North San Joaquin Valley Almond Day
Modesto, January 28, 2010

New Information on Navel Orangeworm Management

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USDA-ARS Navel Orangeworm Areawide Project

Different problems in different parts of the Central Valley.

Purpose - to validate and promote viable management schemes

USDA-ARS Navel Orangeworm Areawide Project

- Improved sanitation
- Mating disruption
- Selective insecticides
- Damage prediction

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Teaching tool -
http://www.almondboard.com/NOWpredictor

USDA-ARS Navel Orangeworm Areawide Project

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Predicts damage to Nonpariel nuts based on parameter estimates:

CORRELATIONS	
Previous Nonpareil Damage:	0.468
Ground Mummies per Tree:	0.196
Tree Mummies per Tree:	0.150
Peach Twig Borer Damage:	0.089
Distance from Pistachios (feet):	??

Data from Paramount Farming, Kern Co.

USDA-ARS Navel Orangeworm Areawide Project

Three regions:

- North (San Joaquin to Butte Co.)
- Central (Fresno and Madera Co.)

  Joel Siegel, USDA-ARS, Parlier
- South (Kern Co.)

  Brad Higbee, Paramount Farming

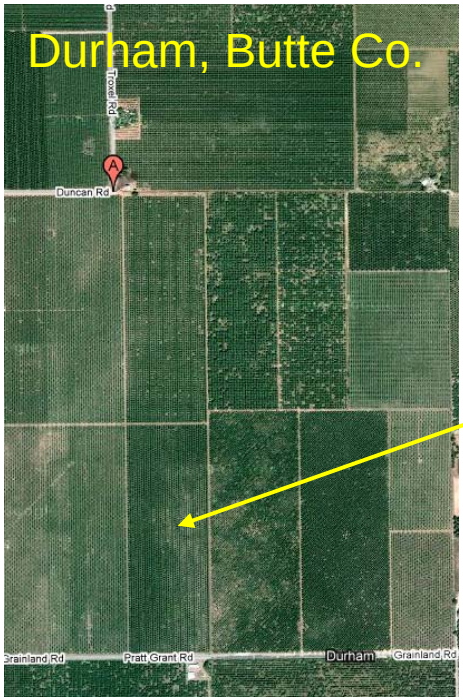
Navel Orangeworm Areawide Project, Almonds Northern Region, Initiated Fall, 2008

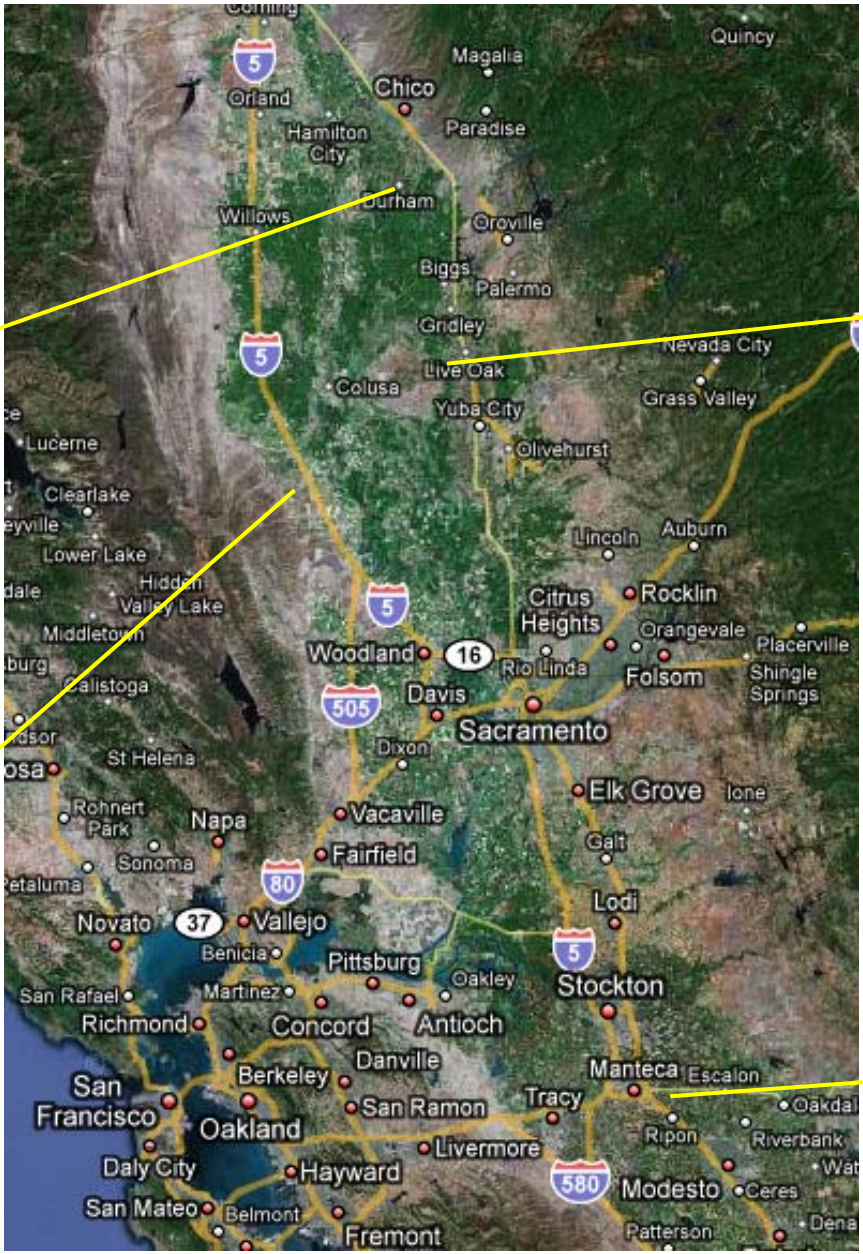
Purpose -

Validate effects of orchard sanitation, mummy load, harvest timing, and navel orangeworm (NOW) development on the risk of NOW damage in the northern region as it will relate to cultural controls, reduced-risk insecticides and mating disruption.

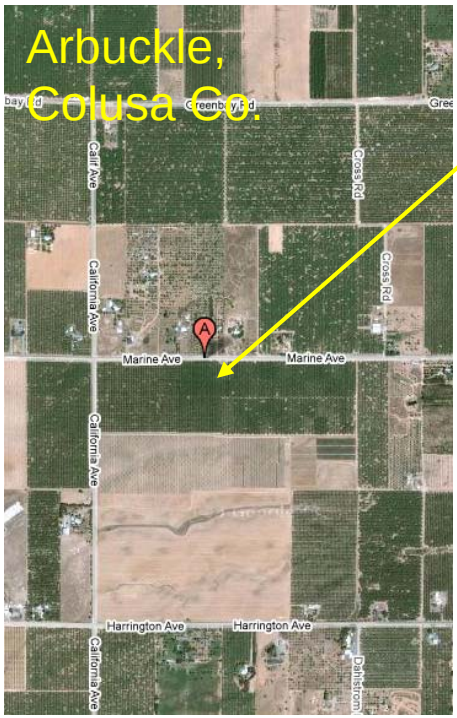
Approach -

Standardized protocols were implemented at 4 sites to validate and quantify parameters in the northern region for the NOW damage prediction model.


Durham, Butte Co.
Duncan Rd
Grainland Rd
Pratt Grant Rd
Durham


Quincy
Magalia
Chico
Orland
Paradise
Hamilton City
Willows
Durham
Oroville
Biggs
Palermo
Gridley
Nevada City
Live Oak
Colusa
Yuba City
Grass Valley
Lucerne
Olivehurst
Clearlake
Lower Lake
Lincoln
Auburn
Hidden Valley Lake
Middletown
Citrus Heights
Rocklin
Orangevale
Placerville
Woodland
Rio Linda
Folsom
Shingle Springs
Calistoga
Davis
Sacramento
St Helena
Dixon
Elk Grove
Ione
Rohnert Park
Napa
Vacaville
Sonoma
Fairfield
Galt
Lodi
Novato
Vallejo
Benicia
Pittsburg
Oakley
Stockton
San Rafael
Martinez
Richmond
Concord
Antioch
Danville
Berkeley
Manteca
Escalon
San Francisco
Oakland
San Ramon
Tracy
Ripon
Riverbank
Livermore
Daly City
Hayward
Modesto
Ceres
San Mateo
Belmont
Fremont
Patterson


Live Oak,
Sutter Co.
N Butte Rd
Almond Orchard Rd
Pennington


Arbuckle,
Colusa Co.
Marine Ave
Gross Rd
California Ave
Harrington Ave


Manteca,
San Joaquin Co.
Graves Rd
S Harlan Rd


Durham, Butte Co.


Live Oak, Sutter Co.

