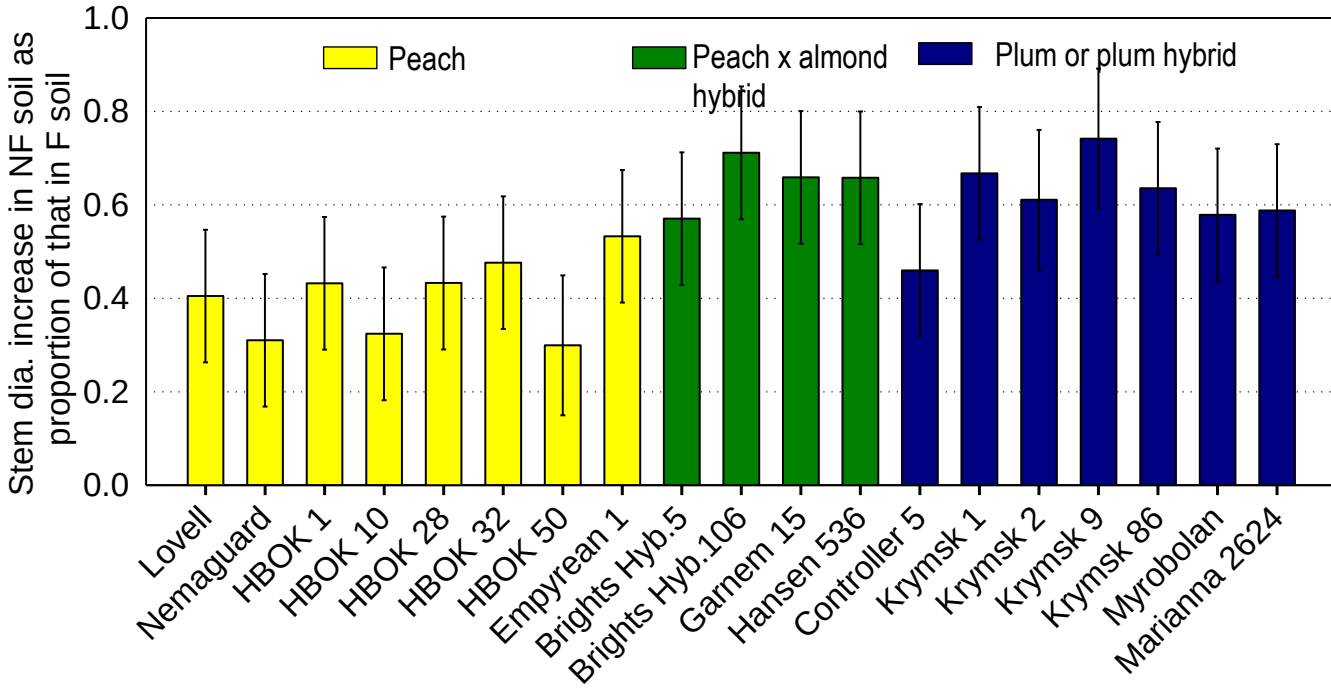
Validation of sudan rotation value, peach replant trial, Parlier, CA

Treatment[a]	Cost of treatment ($ / acre)	Cummulative yield (lb / ac)	$ 0.24 / lb	$ 0.12 / lb	$ 0.06 / lb	$ 0.03 / lb
No sudan rotation (control)	0	72,320	0	0	0	0
Piper sudan grass rotation	217	84,174	1,911	849	317	51

