CONTINUED TESTING OF PHEROMONE "MESO-EMITTERS" FOR MATING DISRUPTION OF CODLING MOTH IN CALIFORNIA

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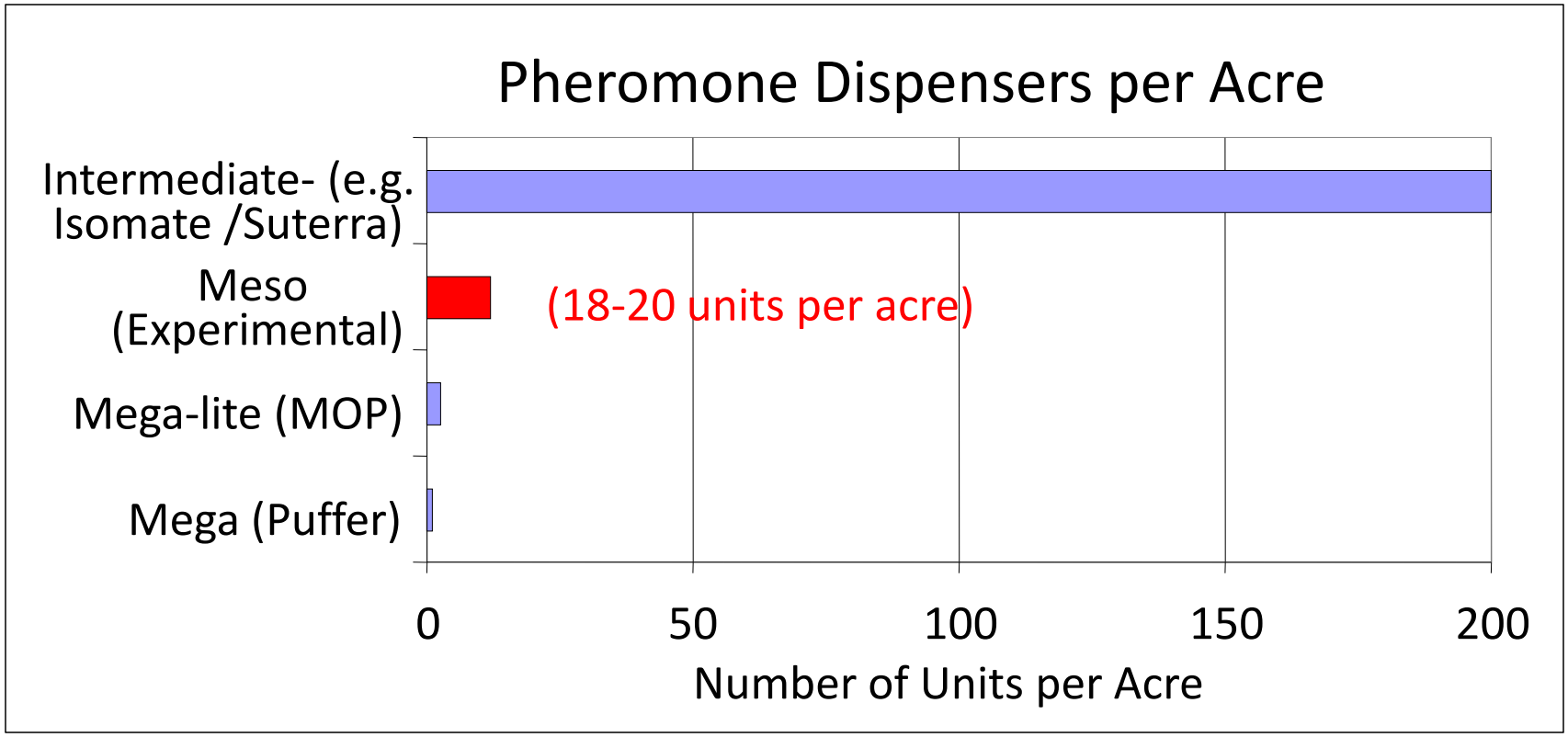
- Goal: build the most cost-effective pheromone program that provides adequate damage suppression
  - Optimize overall costs
  - Build good pheromone strategy
  - Recognizes but minimize insecticide interventions
    - High CM densities often require insecticide supplements
    - Other pests (leafrollers, NOW) may require treatments
  - Does not preclude alternative objective of improved pheromone programs
- 2009 field trial focus – Large block testing of “best” mesos from 2007 and 2008
  - Meso-emitter rate trials (walnuts only) – not shown
  - Meso-emitter large plot efficacy trials (walnuts and pears)