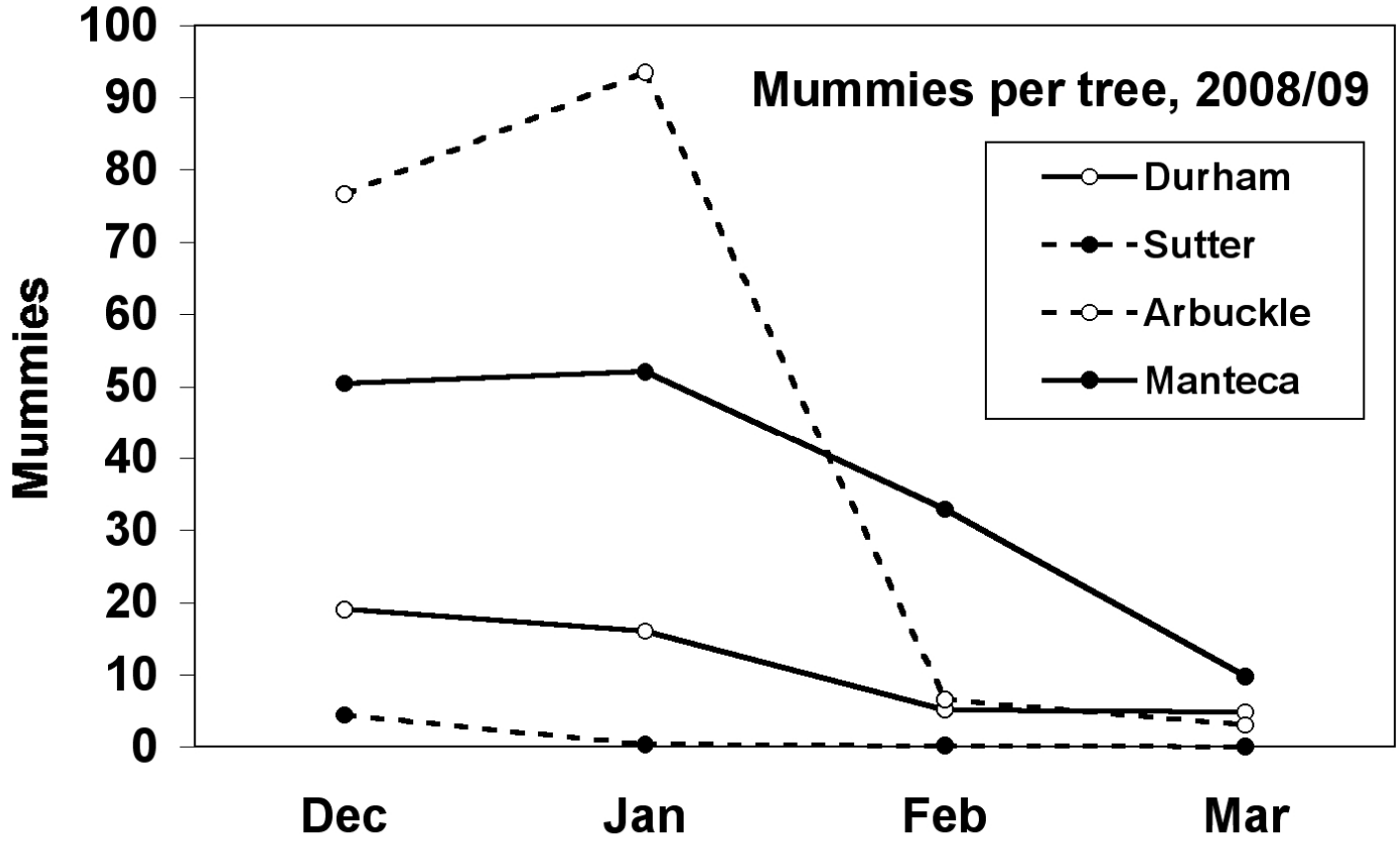

Arbuckle, Colusa Co.


Manteca, San Joaquin Co.

Sanitation - mummy carryover, 2008-09.

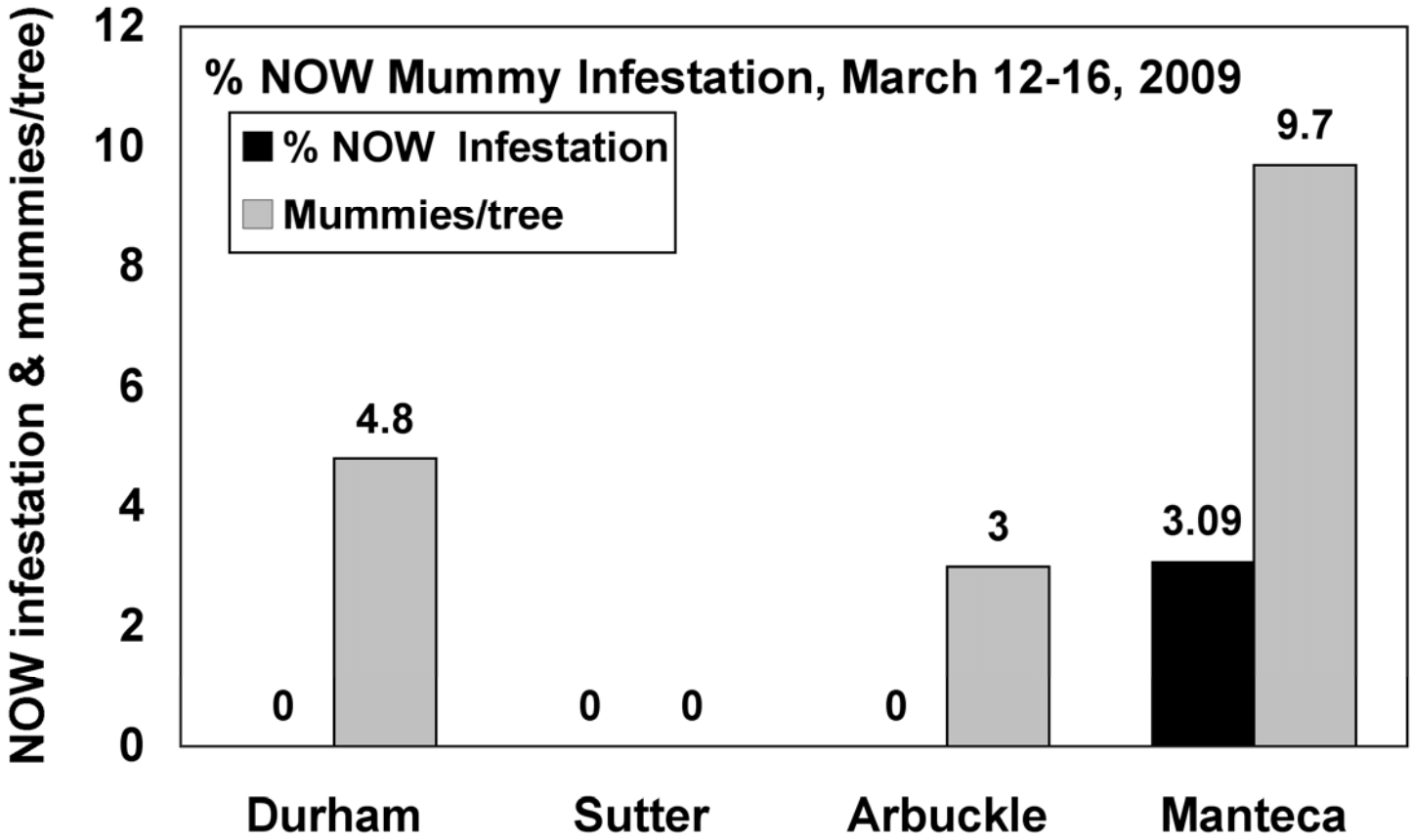
Sanitation - mummy carryover, 2008-09.

Number of natural Nonpariel mummies per tree, 2009.



N=10 Nonpariel trees per site

Percent of remaining natural Nonpariel mummies that were infested when collected on March 12-16, 2009.



N=10 Nonpariel trees per site

NOW Survival in Tree Mummies.