Non-fumigants: rootstocks and mgt. of replant disease

2011-12 trial





Key point: Rootstocks vary significantly in resistance to RD

Nemaguard, C35-fumigated soil

Nemaguard, NF soil

Hansen 536, C35-fumigated soil

Hansen 536, NF soil

Recent, Cal-DPR funded work to optimize fumigant use

1. Use a greenhouse-based peach seedling bioassay to increase knowledge available on the need for preplant fumigation

2. Augment bioassay testing results with orchard validations

3. Demonstrate and optimize GPS-controlled spot fumigation in commercial almond orchards

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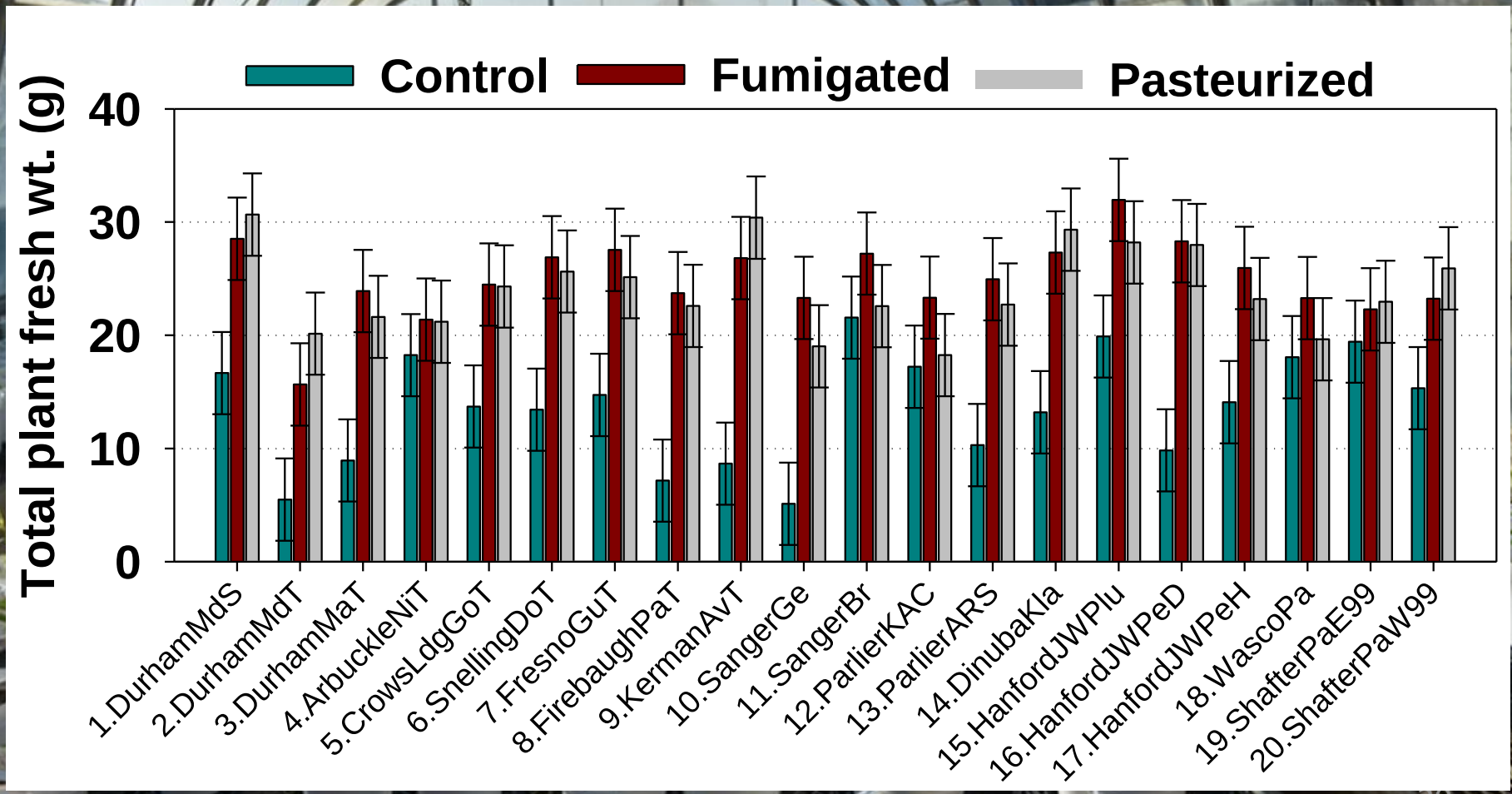
Soil sampling for bioassays

Bioassay procedure

Bioassay results



Recent: managing replant disease without fumigants, Kearney Ag Center Trial, 2013-14

