

Developing a Behaviorally-Based Attract and Kill System for Spotted Wing Drosophila



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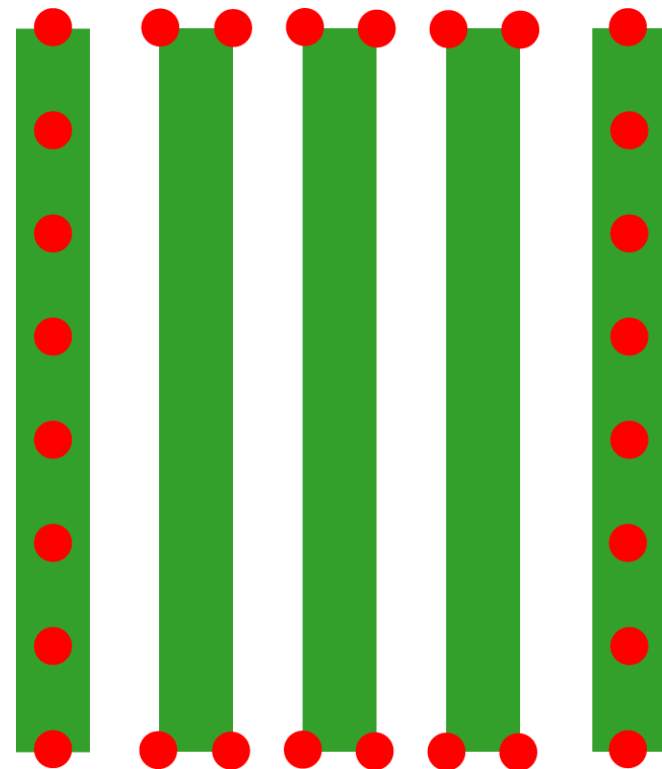


Optimizing Components of Trap-Based Monitoring and Management Systems

- Visual Stimulus
- Olfactory Stimulus
- Deployment Strategy
- Capture Mechanism



Perimeter-Based Attract and Kill System for Apple Maggot



“Proof of Concept” Attract-and-Kill Study

Will SWD alight on red spheres?

What effect does their presence have on infestation?



- Released 25 males and 25 females into field cages.
- Treatments
 - Sphere alone
 - Sphere + olfactory attractant
 - Sphere + raspberry plant
 - Sphere + olfactory attractant + raspberry plant
 - Raspberry plant alone
- Flies foraged freely for 48 h.
- Recorded number of SWD captured (kill) and number of larvae + pupae recovered from fruit (control).

SWD infestation in raspberries reduced by 50% when sphere included in the cage.

SWD alighted on spheres, but captures reduced by 50% in presence of raspberry plant.



Can We Develop an Attract and Kill System for SWD?

- Visual Stimulus
- Olfactory Stimulus
- Deployment Strategy
- Capture Mechanism



Does SWD Respond To Visual Cues?



What Did We Know?

- Visual cues used by drosophilids to discriminate among hosts (Menne and Spatz 1977).
- *Drosophila melanogaster* utilizes visual cues, particularly vertical edges, when responding to odor (Frye et al. 2003).
- Basoalto et al. (2013) reported that flies responded in greatest numbers to red and black stimuli in laboratory studies, but didn't necessarily translate in the field.

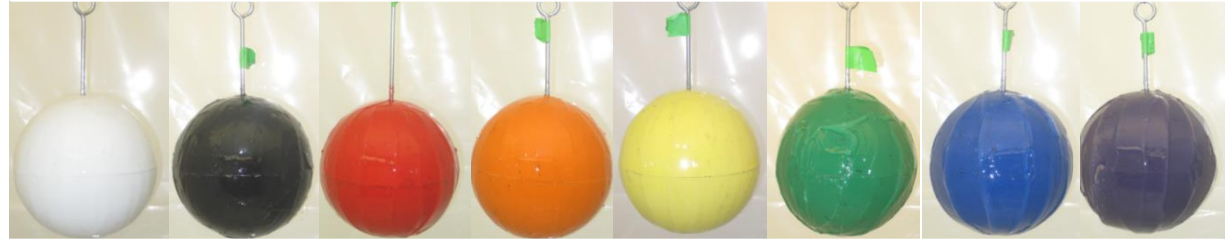
Visual Ecology of SWD

- Identifying Attractive Visual Cues
- Color, Shape and Size
- Laboratory, Semi-field and Field Trials

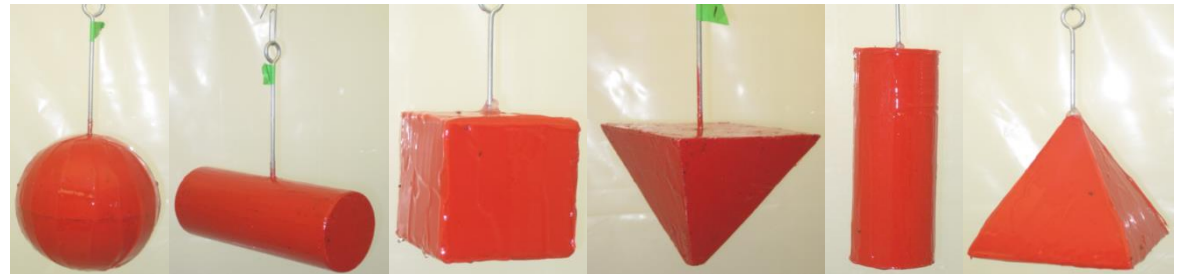


Visual Stimuli

Color



Shape

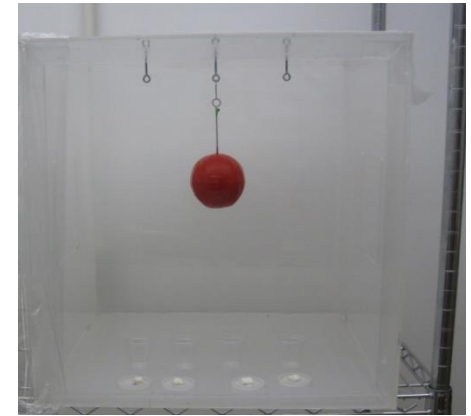


Size



Laboratory

- Release 20 colony-reared, mature anesthetized SWD into cage.
- SWD permitted to freely forage for 6h.