Preinfested Nonpariel nuts (30 per bag, 12 bags per orchard) were hung in trees in Fall, 2008, and collected March 23-25, 2009

Infestation of preinfested Nonpariel nuts (30 per bag, 12 bags per orchard) hung in trees in Fall, 2008, and collected March 23-25, 2009

Location	% NOW infestation Mean[1] ± SD	
Room temp (lab)[1]	22.49 ± 0.37	A
Davis (outdoor sheltered)[2]	16.95 ± 10.68	A
Manteca	13.06 ± 6.27	B
Arbuckle	8.76 ± 5.61	C
Sutter	6.58 ± 3.14	C
Durham	1.05 ± 1.97	C

ANOV statistics - F=11.2372, df=5,58, P<0.0001

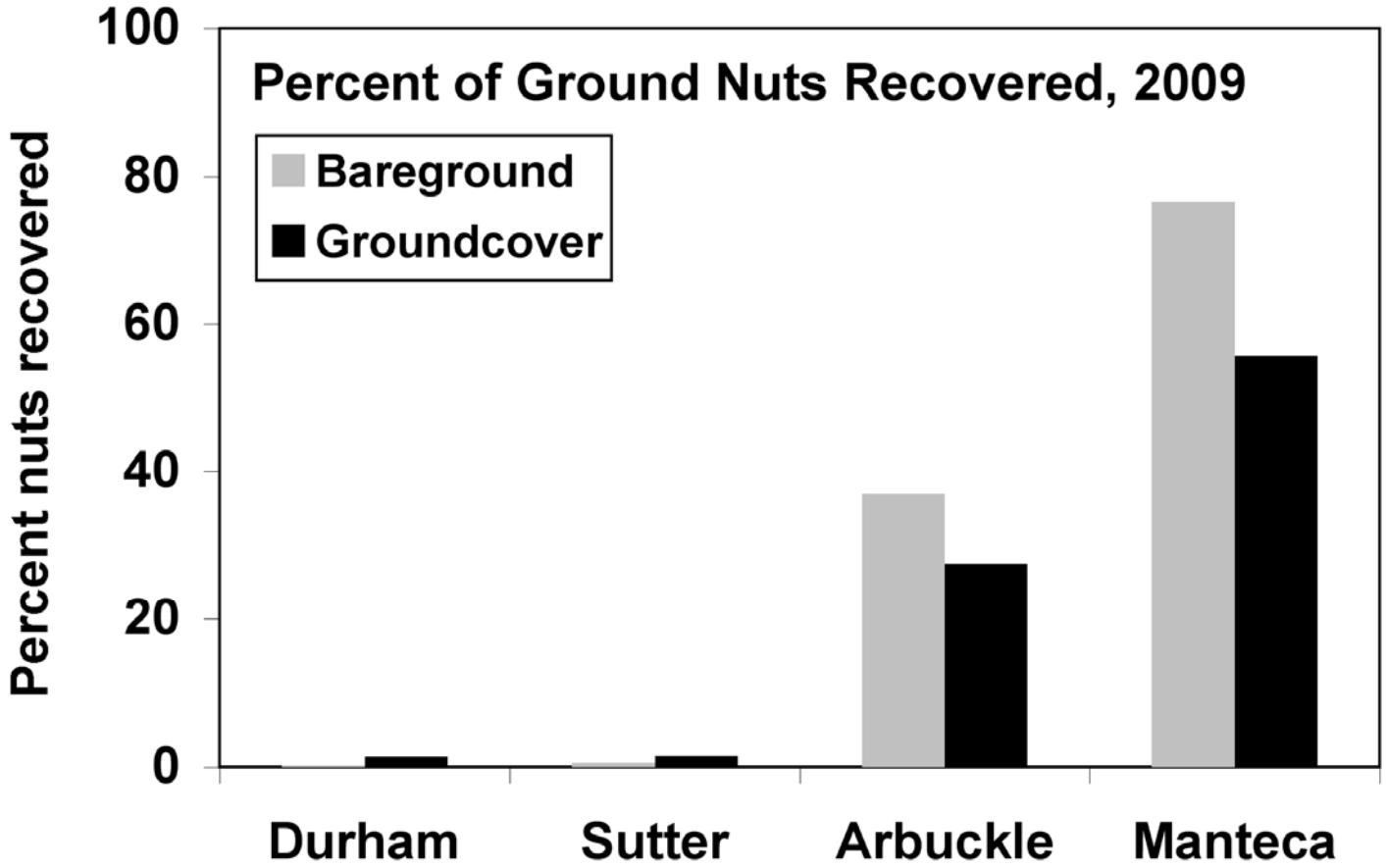
[1] Means followed by the same letter do not differ significantly at P=0.05 by Student's t-test.

NOW Survival in Ground Mummies.

Preinfested, marked Nonpariel nuts (~140 per site, 4 reps) were placed on berms or middles in Fall, 2008, and collected March 12-16, 2009

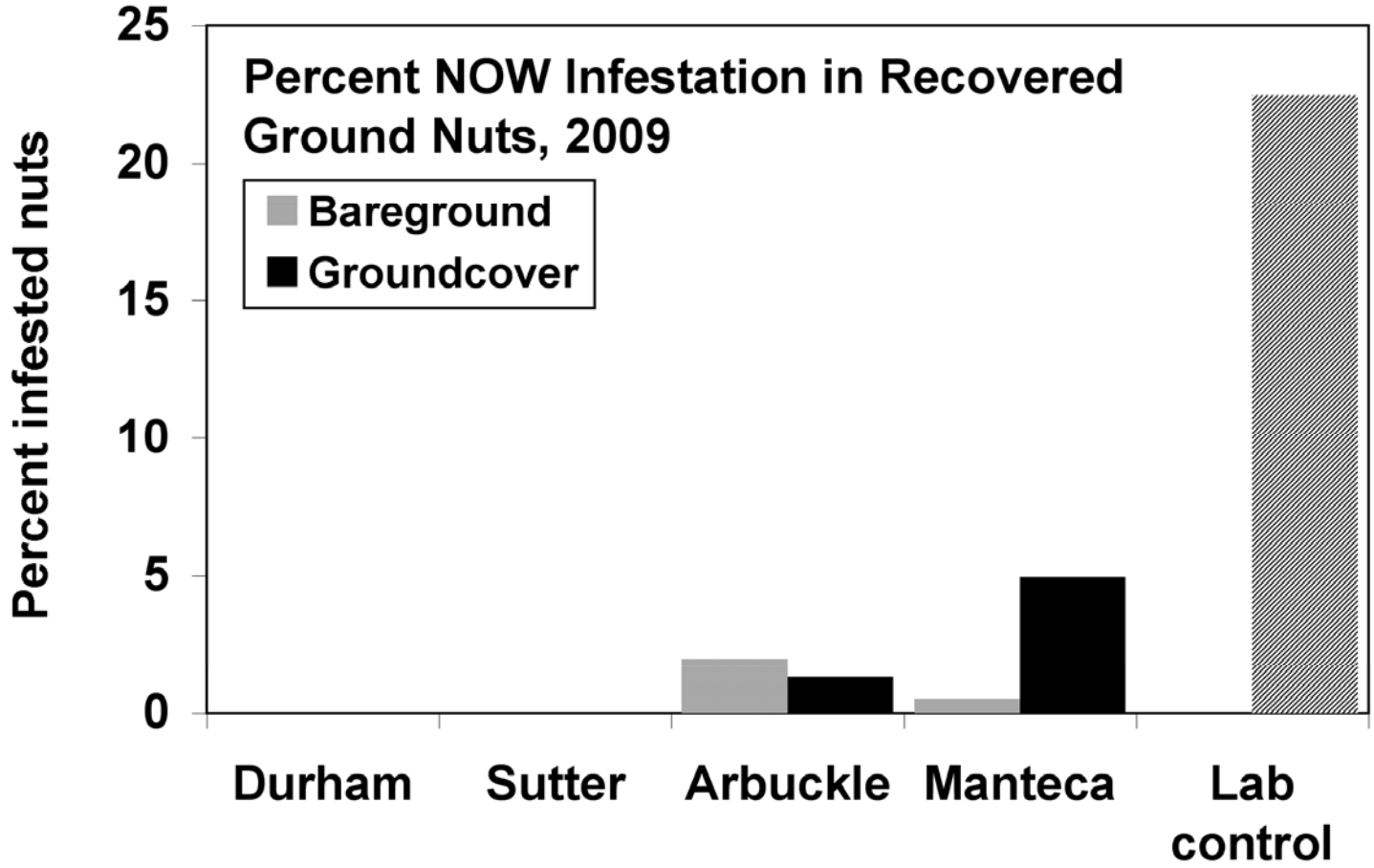
NOW Survival in Ground Mummies.

Recovery of preinfested Nonpariel nuts placed on berms or middles in Fall, 2008, and collected March 12-16, 2009



N=4 reps of ~140 uninfested Nonpariel nuts per site

Infestation of preinfested Nonpariel nuts placed on berms or middles in Fall, 2008, and collected March 12-16, 2009