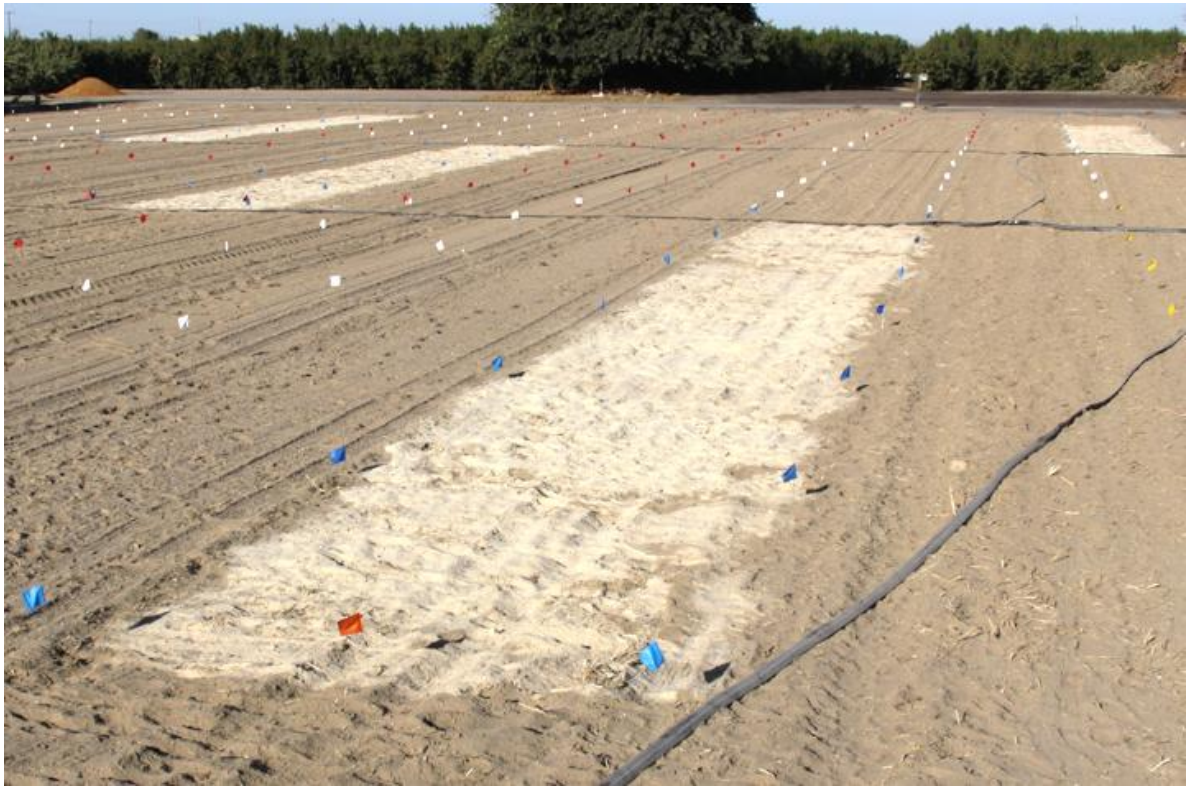
Preplant treatments included:

- Control
- Early removal / fallow or Sudan rotation
- Deep soil ripping
- Anaerobic soil disinfestation (ASD)
- Early and late season fumigation

Preplant NF treatments, KAC trial

Anaerobic soil disinfestation (ASD)

- **ASD developed in Japan and Netherlands, being tested widely for CA strawberries**
- **Initiated by adding readily available carbon substrate to soil, covering with clear tarp, keeping soil moisture near field capacity for several weeks; heat facilitates**
- **Mechanism incompletely understood, but ASD is lethal and/or suppressive to many pathogens**