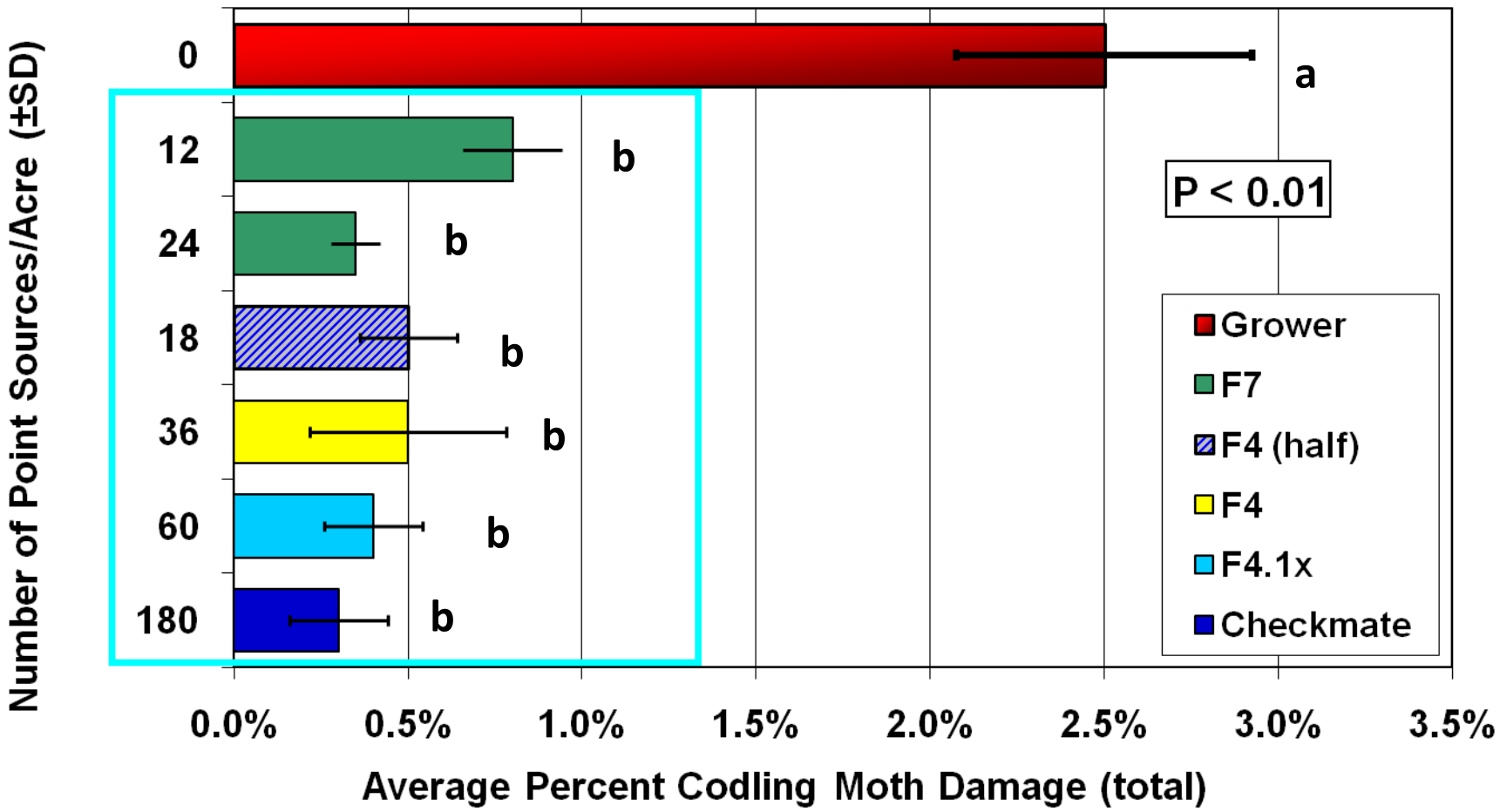
Approaches

- Two axes to consider:
  - Alter the number of dispensers per acre (2006 on)
  - Alter the amount of pheromone per acre (on-going 2008 on)
  - Issues
    - Are the relationships linear between number of point sources and amount of pheromone required per acre OR
    - Are there interactions between the amount of pheromone released per dispenser and possible mechanisms of mating disruption?
    - If true, then multiple studies (or true factorial experiments) will be required, which are extremely difficult to envision logistically

Pheromone “Meso-emitter”

- Hand applied dispenser unit
- Reduced point sources: **18-20 units per acre** vs >160 per acre
- Higher emission rate per unit (vs Checkmate or Isomate)





All treatments statistically different from grower standard, yet not from each other

Selected 20 units per acre as starting point

Current Meso-emitter Products

(Differ in Expected Total Pheromone per Acre)

Isomate “rope” (2008)

G037

CM XL1000
(for comparison)

***** 2009 “ring” is a 5-C TT unit that separates to form a ring of 10 single tubes.
Deployed at 20 rings per acre.

Suterra membrane type dispensers.
G037 deployed at 18 units per acre.

RATIONALE / POTENTIAL BENEFITS OF REDUCED POINT SOURCES

- Rationale
  - Studies support increased point source strategies
  - **BUT** empirical experience with puffers (e.g. Lake County, walnuts in Locke, CA) demonstrate success using reduced emitter point sources
- Potential benefits
  - More rapid application
  - Reduced labor costs
  - Increased opportunity for pheromone use in walnuts
    - Feasible pruning tower application (walnuts)
    - Target sites not suitable for puffer use

CHALLENGES OF SITE SELECTION FOR PHEROMONE FIELD TRIALS

- Lack of independence between treatment plots
  - Pheromone moves, cannot be contained
  - Few sites large enough to accommodate meaningful plot sizes and adequate treatment separation
- Need for productive codling moth pressure in trial sites
  - Low populations do not produce adequate damage for treatment contrasts
  - High populations can overwhelm and bleed across treatments

Changes in Orchard Selection 2009 Field Trials

- Pears
  - – Targeted orchards in 1st year of “relaxed management” (no insecticide applications, limited weed management, sometimes no water)
  - – Expectation of codling moth populations increasing over time
- Walnuts
  - – Used processor data to target sites with 4 year histories of 3-6% damage;

Contrasts

- Pears
  - Pheromone programs (10-20 acres) vs Untreated Control (3-5 acres)
  - Meso pheromone programs vs Conventional pheromone programs (Isomate or Checkmate)
- Walnuts
  - Pheromone programs plus insecticide (5-20 ac) vs same insecticide program (5-20 ac) – “ additive effect of pheromone if damage sufficiently high”
  - Meso pheromone programs plus insecticide vs Conventional pheromone programs plus insecticide