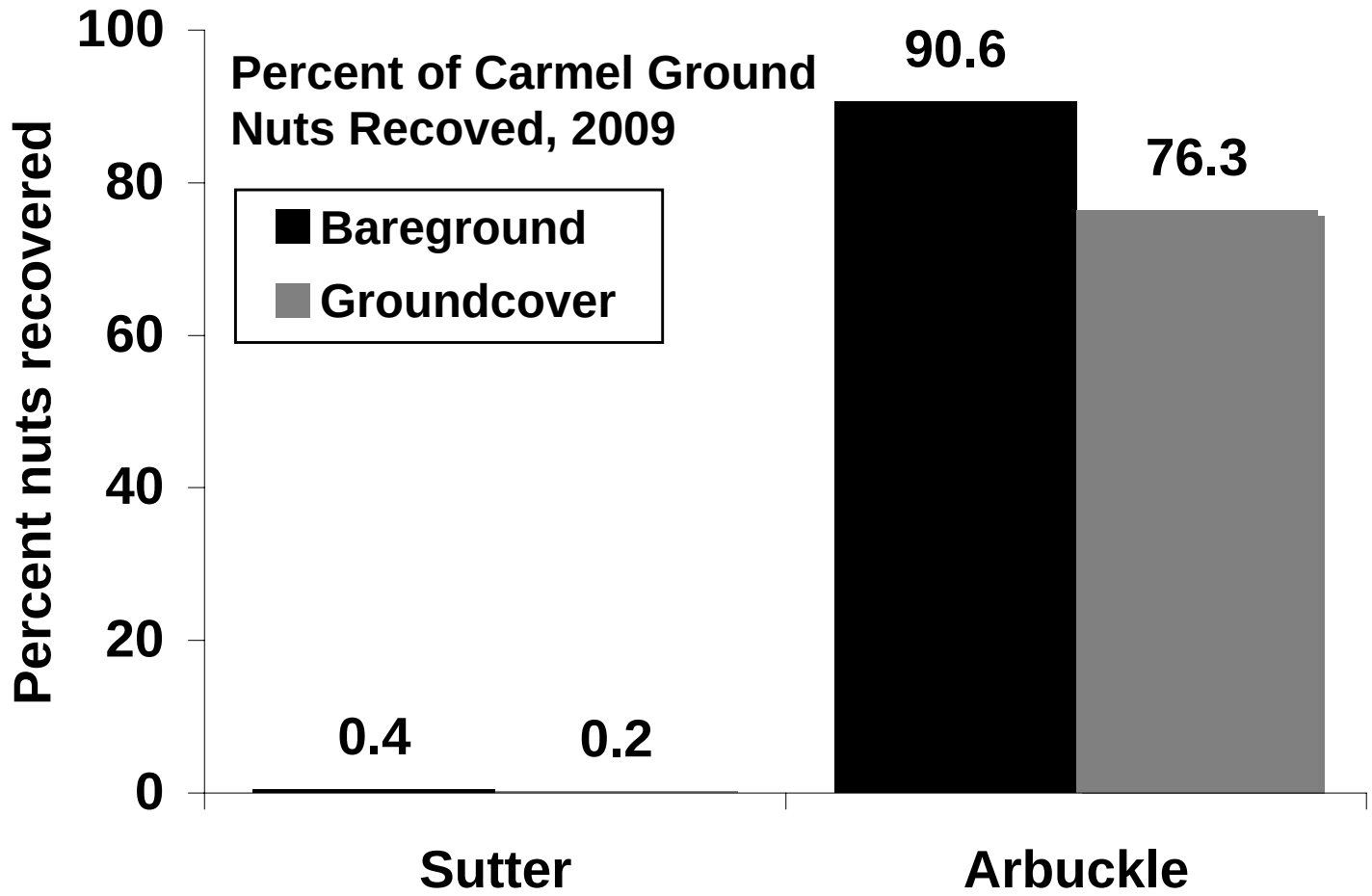


N=4 reps of ~140 uninfested Nonpariel nuts per site

Bare ground plot when collected at Durham, Butte Co., March 14, 2009

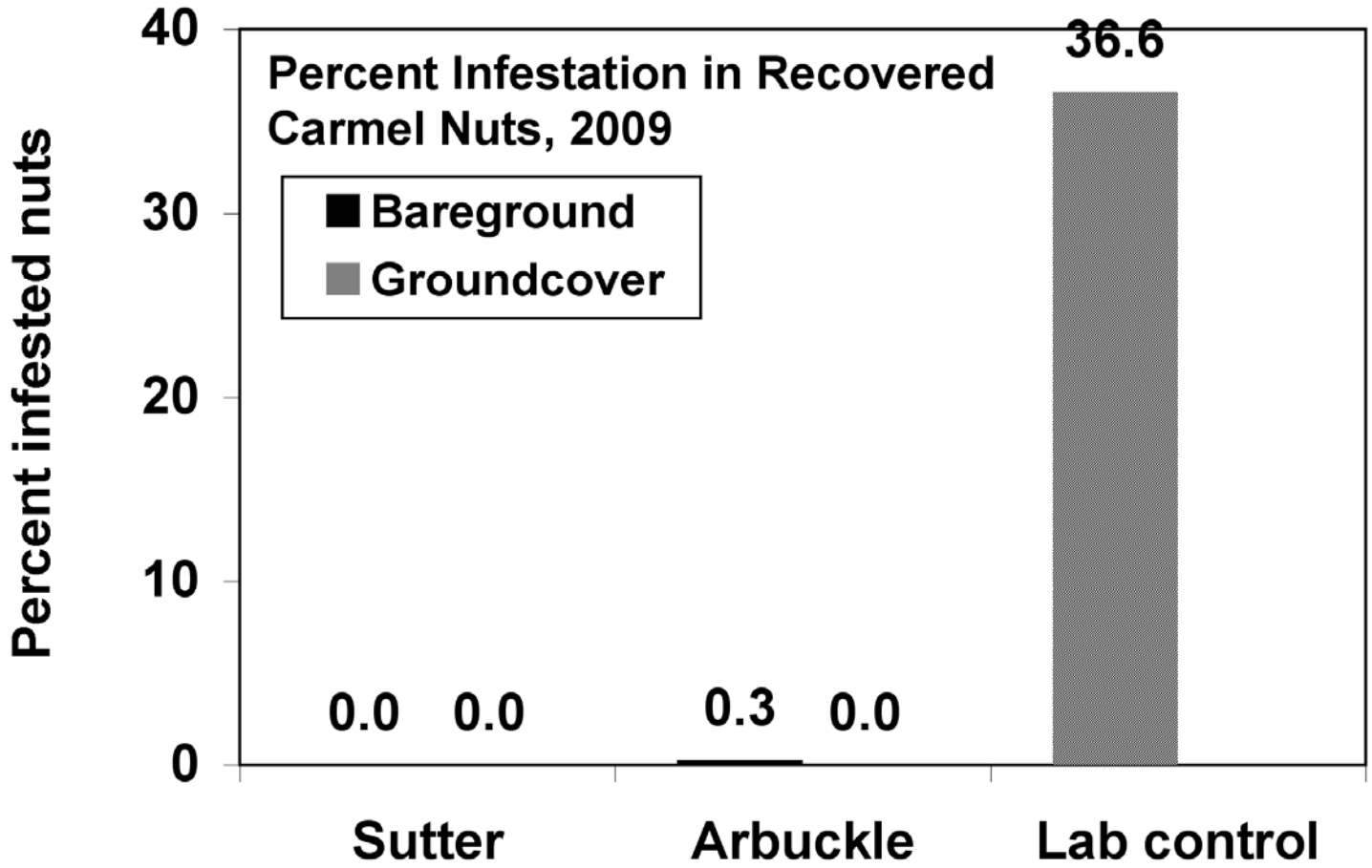
Nonpariel nuts on bare ground plots when collected at Manteca, March 13, 2009

Recovery of preinfested Carmel nuts placed on berms or middles on Nov. 5, 2008, and collected March 13, 2009



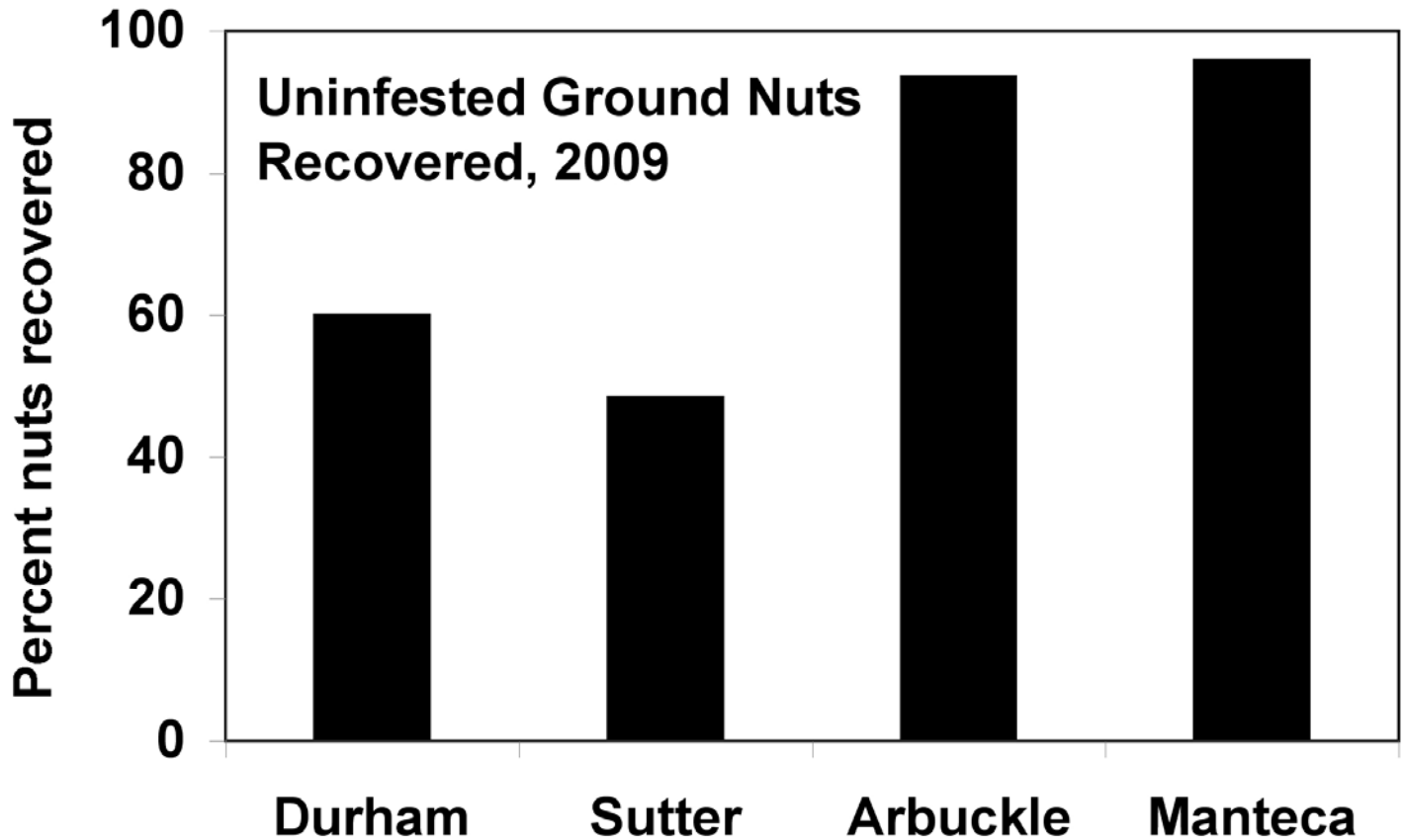
N=4 reps of ~120 uninfested Carmel nuts per site