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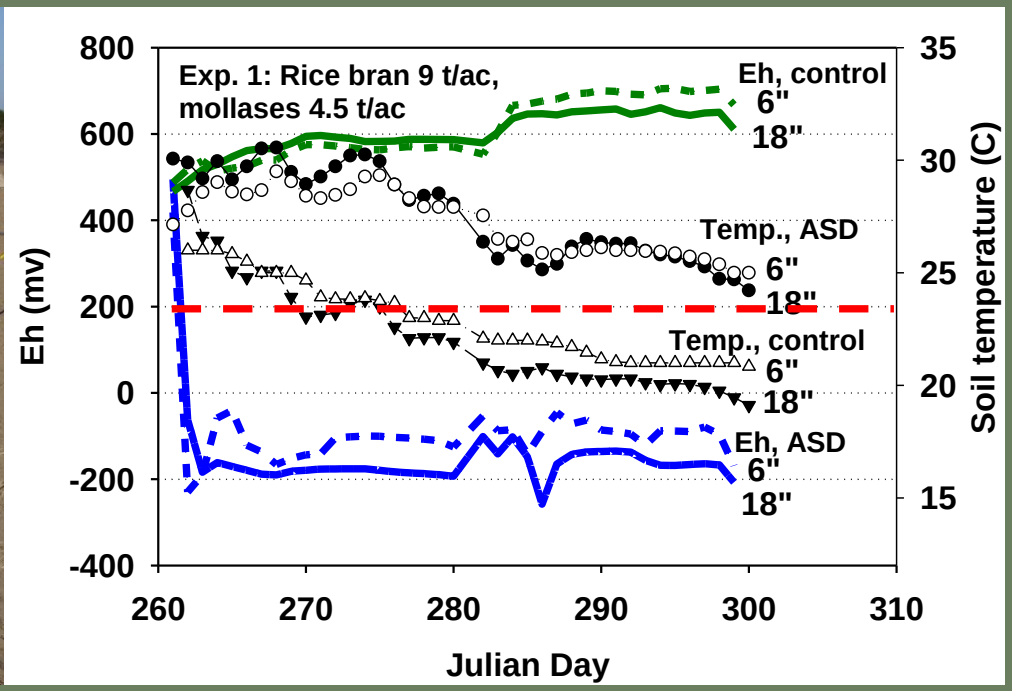