Semi-Field

- Release 30 colony-reared, mature anesthetized SWD.
- SWD permitted to freely forage for 48h.



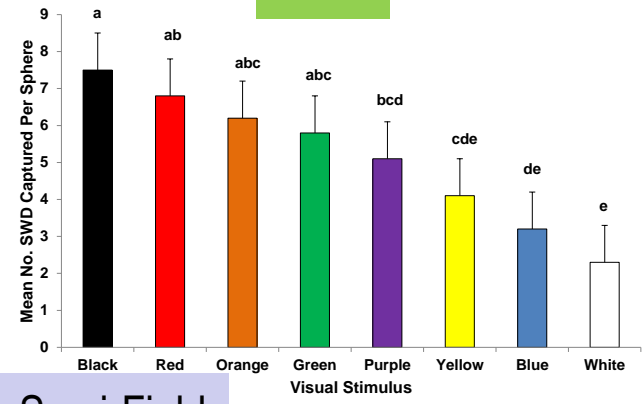
Field

- Assess response of wild SWD populations.
- Stimuli in field for 48h.

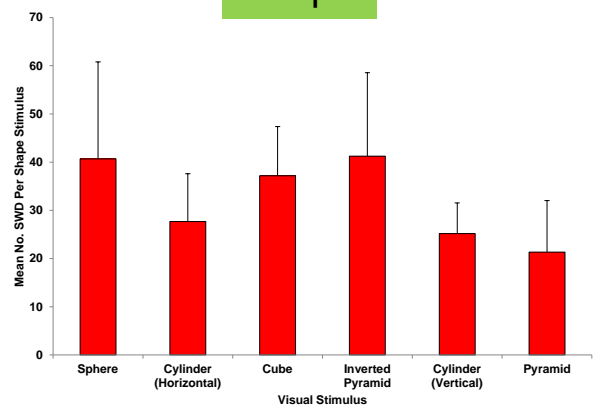


Laboratory

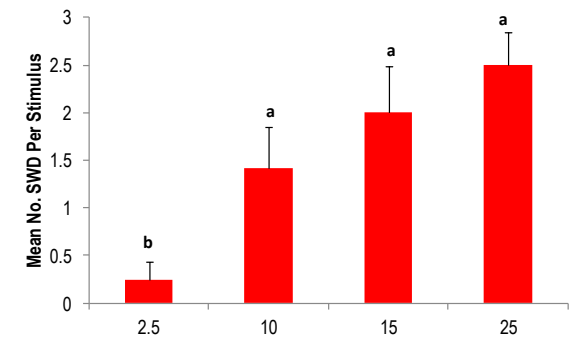
Color



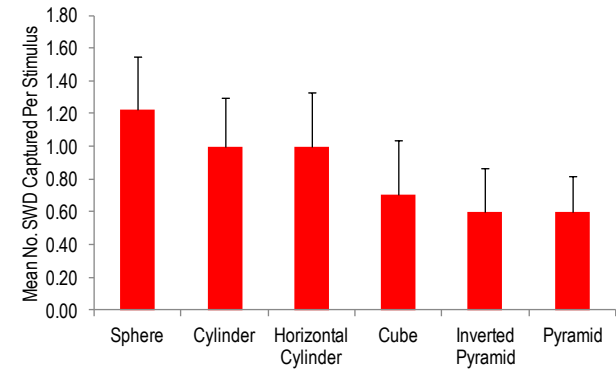
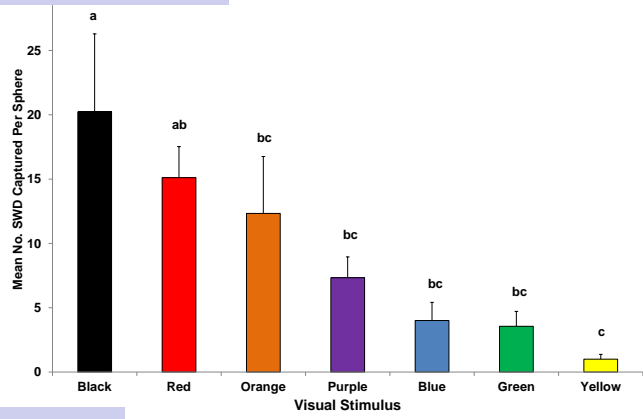
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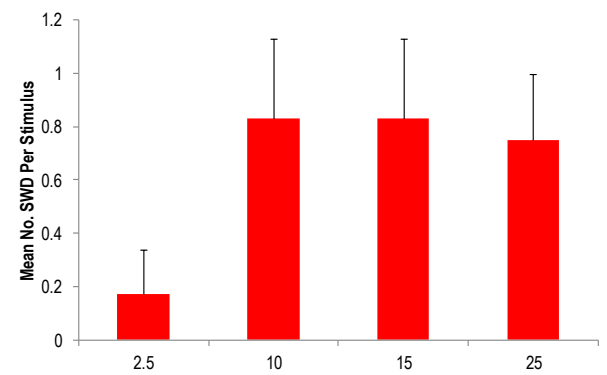
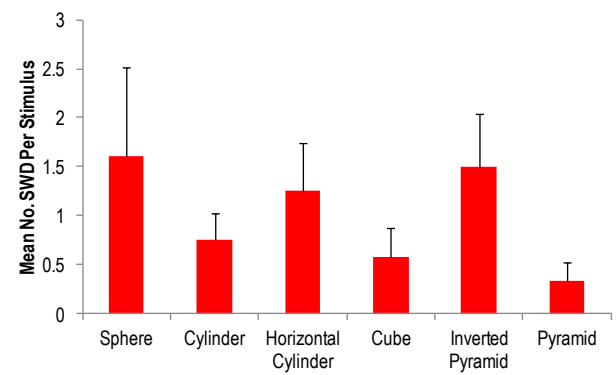
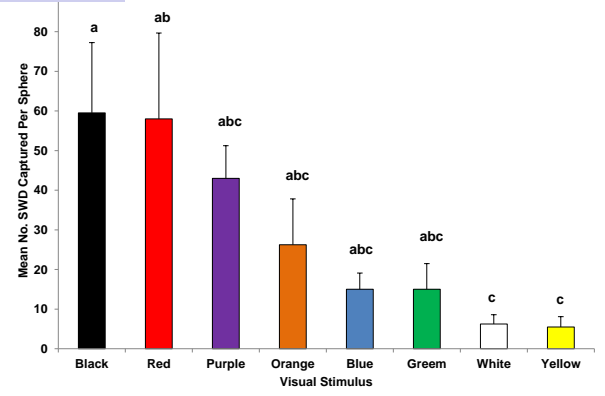
Size