Infestation of preinfested Carmel nuts placed on berms or middles on Nov. 5, 2008, and collected March 13, 2009



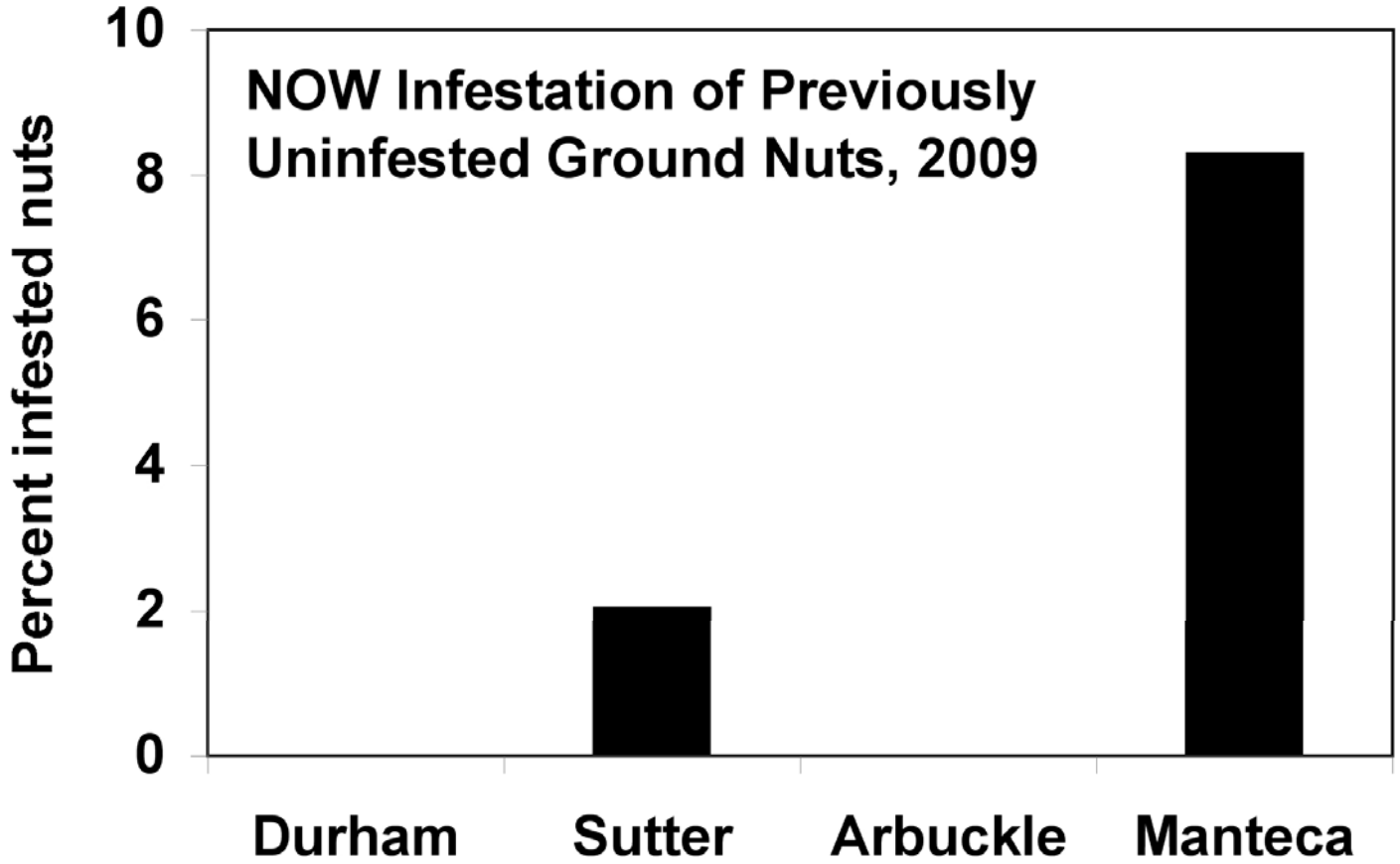
N=4 reps of ~120 uninfested Carmel nuts per site

Average percent of *uninfested* Nonpariel nuts placed on bare ground that were recovered per plot on Dec. 16-17, 2008.



N=4 reps of 125 uninfested Nonpariel nuts per site
Placement dates - Arbuckle and Sutter, Oct. 13; Manteca, Nov. 3; and Durham, Nov. 5, 2008

Average percent of *uninfested* Nonpariel nuts placed on bare ground and recovered that were infested per plot on Dec. 16-17, 2008.



N=4 reps of 125 uninfested Nonpariel nuts per site

Sanitation Guidelines (for year one)

Mummy nut drop

- lowest at Manteca

NOW survival in mummy nuts on trees

- greatest at Manteca

NOW survival in ground mummies

- greatest number of nuts remaining at Manteca

Can ground mummies become infested?

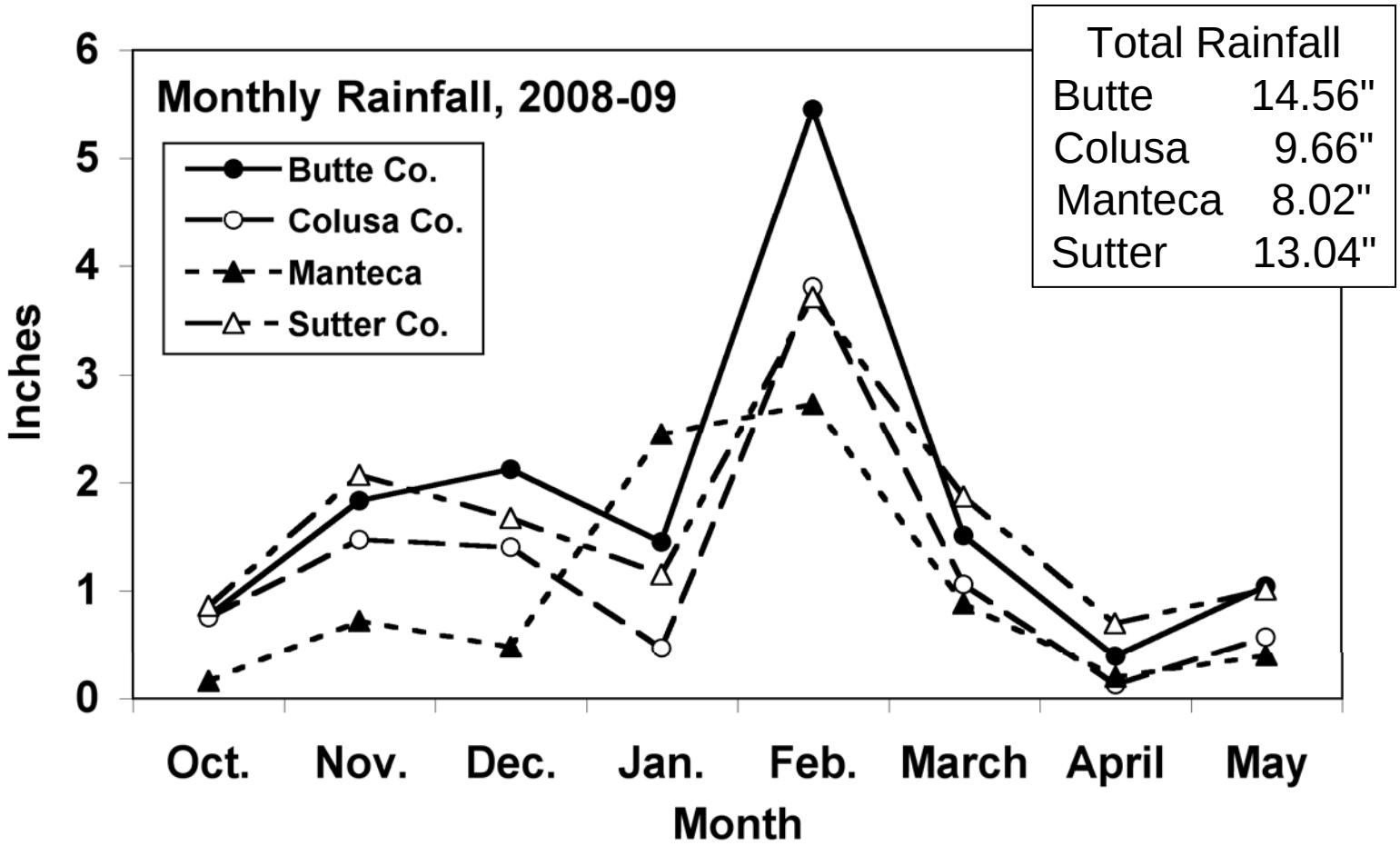
- yes (in Fall)