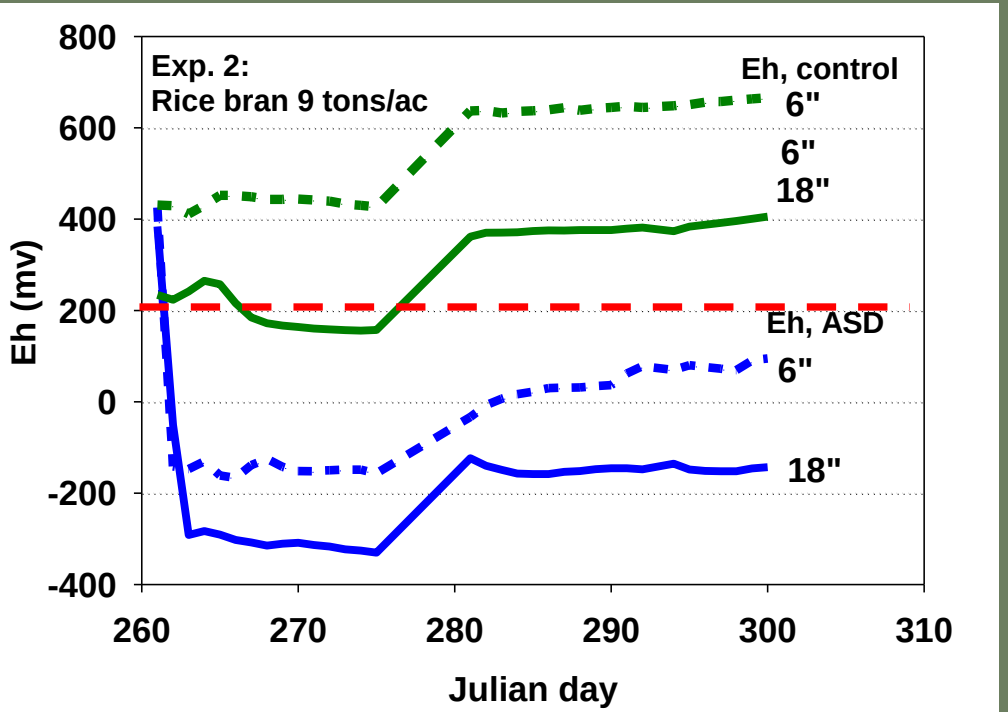
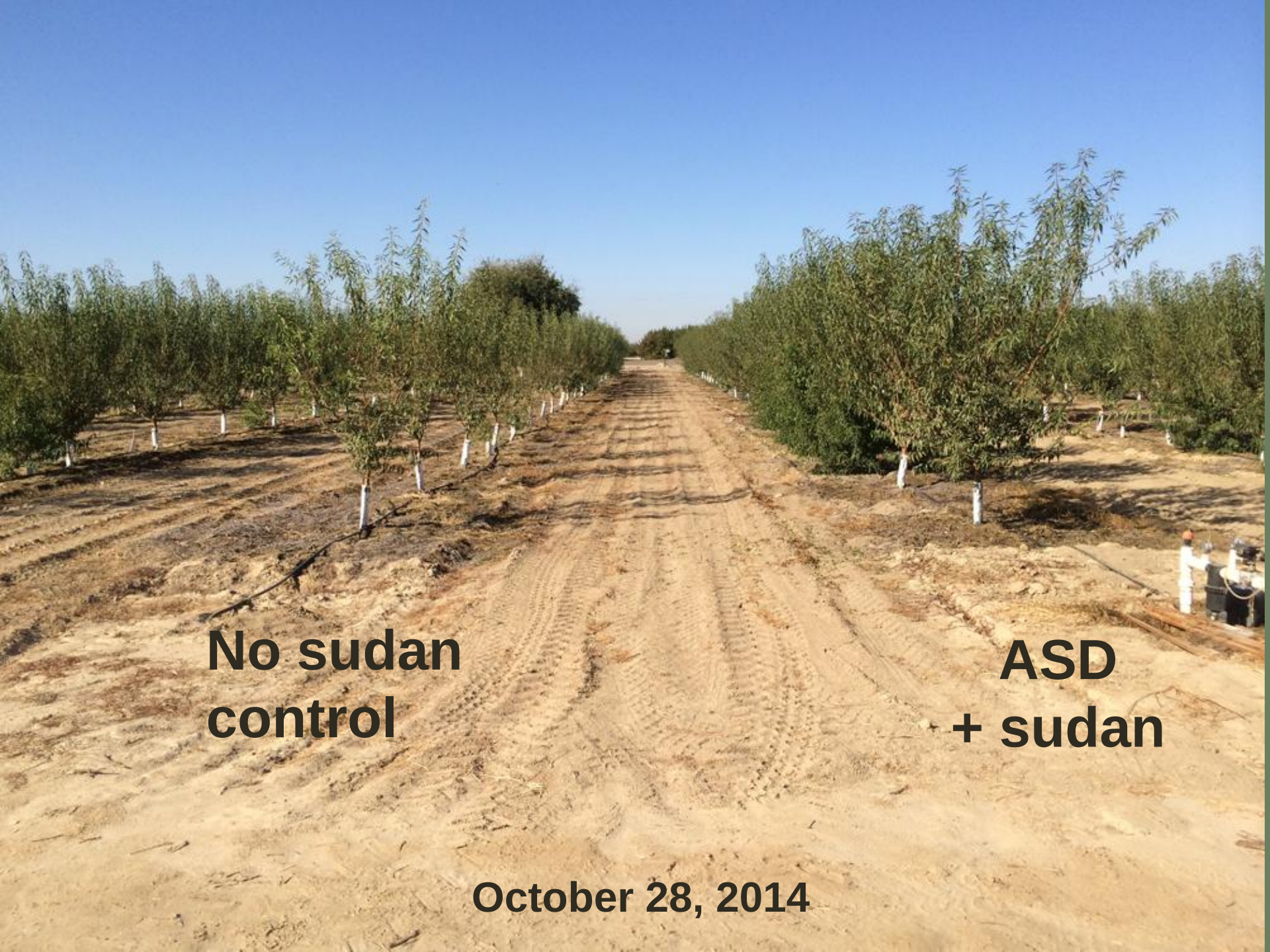
ASD treatment