Semi-Field



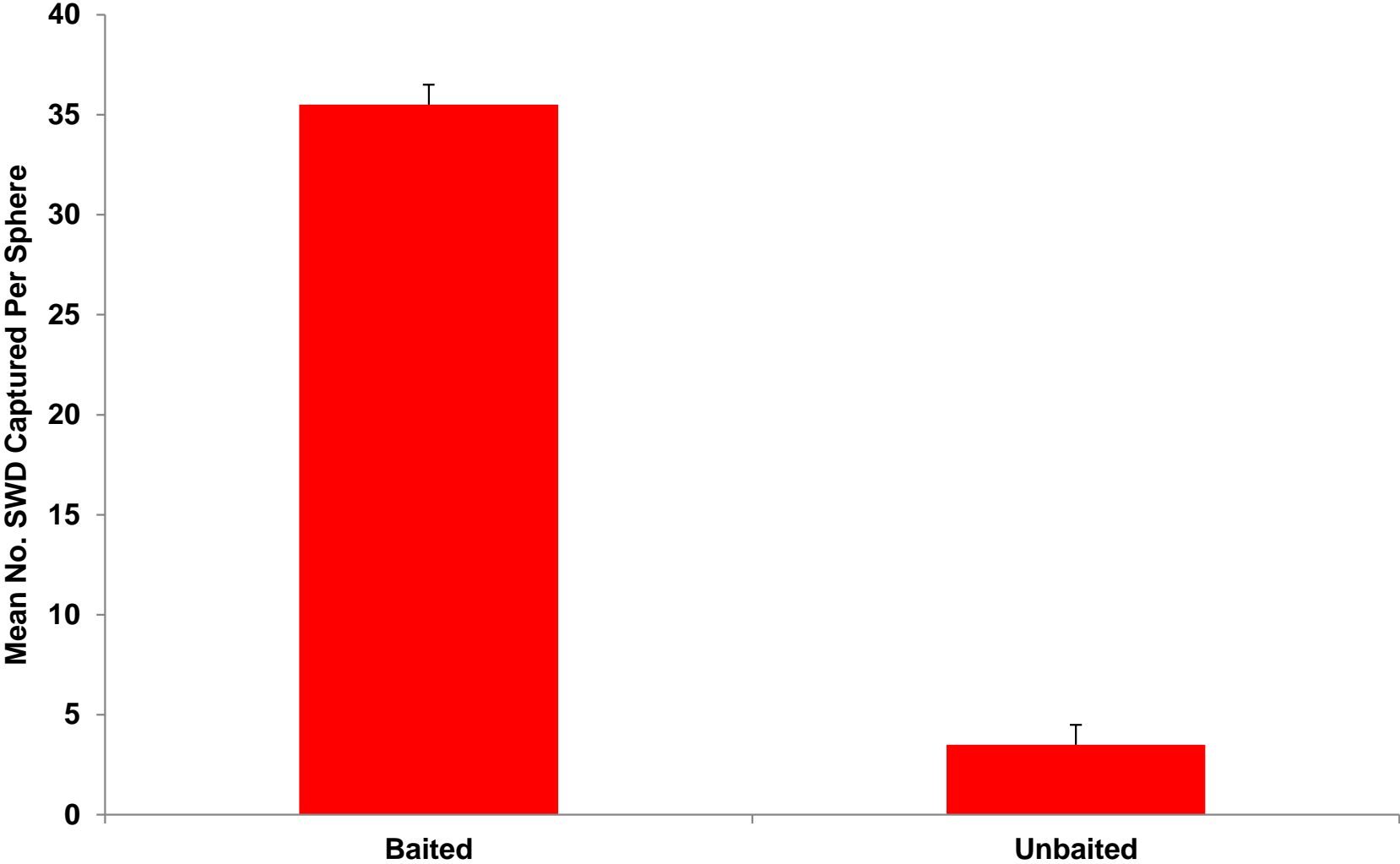
Field



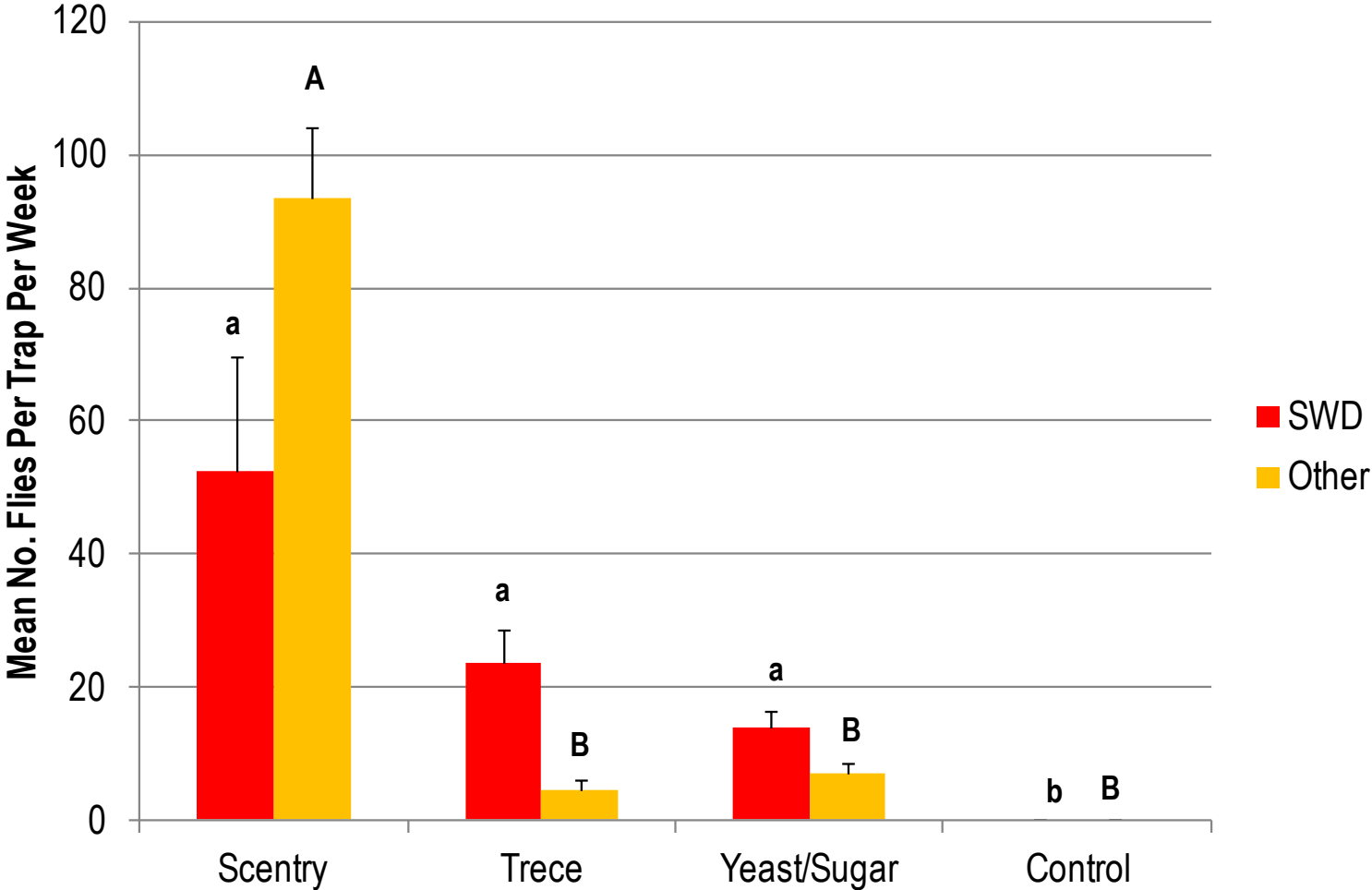
Conclusions From Visual Ecology Trials

- SWD do respond to visual cues.
- Color appears important as black