Sanitation Guidelines

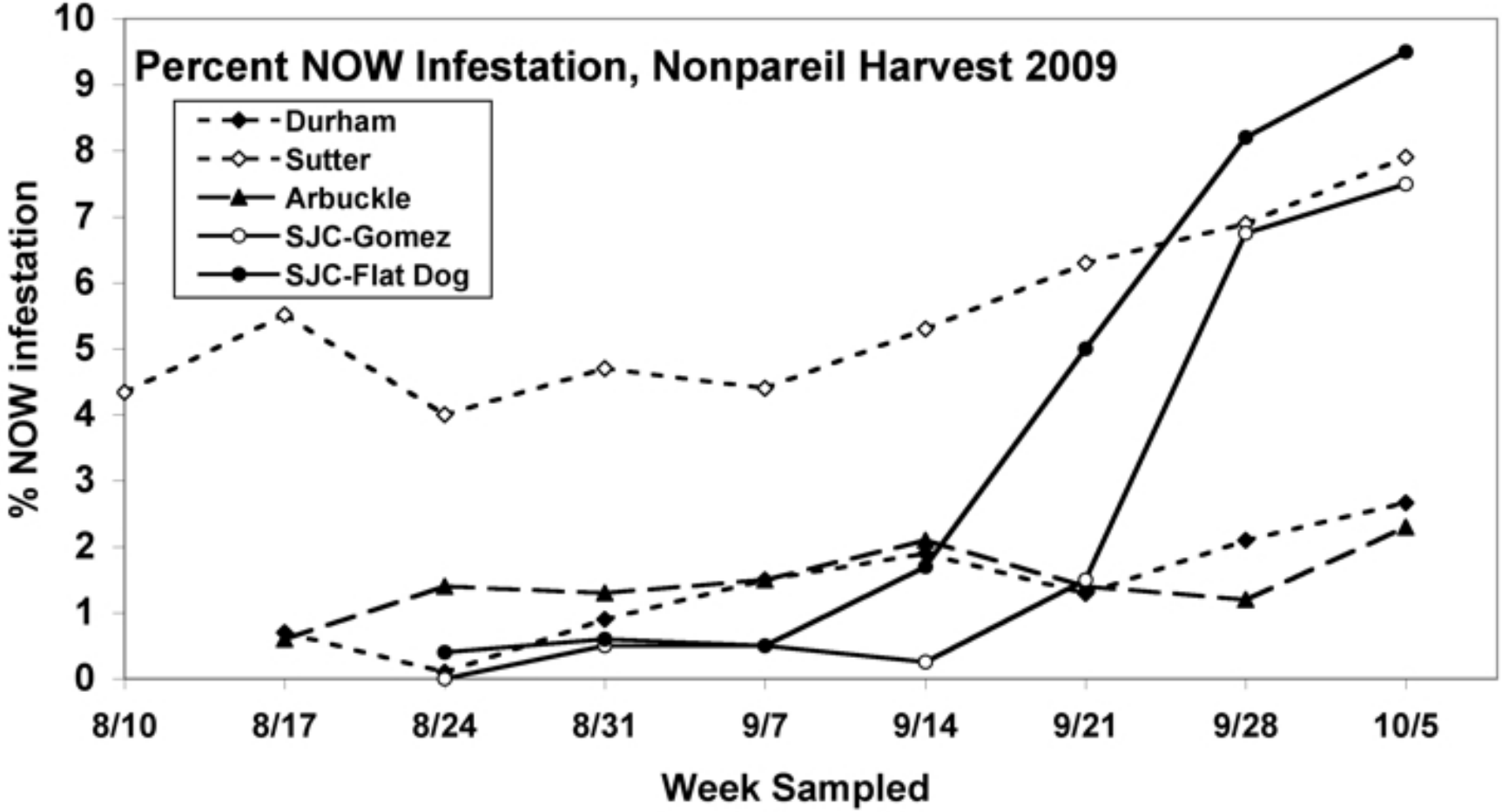
Influencing factors

Rainfall - storm intensity?
Birds and squirrels
NOW density at site; Fall activity

Monthly rainfall at northern areawide sites, 2008-09



Infestation of Nonpariel nuts at weekly intervals after initiation of harvest, 2009 (early harvest)

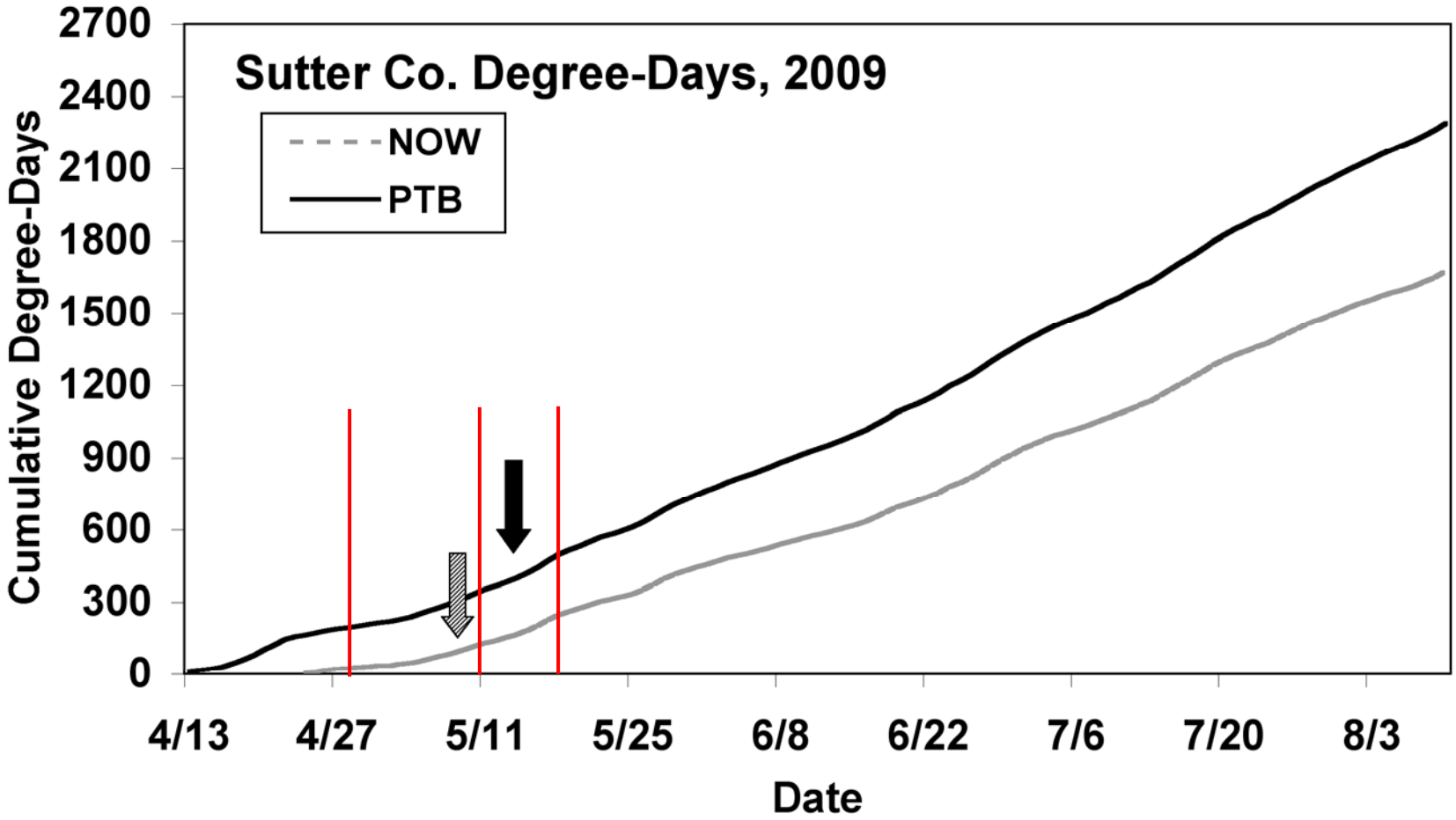


May Sprays

Peach twig borer -
400 DD after biofix
(first moth capture)