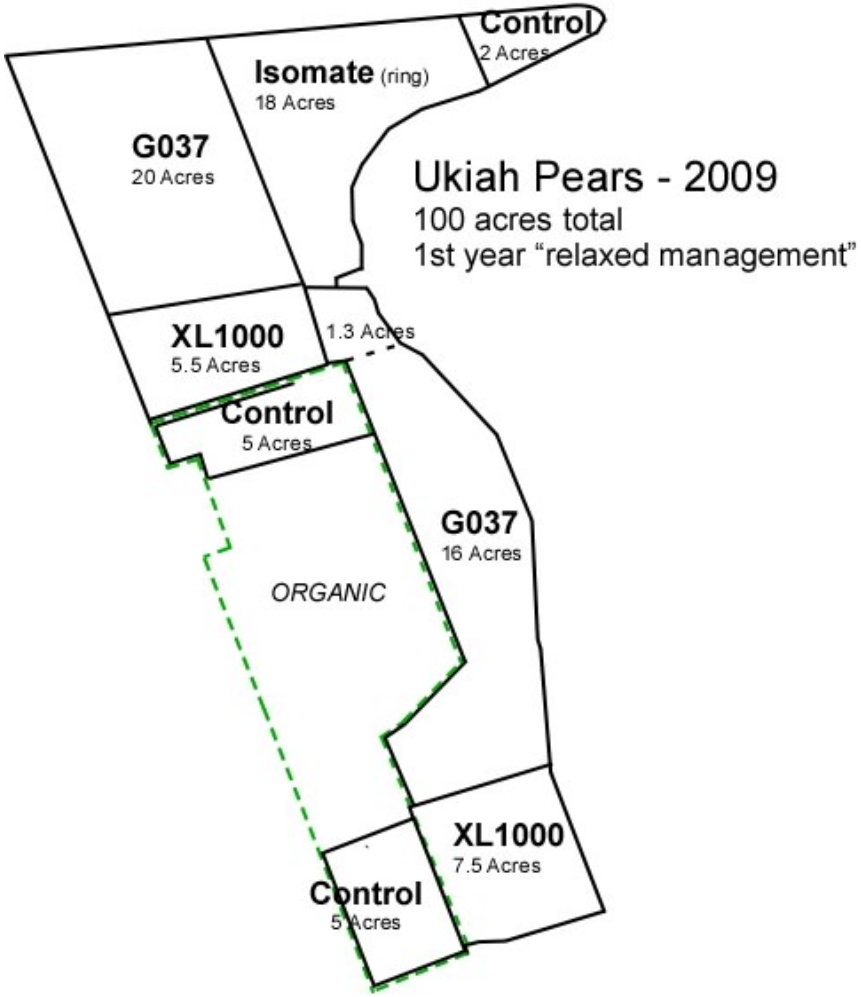
Meso-emitter Efficacy Trials

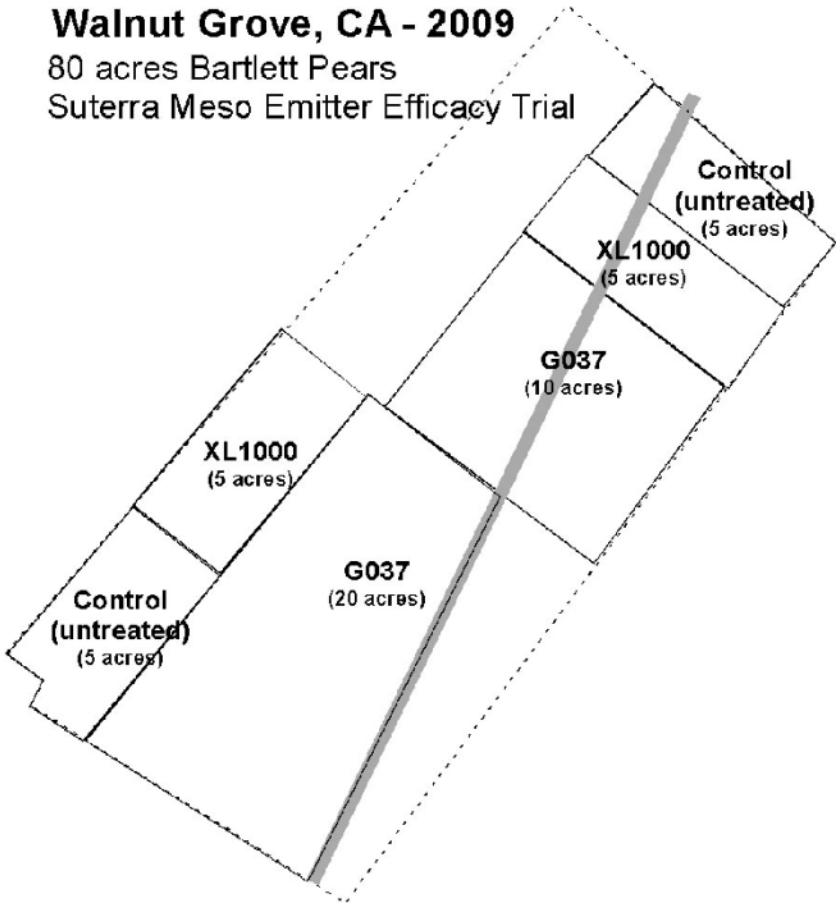
		Treatment Plots (number of acres)			
Crop	**Site**	**Meso (Suterra G037)**	**Ring (Isomate)**	**Pheromone Standard ***	**Control Grower Standard ****
Pears	**Isleton**	**1 (14)**		**1(10)**	**-**
	Walnut Grove	**2 (10,20)**		**2 (5,5)**	**2 (UTC) (5,5)**
	Ukiah	**2 (18,18)**	**1 (16)**	**2 (6,6)**	**3 (UTC) (3,5,5)**
Walnuts	**Colusa**		**1 (7)**	**1 (5)**	**1(5)**
	Gustine	**1 (16)**		**1(5)**	**1(10)**
	Knight's Landing	**1 (18)**		**1 (5)**	**1 (5)**
	Linden	**1 (20)**		**1 (5)**	**1 (5)**
	Tracy		**1 (20)**	**1 (5)**	**1 (UTC) (5)**
	Yuba City	**1 (5)**		**1 (5)**	**1 (8)**
Total number of plots = 34 (306 acres)		**9 (139)**	**3 (43)**	**11 (62)**	**11 (62)**

* Pheromone standard was Checkmate CM XL1000 in all sites except organic Isleton pears which was grower-applied Isomate-C TT.

** Organic Isleton pear site was grower applied pheromone to remainder of site. In walnuts, any insecticide treatments were applied uniformly to both control and pheromone treatments. No insecticides were applied in Tracy site.

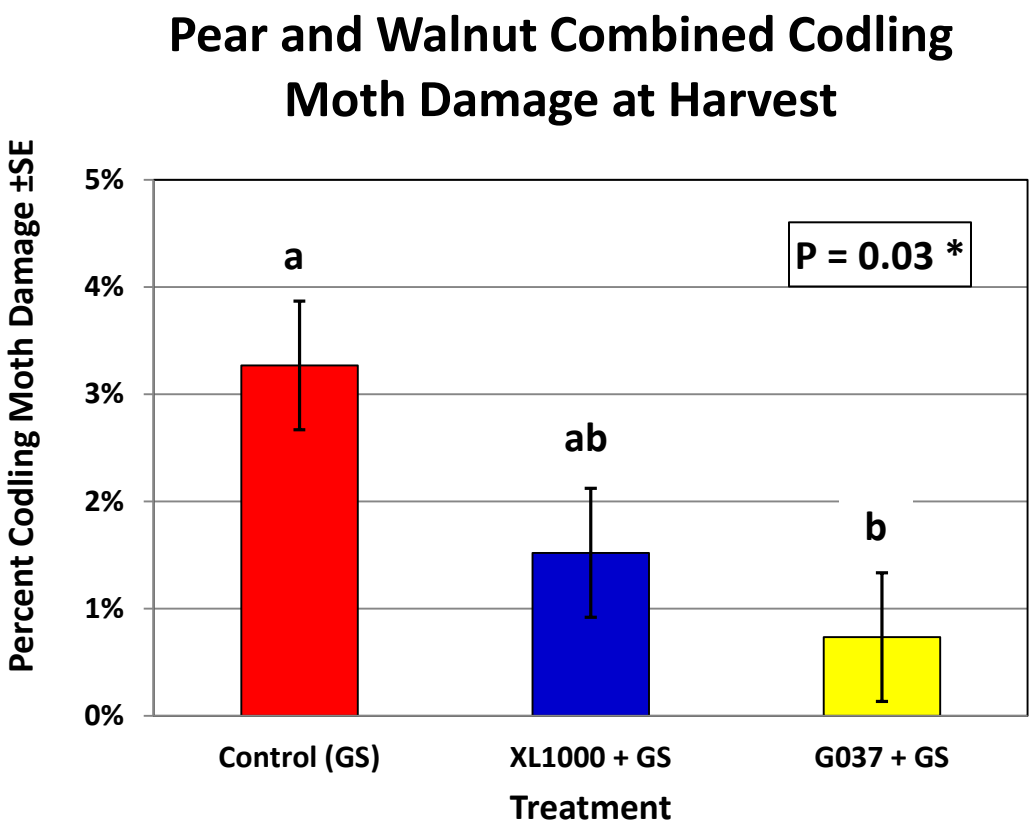
Pear Orchard Plot Maps for Sites in Ukiah and Walnut Grove, CA