and red routinely outperformed other colors.
- A spherical shape with a size greater than 2.5 cm appears acceptable.

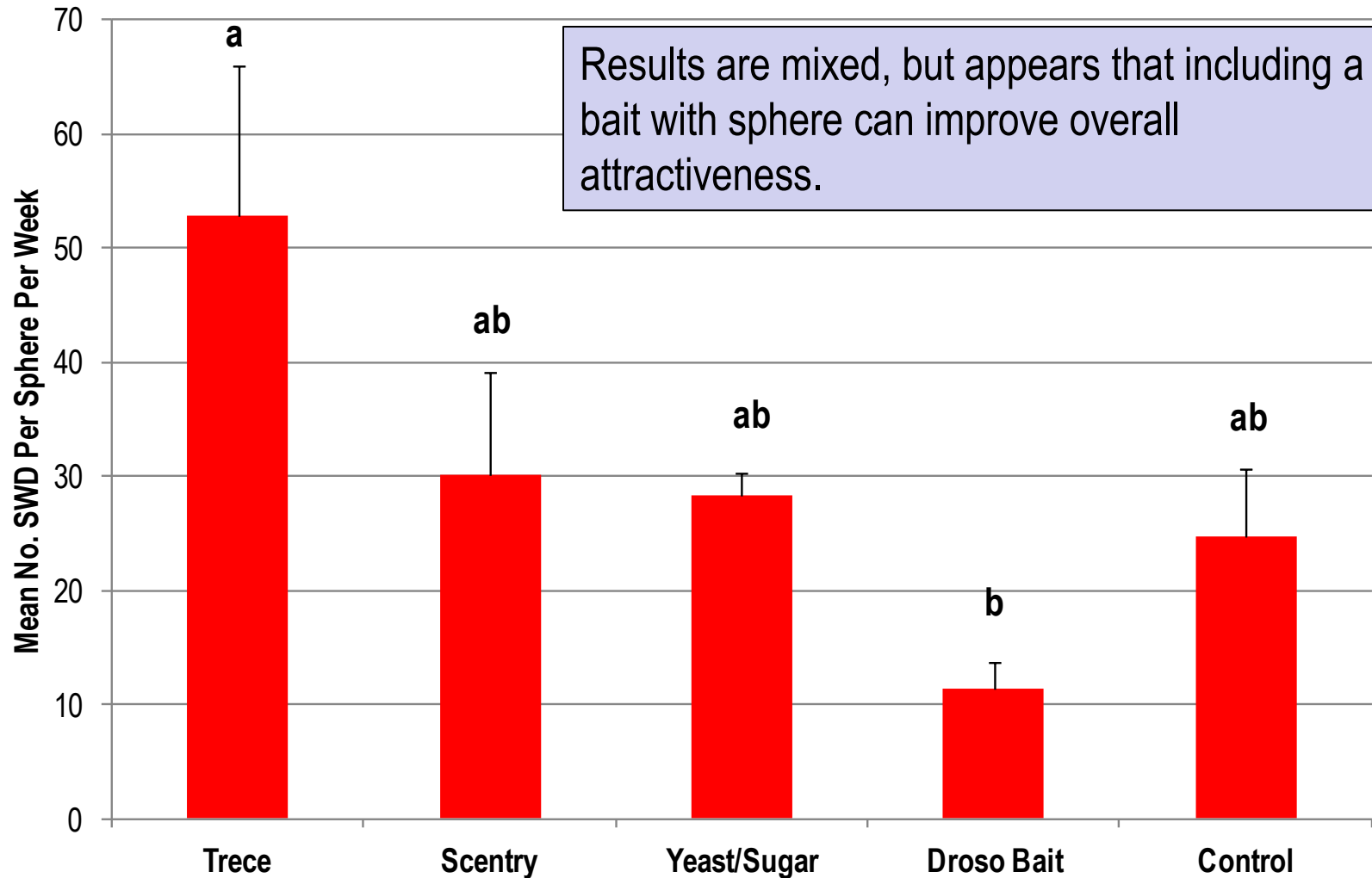
Could An Olfactory Attractant Improve Efficacy?