Navel orangeworm -
100 DD after biofix
(eggs on 50% of traps for 2 consecutive weeks)

Cumulative degree-days from navel orangeworm and peach twig borer biofix dates, Sutter Co., 2009

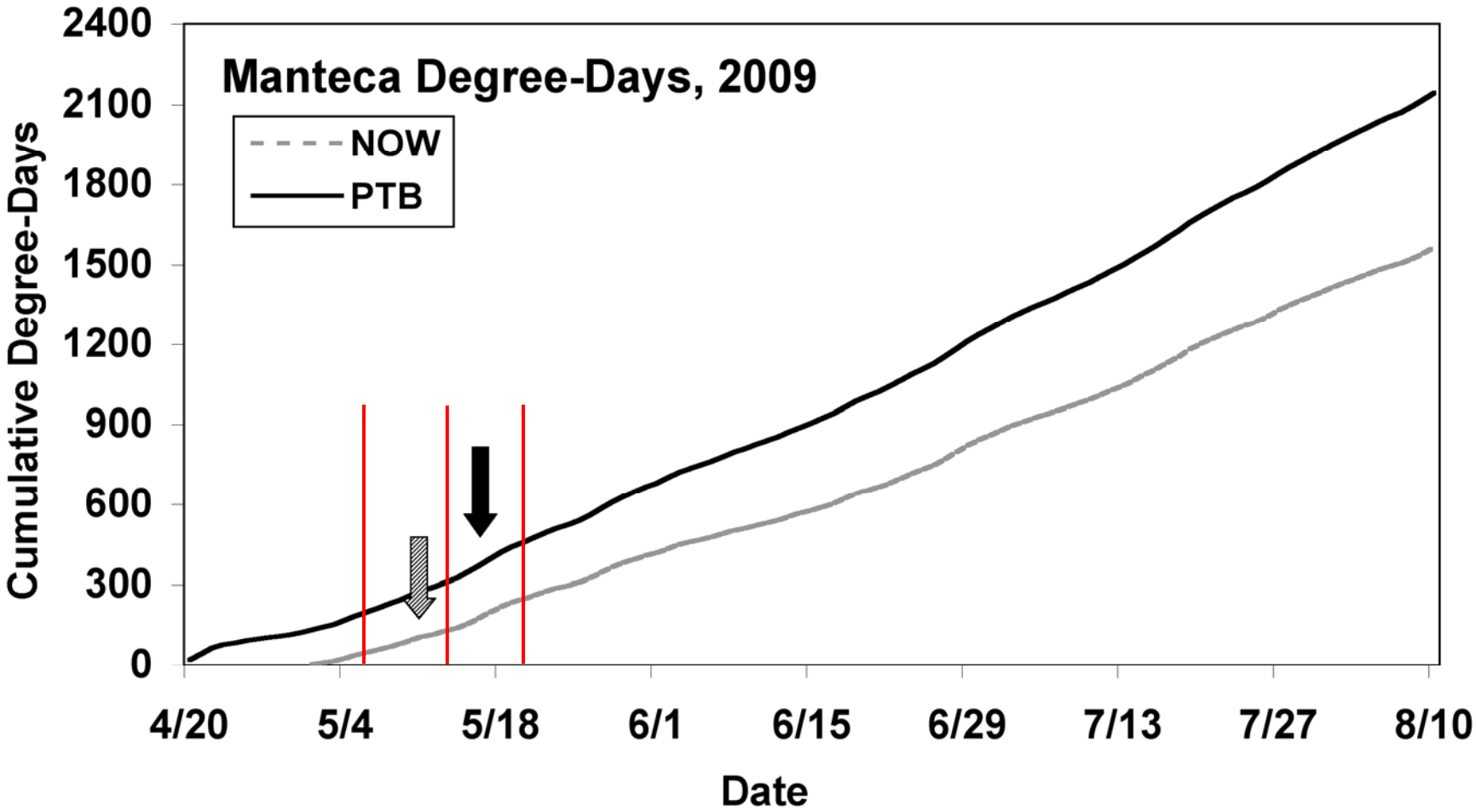


Mean (±SD) peach twig borer shoot strikes per tree, Sutter, 2009

Treatment	Rate (form./ac.)	Application Date	Degree-days	PTB strikes/tree Mean ± SD			
untreated	na	na	na	10.30	±	7.18	A
Tourismo*	10.3 oz	May 12, 2009	367	1.20	±	1.64	F
Tourismo*	13.7 oz	May 12, 2009	367	1.00	±	1.00	F
NAI-3202 EC*	14 oz	May 12, 2009	367	7.20	±	3.03	ABC
NAI-3202 EC*	21 oz	May 12, 2009	367	2.20	±	1.92	EF
Dimilin 2L	12 oz	May 11, 2009	352	6.60	±	3.58	BCD
Dimilin 2L+Lorsban	12 oz+4 pt	May 11, 2009	352	1.80	±	2.49	EF
Athena EW	805.7 ml	May 12, 2009	367	0.80	±	1.10	F
Danitol 2.4EC	16 oz	May 12, 2009	367	1.60	±	2.07	F
Assail 30SG**	6.4 oz	May 12, 2009	367	2.40	±	2.88	DEF
Bifenture 10DF**	16 oz	May 12, 2009	367	0.80	±	0.84	F
Intrepid 2F	16 oz	April 28, 2009	193	2.40	±	2.88	DEF
Intrepid 2F	16 oz	May 11, 2009	352	8.40	±	4.67	AB
Intrepid 2F	16 oz	May 19, 2009	516	6.00	±	3.74	BCDE
Delegate	7 oz	April 28, 2009	193	1.20	±	2.68	F
Delegate	7 oz	May 11, 2009	352	1.40	±	1.95	F
Delegate	7 oz	May 19, 2009	516	4.20	±	3.56	BCDEF
Altacor 35WG***	4.5 oz	April 28, 2009	193	0.40	±	0.89	F
Altacor 35WG***	4.5 oz	May 11, 2009	352	0.20	±	0.45	F
Altacor 35WG***	4.5 oz	May 19, 2009	516	3.40	±	3.44	CDEF
Proclaim	4.0 oz	May 11, 2009	352	2.00	±	1.58	EF

Means followed by the same letter are not significantly different by StudentÕs t-test at $P < 0.05$
*NIS surfactant added @ 0.25% v/v
**Silicone surfactant added @ 1% v/v + MSO
***Induce (Latron) added - NIS @ 1.0 v/v

Cumulative degree-days from navel orangeworm and peach twig borer biofix dates at Manteca, 2009



Making the sentinal mummy strands
20 uninfested mummies per strand

Placement of the sentinal mummy strands at the beginning of Spring NOW oviposition - 200 nuts per treatment.