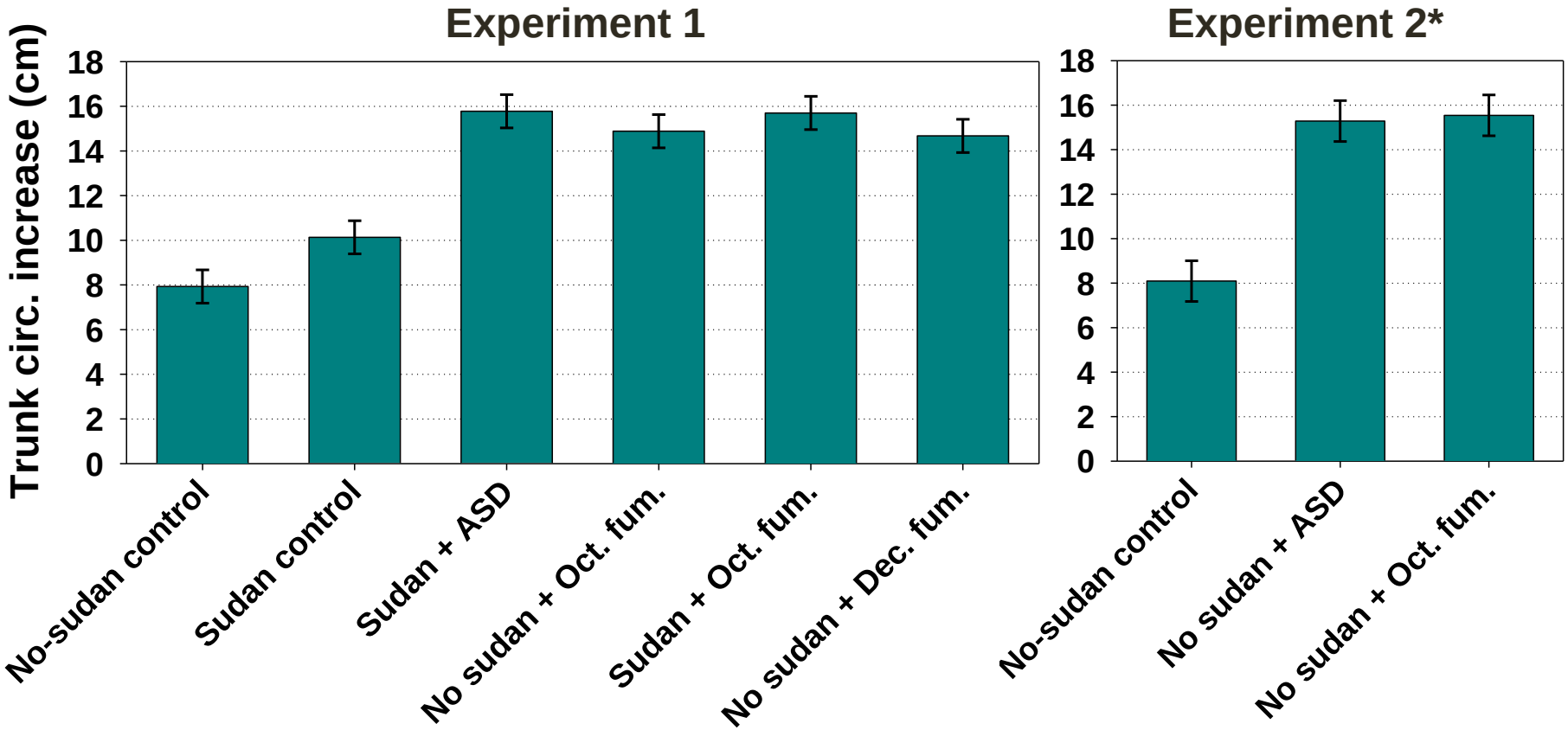





No sudan
control
ASD
+ sudan
October 28, 2014


Oct. fumigation
w/ Telone C35,
+ sudan
No sudan
control
October 28, 2014

Effects of preplant soil treatments on 1st-year growth of almond (after peach on Nemaguard)



***No sig. effect of ripping depth (2 vs. 4 ft)**

A key drawback of ASD is cost; it needs optimization to be economical

Estimated cost of ASD: $2439 / acre
(50% strips; all materials and application)

Estimated cost of Telone C35: $1143 / acre
(50% strips; all materials and application, no tarp)

- **(In addition to re-testing our 2013-14 ASD treatments, we are testing lower-cost ASD treatments in 2014-15)**
- **Low-cost yet effective ASD substrates needed**

Summary

- **Both plant parasitic nematodes and replant disease (RD) important considerations for prune**
- **Careful sampling advised for assessment of nematodes, they are not "everywhere"**
- **Pre-plant fumigation with 1,3-D-containing fumigants advisable for nematode infestations**
- **Sampling protocol not available for RD**
- **Pre-plant fumigation with CP-containing fumigants advisable for expectation of RD**
- **Rootstocks should be considered carefully when replanting, data becoming available to help**
- **Non-fumigant approaches for management of replant problems hold promise**

Photo: California Agriculture