Suterra Meso-emitter Efficacy

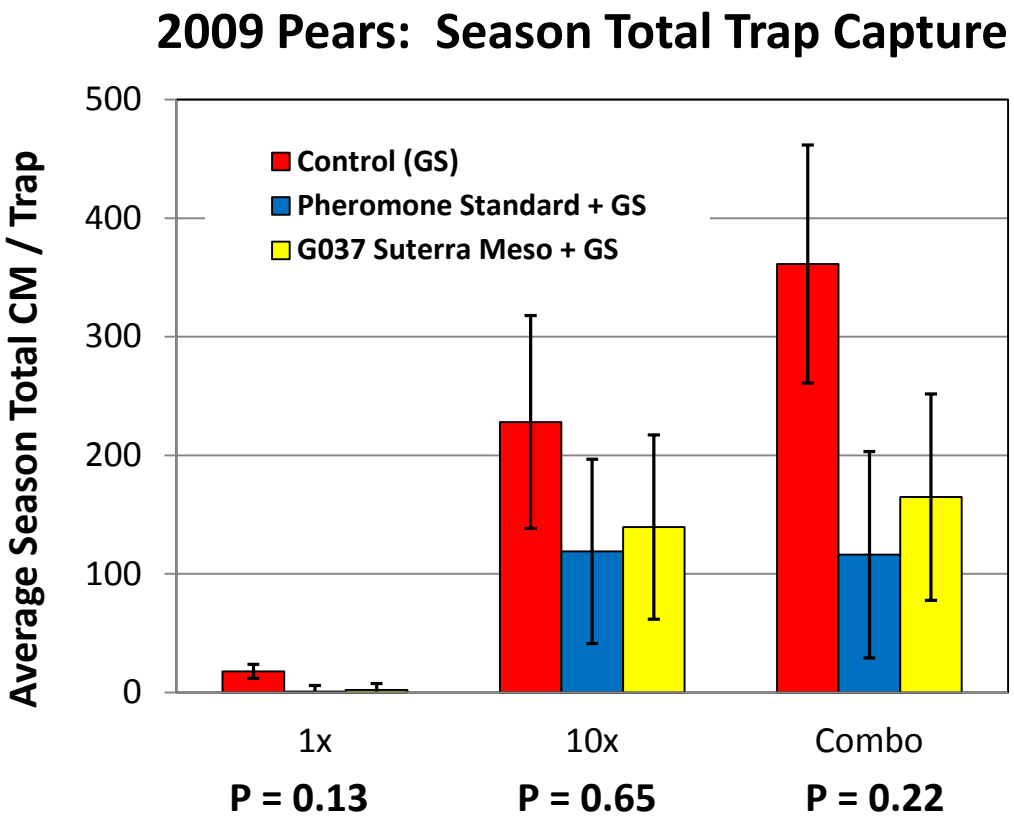
Combined commodity data (n=8)



- Damage was significantly suppressed by meso program compared to control
- No statistical difference between meso and standard pheromone programs
- Control plots were as follows
  - Pears – untreated controls
  - Walnuts - may have included insecticide treatments applied by the grower uniformly to both control and pheromone plots.

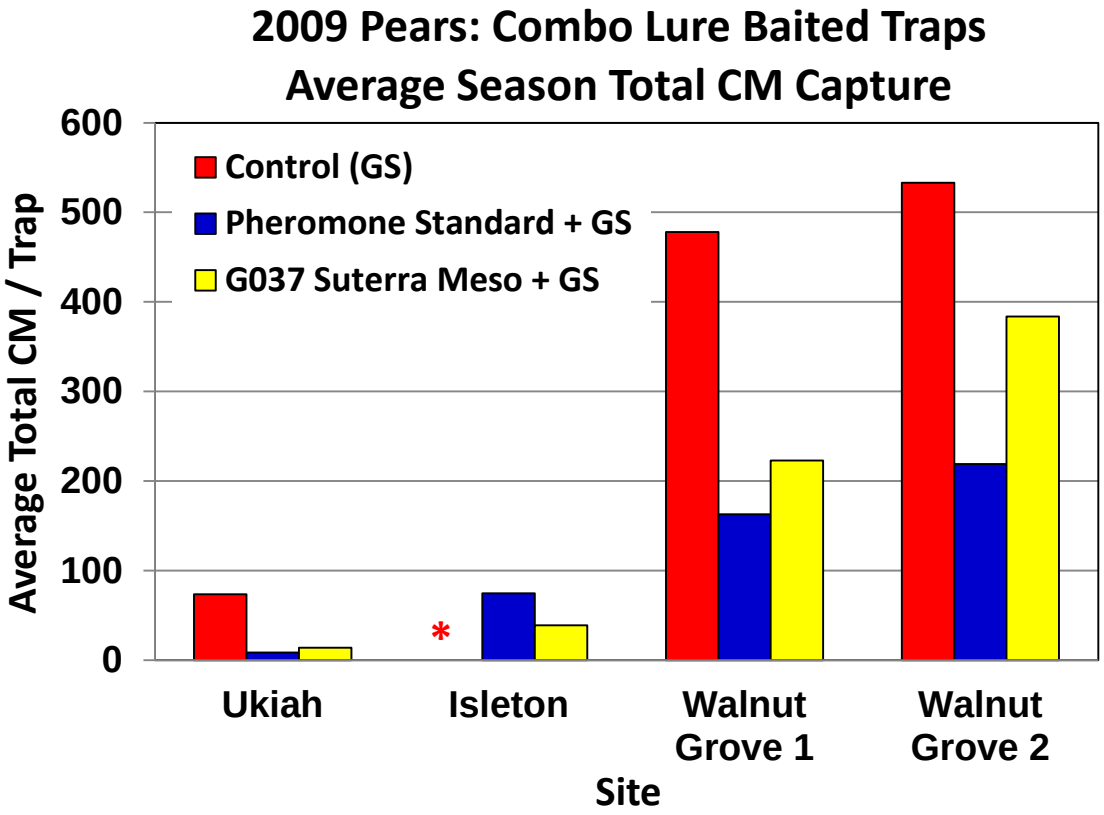
Blocks with 0% damage in all treatments excluded

Pears: Trap Capture and Suppression



- For each lure type higher numbers collected in untreated controls
- Lack of independence between plots indicated by low 1x counts in untreated controls
- No significance between plot treatments
- Even with large blocks, there is pheromone intrusion

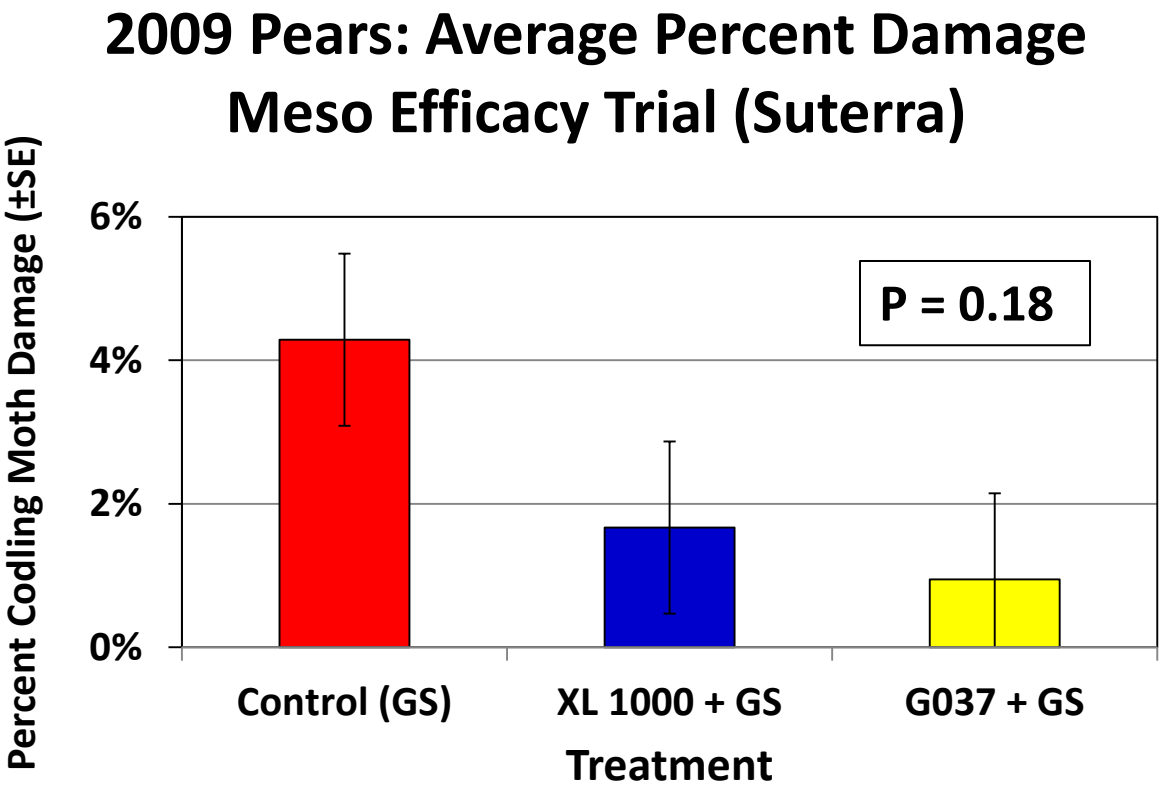
Pears: Codling Moth Pressure
CM/DA Combo Lure Traps



* No control block in Isleton site.