Proportion of navel orangeworm infested mummies, Manteca, 2009

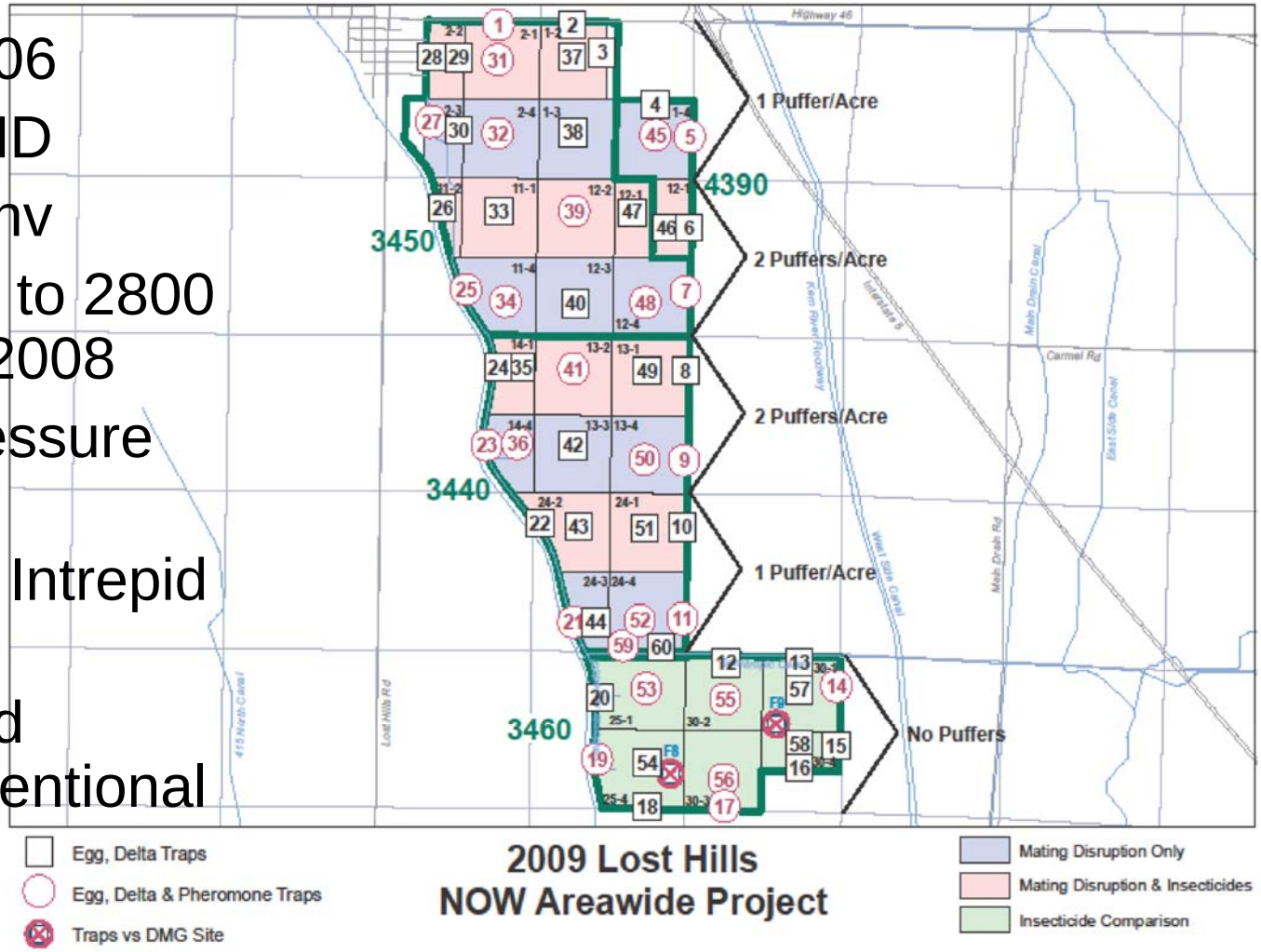
Treatment	Chemical	Rate (form/ac)	Date	DD	Proportion of infested mummies: All NOW Mean ± SD		Live NOW Mean ± SD	
Control (water)			5/14		0.15 ± 0.1	A	0.10 ± 0.1	A
Belt	flubendiamide	4.0 oz	5/14	128	0.02 ± 0.0	B	0.02 ± 0.0	B
Belt*	flubendiamide	4.0 oz	5/14	128	0.00 ± 0.0	B	0.00 ± 0.0	B
Dimilin 2L	diflubenzuron	12 oz	5/14	128	0.12 ± 0.1	A	0.10 ± 0.1	A
Dimilin 2L +	diflubenzuron +	12 oz+	5/14	128	0.00 ± 0.0	B	0.00 ± 0.0	B
Lorsban	chlorpyrifos	4 pt						
Athena EW	bifenthrin + abamectin	805.7 ml	5/14	128	0.00 ± 0.0	B	0.00 ± 0.0	B
Danitol 2.4EC	fenpropathrin	16 oz	5/14	128	0.02 ± 0.0	B	0.00 ± 0.0	B
Assail 30SG*	acetamiprid	6.4 oz	5/14	128	0.05 ± 0.1	B	0.02 ± 0.0	B
Assail 70WP*	acetamiprid	2.7 oz	5/14	128	0.06 ± 0.1	B	0.02 ± 0.0	B
Bifenture 10DF*	bifenthrin	16 oz	5/14	128	0.01 ± 0.0	B	0.01 ± 0.0	B
Intrepid 2F	methoxyfenozide	16 oz	5/6	49	0.03 ± 0.1	B	0.01 ± 0.0	B
Intrepid 2F	methoxyfenozide	16 oz	5/14	128	0.02 ± 0.0	B	0.01 ± 0.0	B
Intrepid 2F	methoxyfenozide	16 oz	5/20	234	0.02 ± 0.0	B	0.01 ± 0.0	B
Delegate	spinetoram	7 oz	5/6	49	0.03 ± 0.0	B	0.02 ± 0.0	B
Delegate	spinetoram	7 oz	5/14	128	0.03 ± 0.0	B	0.01 ± 0.0	B
Delegate	spinetoram	7 oz	5/20	234	0.02 ± 0.0	B	0.02 ± 0.0	B
Altacor 35WG*	chlornitraniliprone	4.5 oz	5/6	49	0.01 ± 0.0	B	0.01 ± 0.0	B
Altacor 35WG*	chlornitraniliprone	4.5 oz	5/14	128	0.01 ± 0.0	B	0.01 ± 0.0	B
Altacor 35WG*	chlornitraniliprone	4.5 oz	5/20	234	0.01 ± 0.0	B	0.00 ± 0.0	B
Altacor 35WG +	chlornitraniliprone +	4.5 oz+	5/14	128	0.01 ± 0.0	B	0.01 ± 0.0	B
Asana XL*	esfenvalerate	10 oz						
Proclaim	emamectin benzoate	4.0 oz	5/14	128	0.01 ± 0.0	B	0.01 ± 0.0	B

ANOV statistics - [1]*F*=7.2826, df=20,213, *P*<0.0001; [2]*F*=6.6166, df=20,213, *P*<0.0001

Means followed by the same letter do not differ significantly at *P*=0.05 by StudentÕs-**t**est

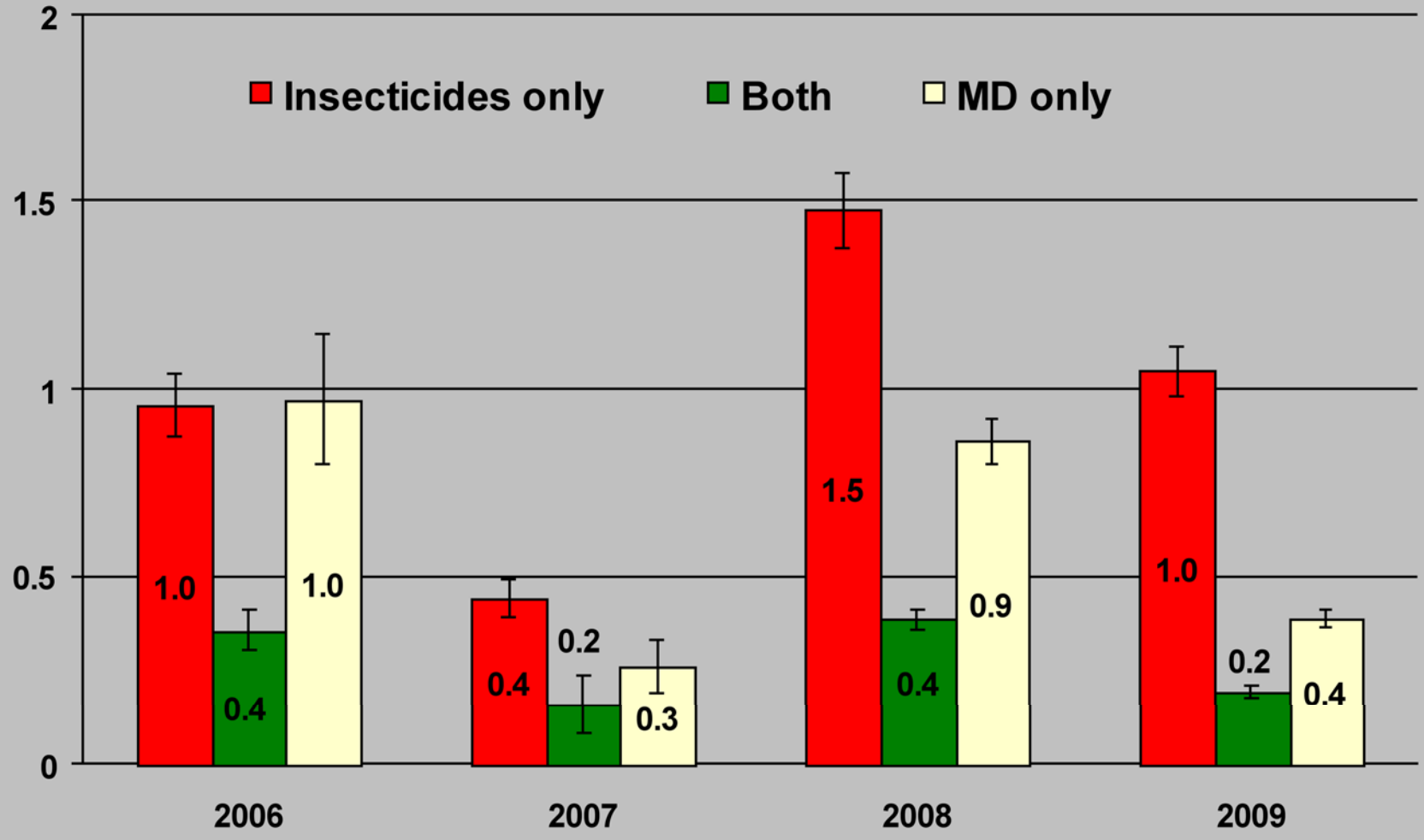
Lost Hills Areawide NOW Mating Disruption

- Started in 2006
  - 1800 ac MD
  - 800 ac conv
  - Expanded to 2800 ac MD in 2008
- Moderate pressure
- Conventional program = 2 Intrepid applications
- MD alone and without Conventional



Lost Hills Areawide NOW MD Project

Processor/huller samples - All Varieties



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