2014 Bait Comparison In Standard Deli Cups



2014 Bait Comparison In Association With Spheres



Can We Replace Tangletrap as Killing Agent?

- Evaluate lethality of attracticidal spheres developed for AMF for SWD.
- Cap contains a feeding stimulant (sugar) and toxicant.
- Exploits environmental moisture to continuously renew toxicant on sphere surface.

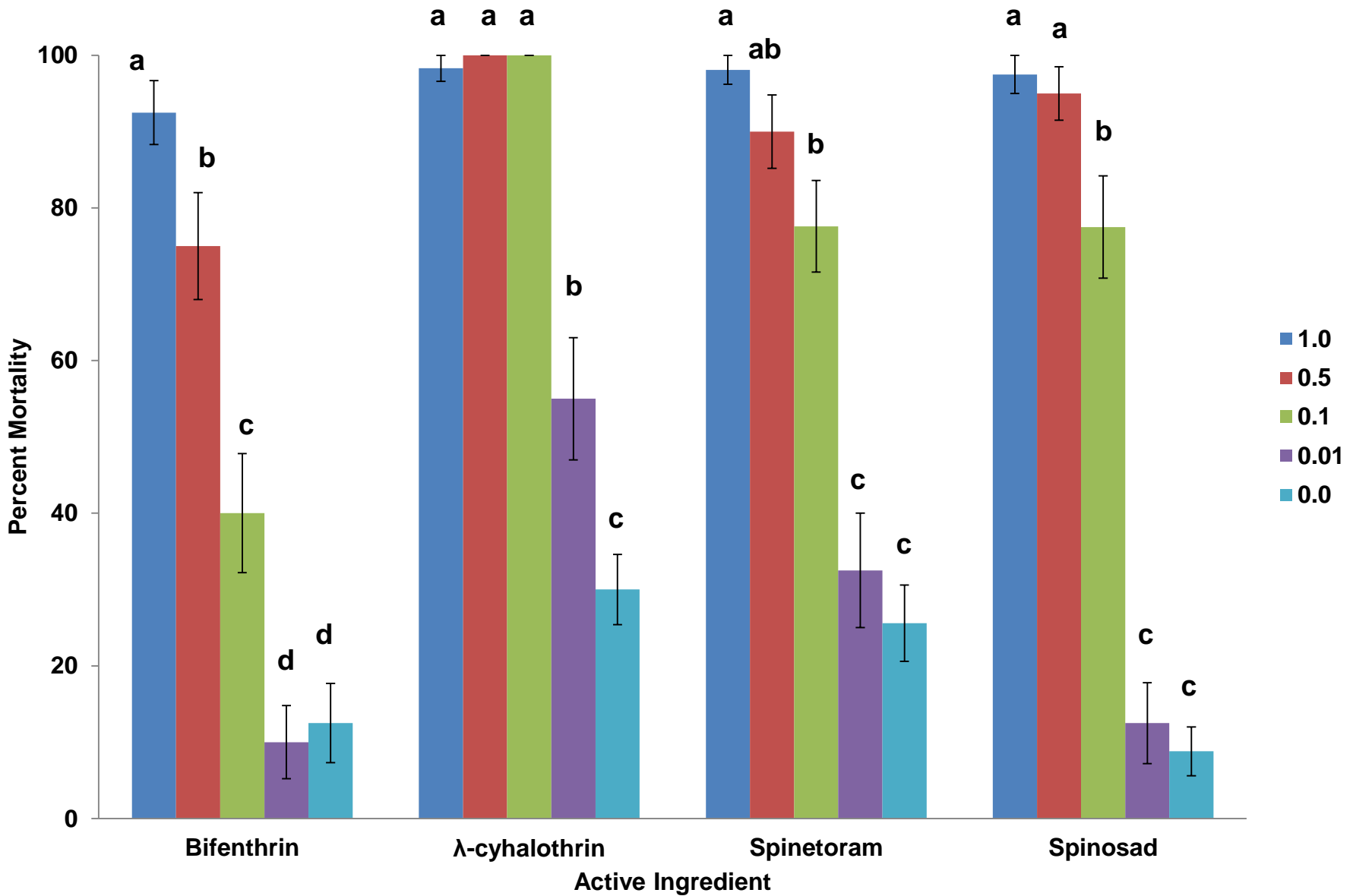


Laboratory Evaluation of Lethality

- Insecticides: Bifenthrin, Lambda-cyhalothrin, Spinetoram, and Spinosad.
- Rates: 0.0, 0.01, 0.1, 0.5 and 1.0% a.i.
- Evaluated a minimum 20 males and 20 females/insecticide/rate.
- Released at sphere equator and allowed to forage freely for 5 min. Measured foraging time.
- Evaluated toxic effects at 0, 24 and 48 h after exposure



Lethality



Field Trial of Attracticidal Spheres

Can we reduce SWD infestation in a susceptible crop using attracticidal spheres?