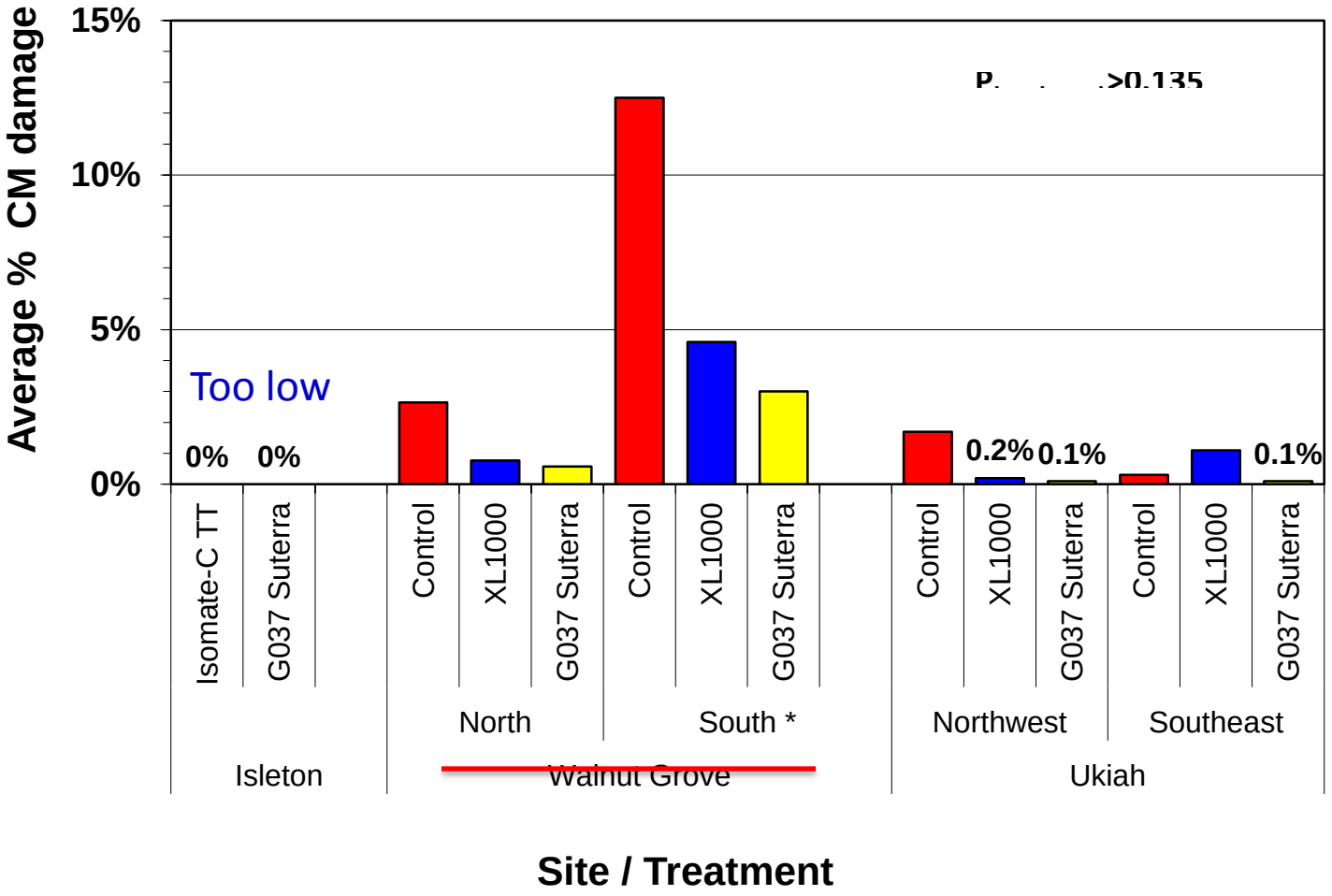
- High variation across sites
  - Range 80 to >500 in untreated controls (no control in Isleton site)
  - Range 13 to 380 in meso treatments

Pear Codling Moth Damage



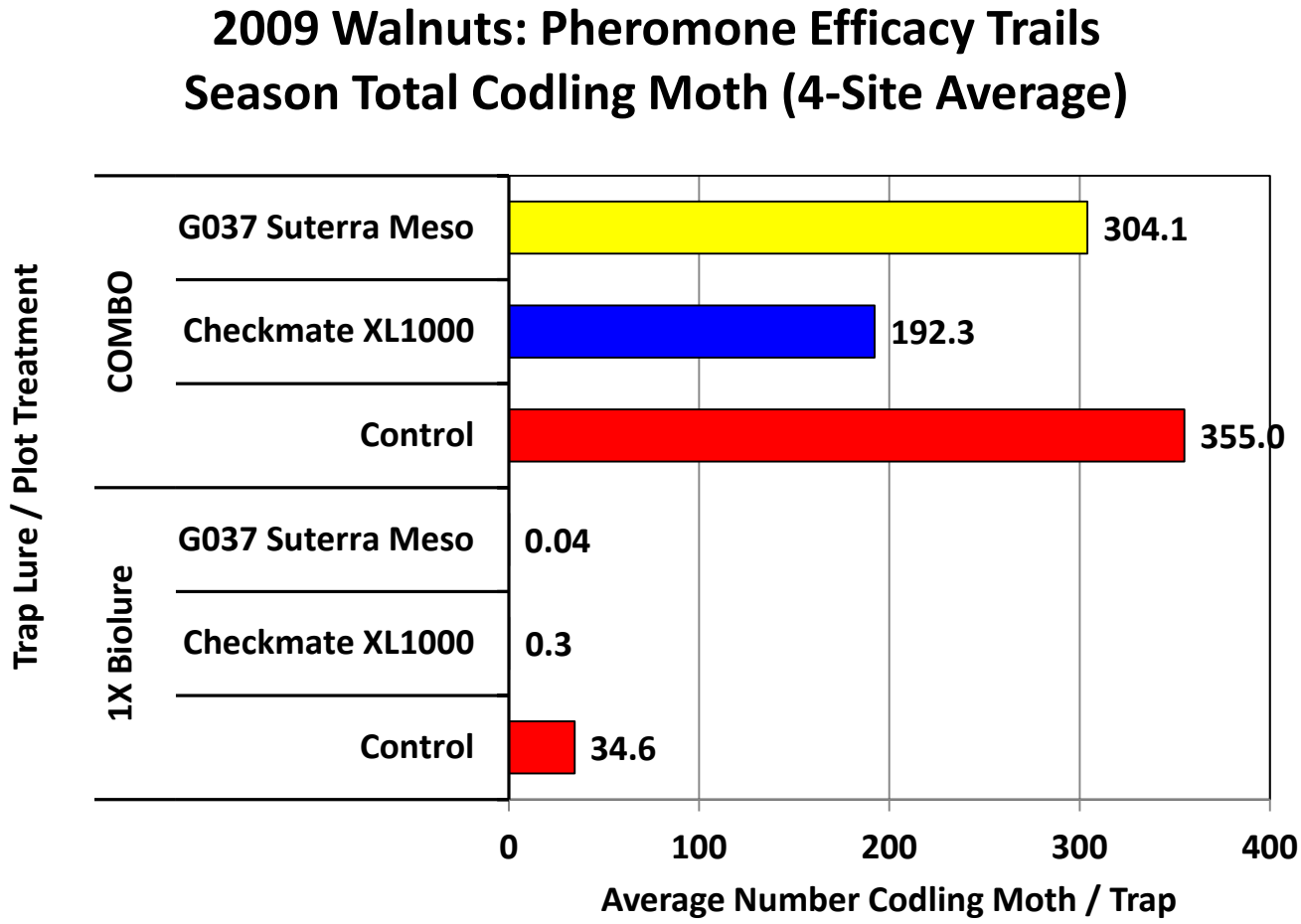
Pattern is similar to overall trend, but not statistically different due to smaller number of reps and low population levels in one orchard

2009 Pears: Suterra Meso Efficacy Trial
Codling Moth Damage at Harvest



- **Damage patterns relative to treatment were similar across sites**

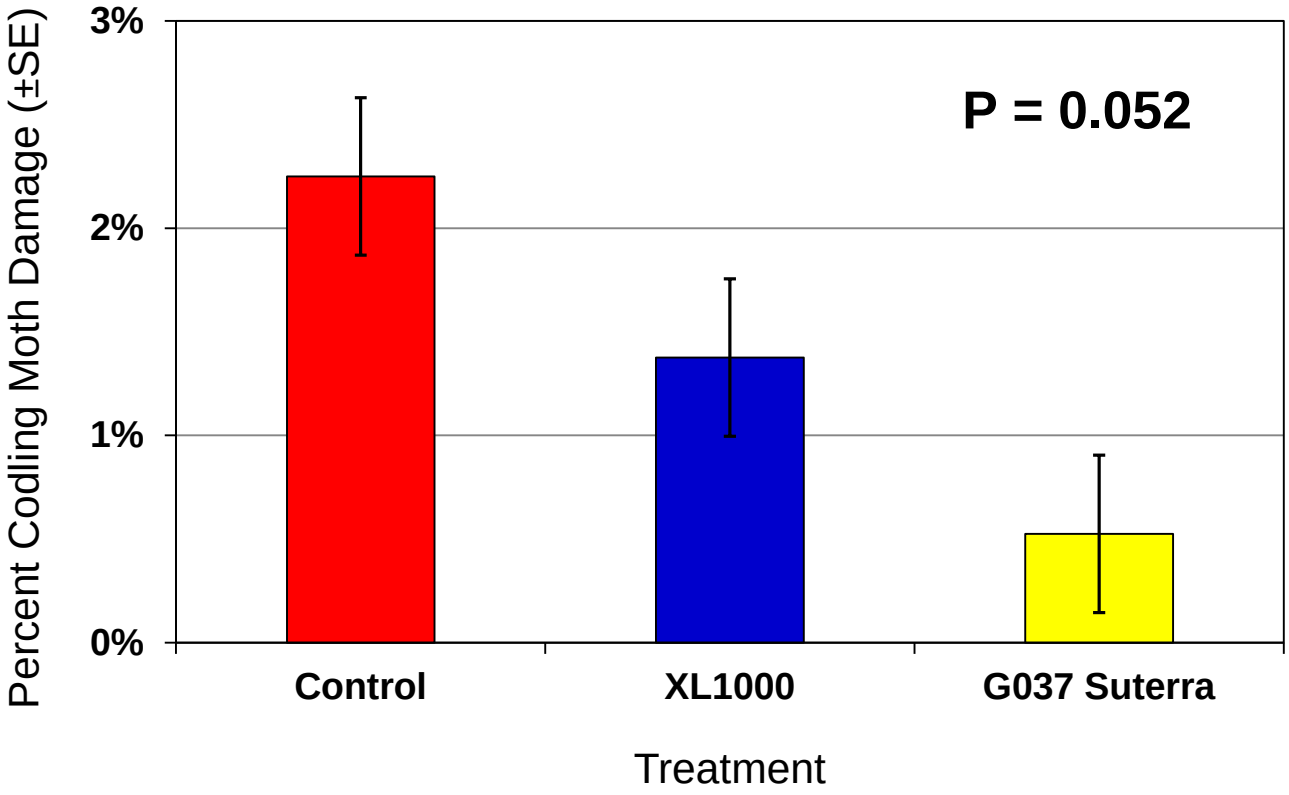
Walnut Codling Moth Trap Counts and Suppression