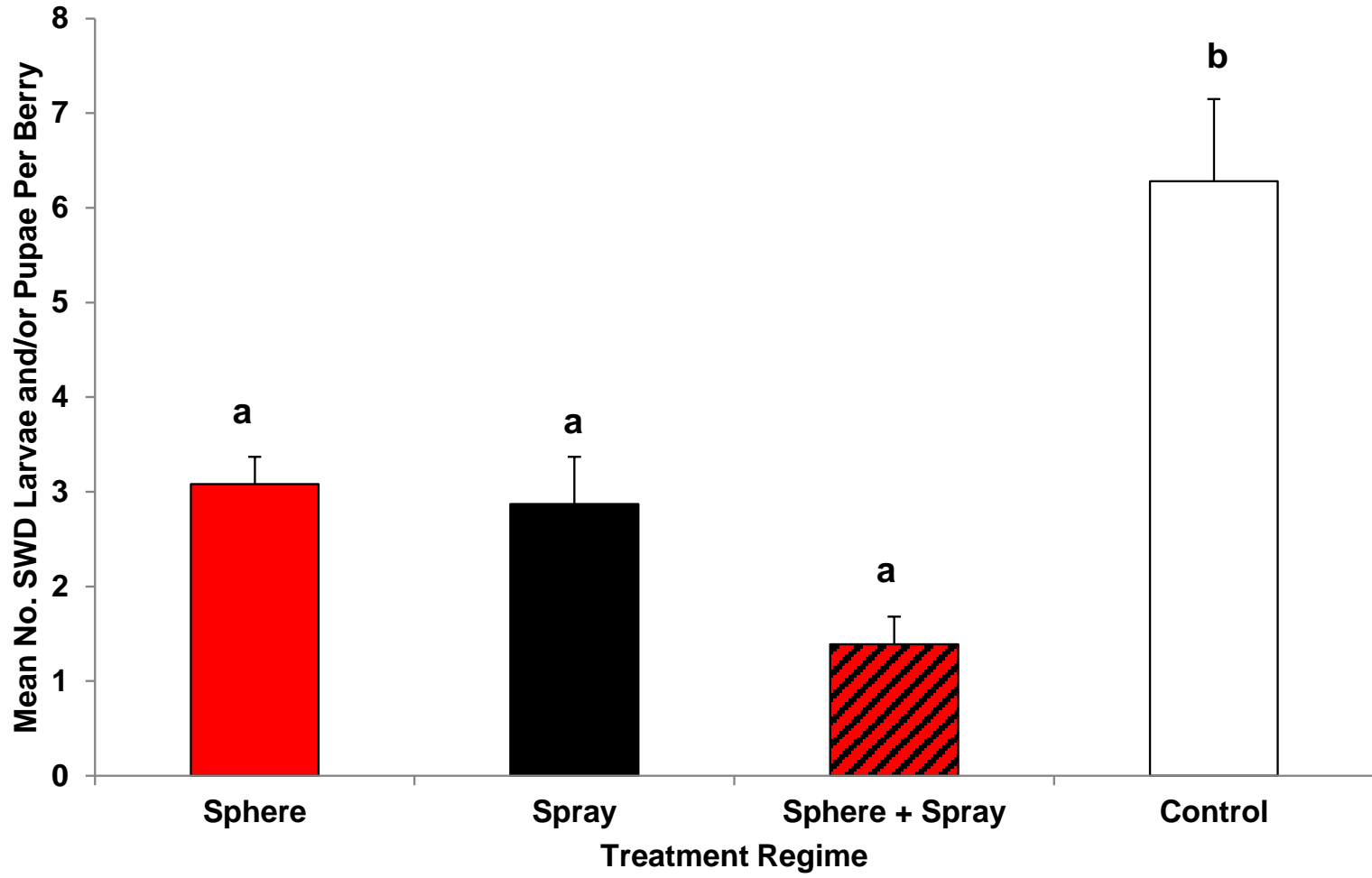


Experimental Set-Up



- Potted raspberries with ripe fruit placed in field.
- Four experimental treatments evaluated for SWD management.
 - 1) weekly sprays (Brigade, Entrust or Danitol)
 - 2) 1% Delegate attracticidal spheres (1 per plant)
 - 3) sprays + spheres
 - 4) Control
- Monitored SWD populations with traps baited with yeast/sugar.
- Harvested ripe berries and evaluated infestation rates.

Infestation Rates from Attracticidal Sphere Field Trial



Can We Find a Better Insecticide Formulation?