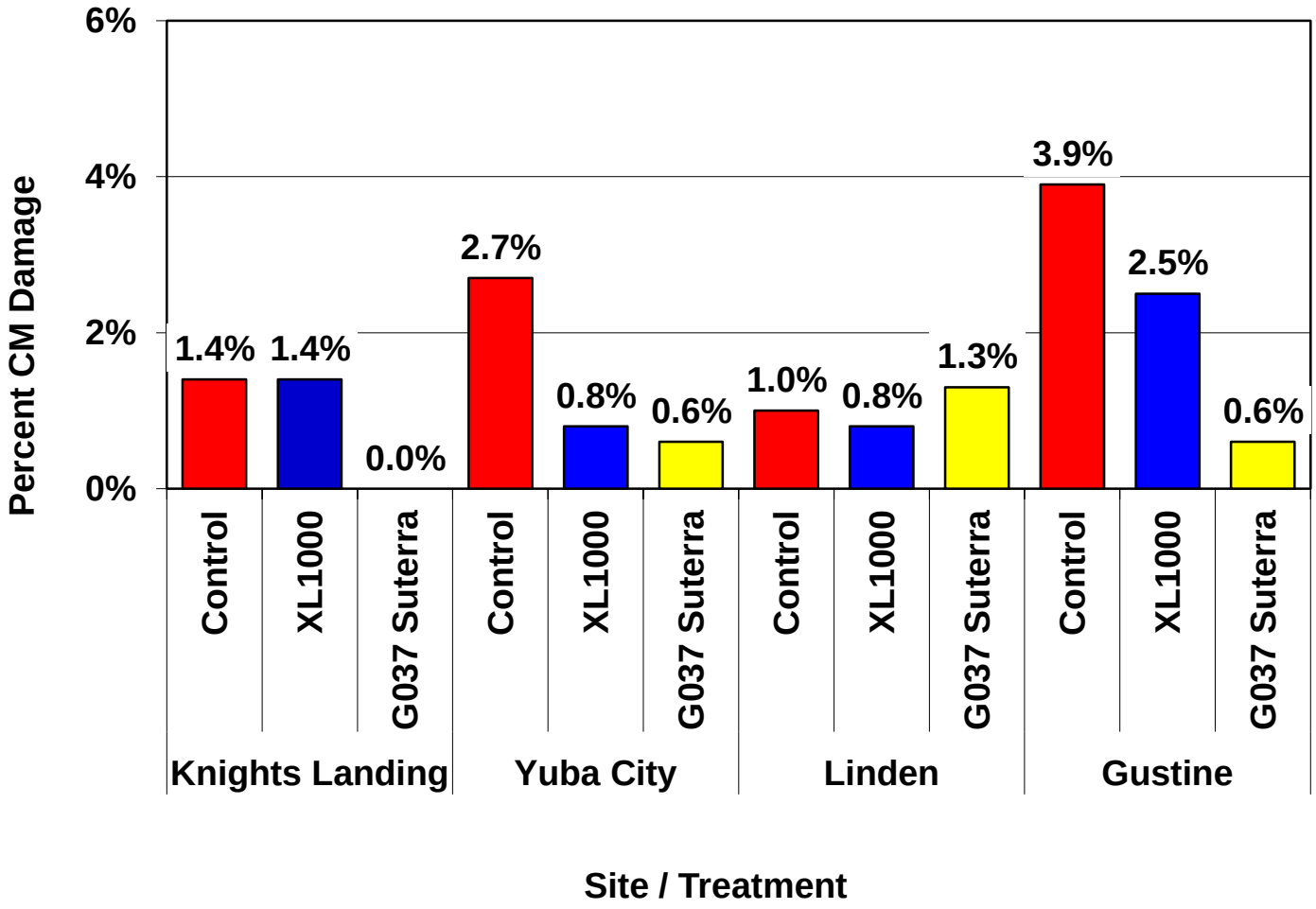
Seasonal moth counts high in all plots (mean 190-360)

Trap suppression comparable at ca. 99%

Codling Moth Damage at Harvest
2009 Walnut Meso Efficacy Trial
(4-Site Average)