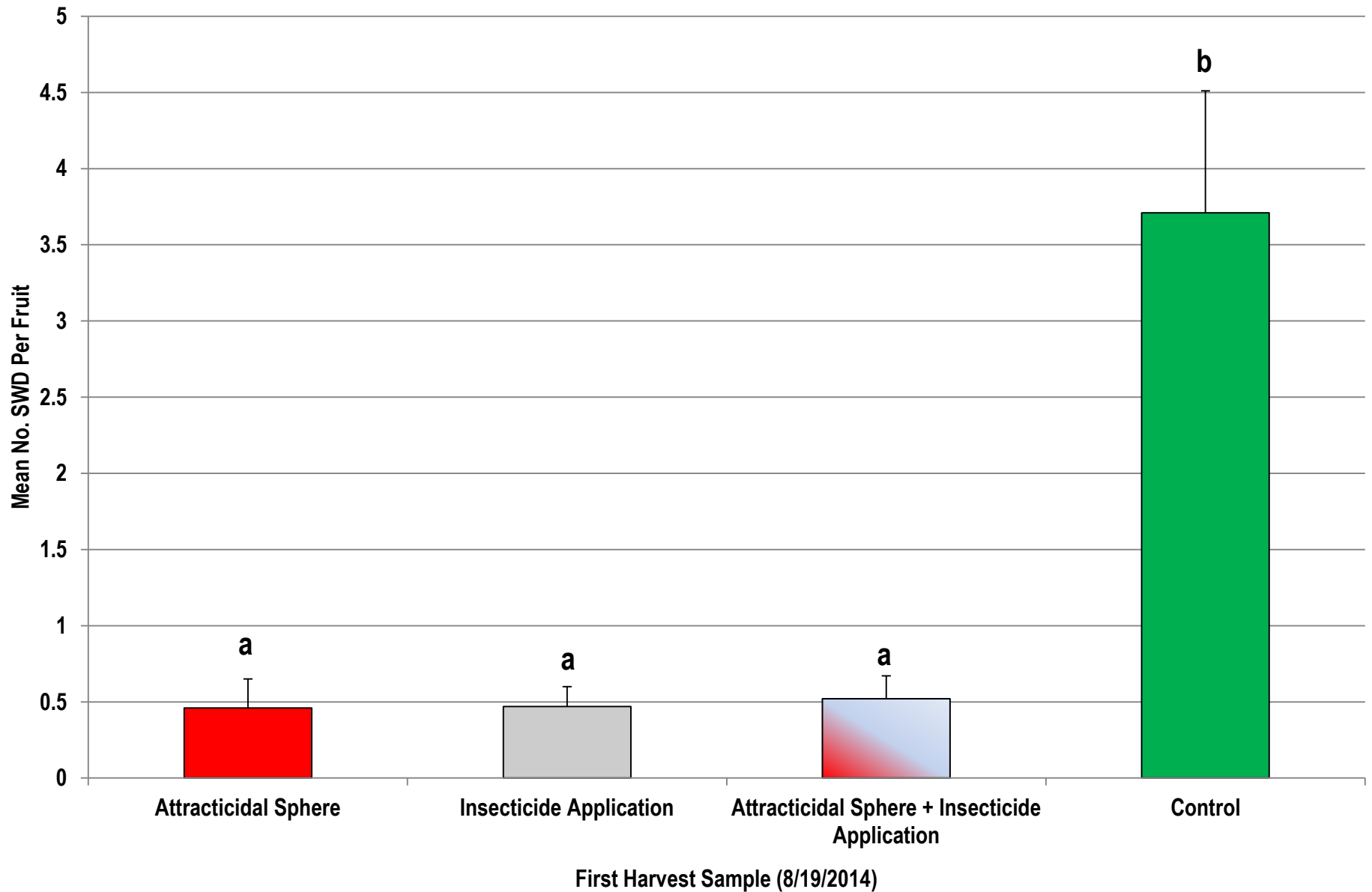


Continued Lethality Trials

- Toxicant Requirements With Current System
 - Dry formulation
 - High % AI
 - Ideally, an organically approved material
- Venom (Dinotefuran) was very promising in laboratory trials.
- 1% Venom used in field trials in 2014.

2014 Field Trial

- Raspberry planting.
- Four experimental treatments evaluated for SWD management.
 - 1) weekly sprays (Brigade, Delegate or Danitol)
 - 2) 1% Venom attracticidal spheres (1 per plant)
 - 3) sprays + spheres
 - 4) Control
- Monitored SWD populations with traps baited with yeast/sugar.
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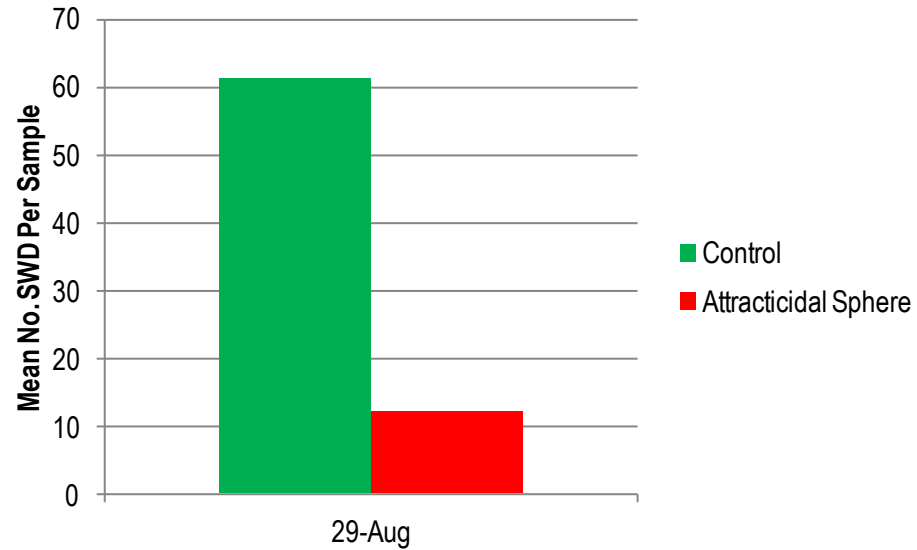
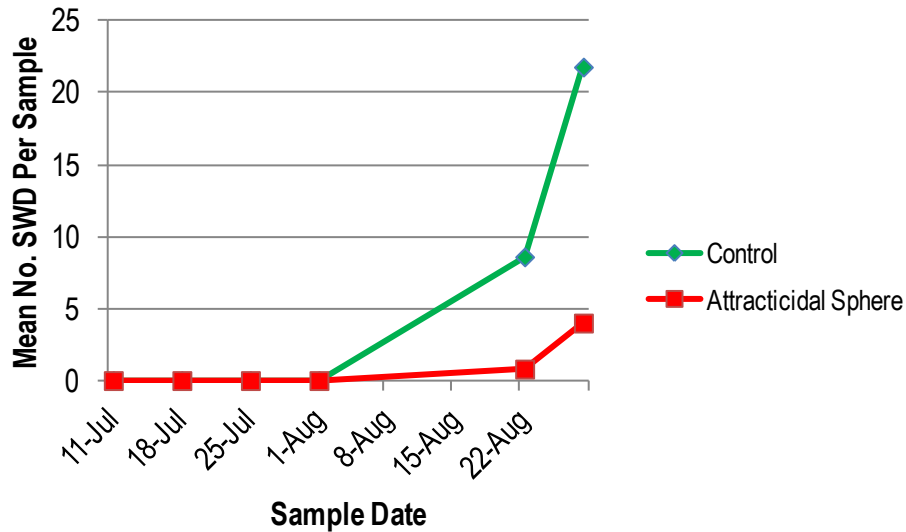
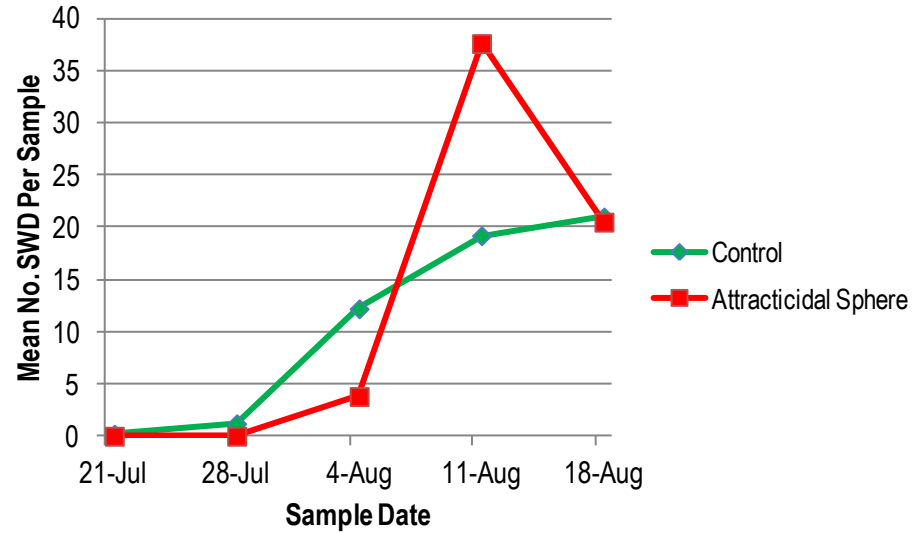
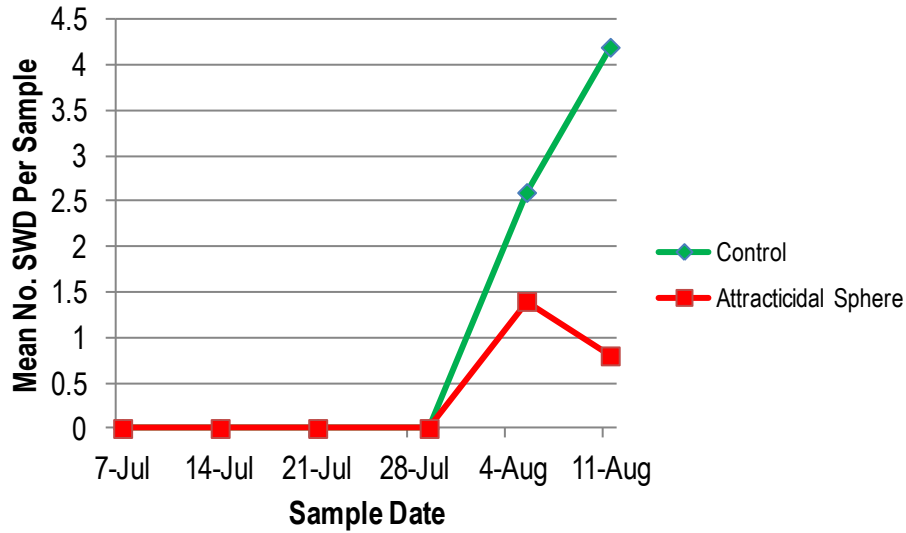


What If We Include A Bait?

- Raspberry plots of four NH Growers.
- Two experimental treatments evaluated for SWD management.
 - 1) Grower Control (Normal Practice)
 - 2) Grower Control + 1% Venom attracticidal spheres (1 sphere every 3 m) + Trece SWD Bait
- Harvested ripe berries and evaluated infestation rates.



Preliminary Results



Tentative Conclusions

- Baited attracticidal spheres appeared to have a positive impact on SWD infestations in raspberry plantings.
- Lower infestation rates in all samples, except one.
- As populations increase, control breaks down.

Next Steps

- Behavioral trials assessing SWD response to spheres +/- baits in context of host plants.
- SWD behavior in host plants.
- Attracticidal sphere formulation issues.
- Deployment strategy.

Post-Doctoral Position Available

- *Leskey laboratory seeking a post-doctoral researcher to aid in trials aimed at understanding the behavioral ecology of SWD and developing an effective behaviorally-based management strategy for this invasive pest. Email Tracy Leskey at tracy.leskey@ars.usda.gov for more information.*

Acknowledgments



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