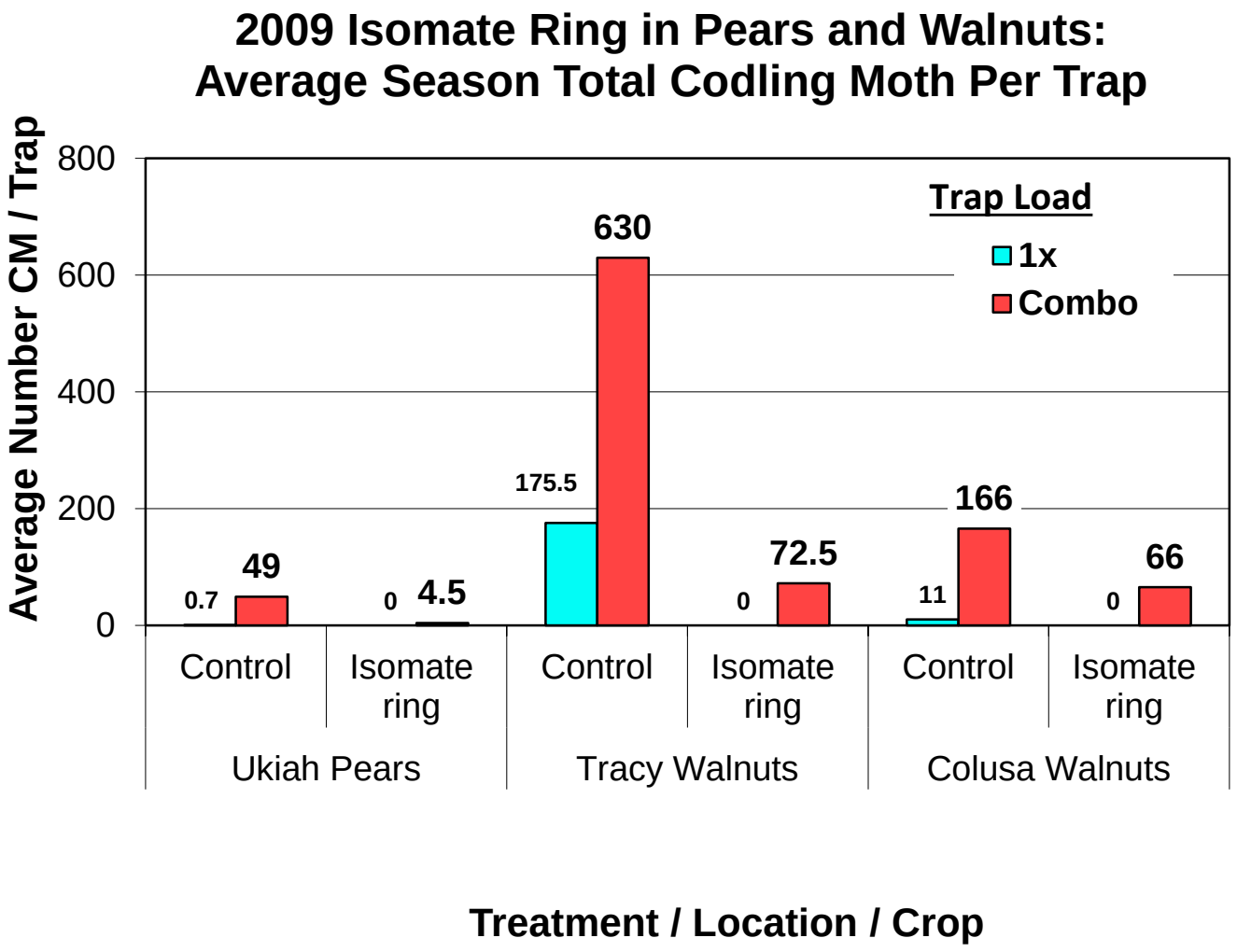


2009 Walnuts: Codling Moth Damage at Harvest
Meso-emitter Efficacy Trials (Suterra Membrane)



Variation in both pressure and outcome observed across orchards

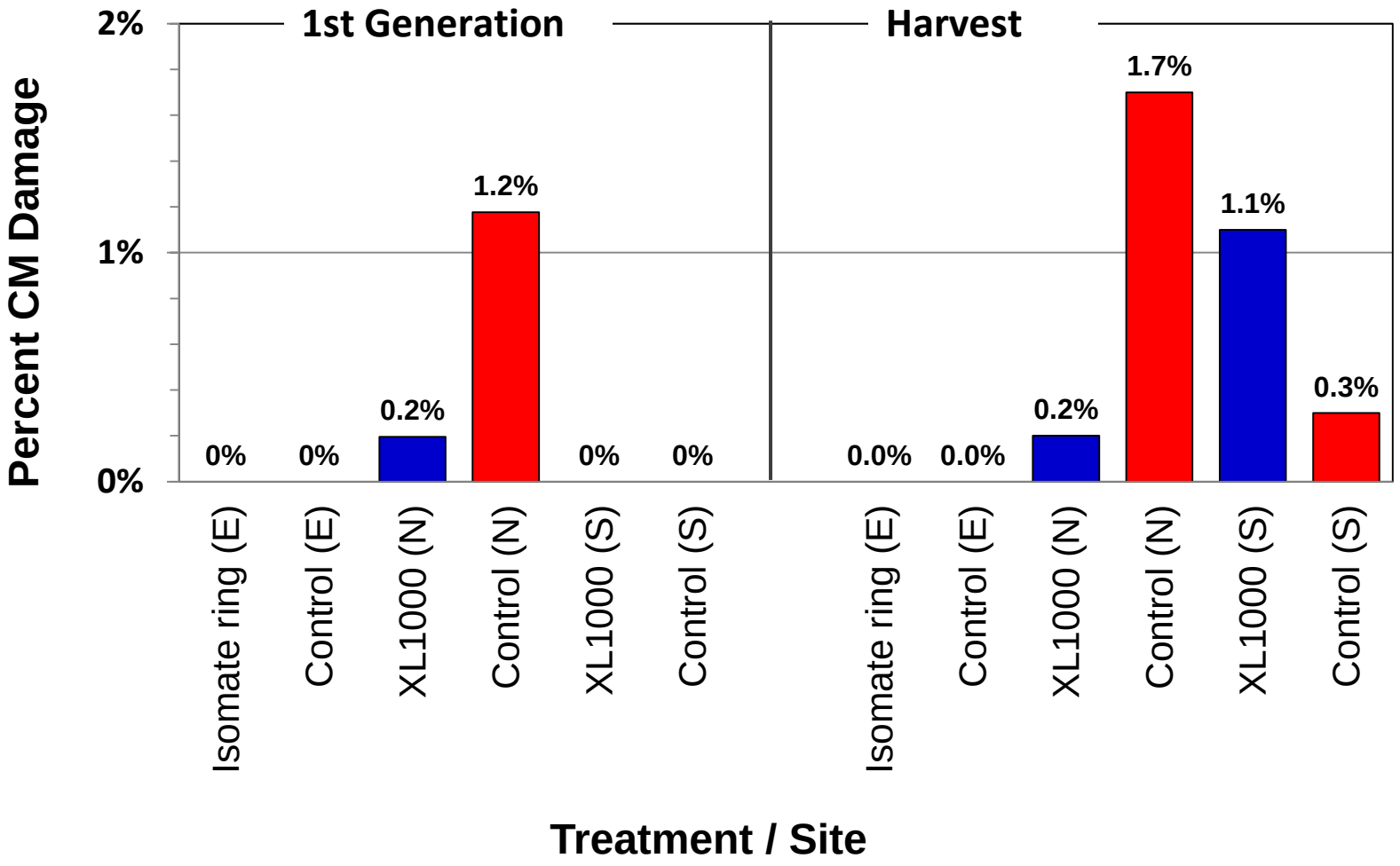
Isomate Rings - Codling Moth Counts



Good suppression of 1X lures and good population pressures in 2 of 3 orchards

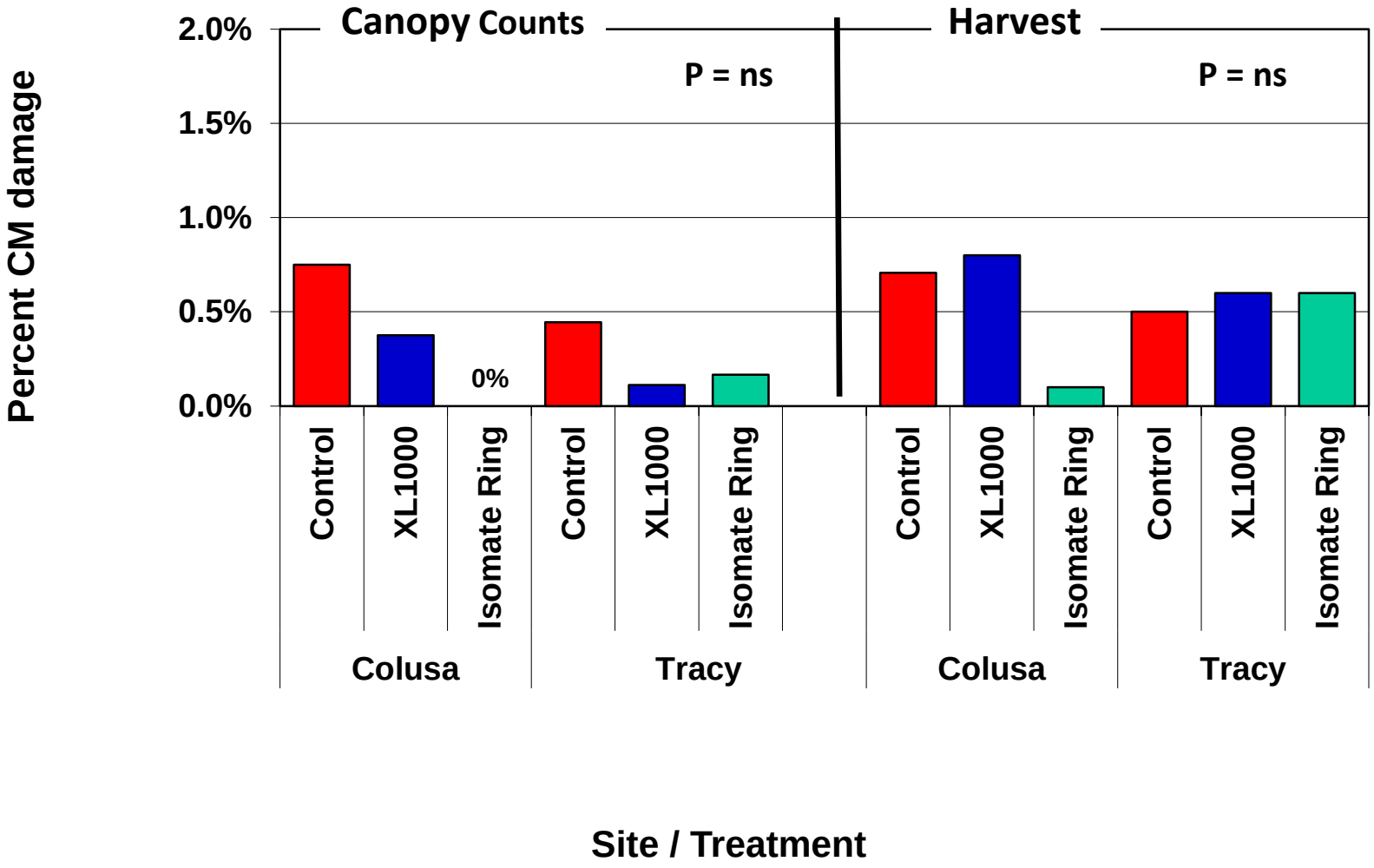
2009 Pears: Isomate Ring Trial - Ukiah

Codling Moth Damage



0% damage observed in ring plots compared to low damage in other plots

2009 Walnuts: Isomate "Ring" Efficacy Trials
Codling Moth Damage



SUMMARY

- Meso-emitter treatments provided control comparable to standard pheromone programs across a range of pressures
- Differences were statistically significant for pooled data from walnuts and pears
- Trap suppression (1x) averaged 95% or more in both meso and standard pheromone programs which is different than in 2008
- Damage suppression patterns were consistent across commodities
- Time of application reduced more than 80% in pears and 90-95% in walnuts.

Acknowledgments

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