

The background of the slide features a large, faint watermark of the Rutgers University seal. The seal is circular and contains the text "RUTGERS STATE UNIVERSITY" around the perimeter. In the center of the seal is a sunburst design with a central sun and rays extending outwards.

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School of Environmental
and Biological Sciences

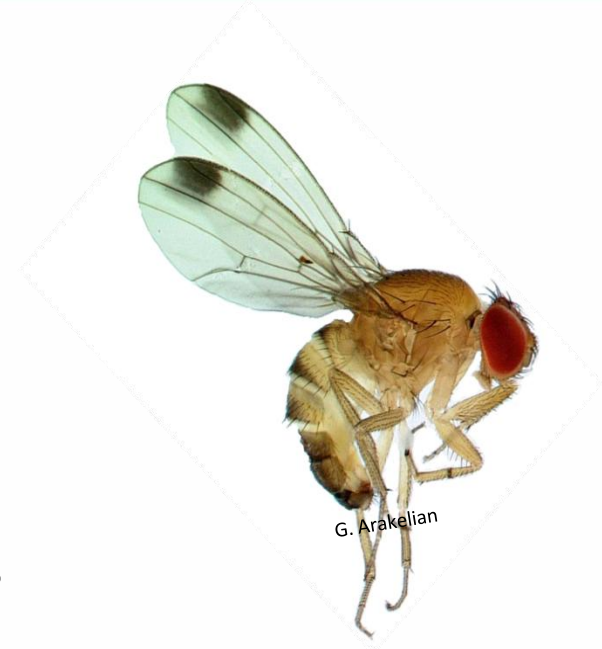
OLFACTORY CUES AND CHEMICAL CONTROL

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Blueberry/Cranberry Entomologist

The Problem

- Spotted Wing Drosophila (SWD)-
New invasive pest from Asia.
- First detected in California in
2008. In Northeast in 2011.
- Multiple hosts – soft-skinned fruits
(berries).
- Attacks healthy ripening fruit.
- Early detection critical for
management.



Current Monitoring

- Baits
 - Yeast
 - Sugar-Yeast
 - Apple Cider Vinegar (ACV)
 - ACV+Wine
- Variable Efficacy
 - Not good predictors of infestation
 - Not early enough warning



Monitoring - Challenges

- Baits based on fermentation products.
- Female flies seek healthy fruit for oviposition.
- Chemical cues involved in host-finding behavior are unknown.
- Identify a lure for easy early detection.



■ Blueberry



■ Cherry



■ Raspberry



■ Strawberry

Objectives

Develop a better attractive lure for early detection of SWD.

- Determine the behavioral responses of SWD to fruit extracts.
- Identify volatile emissions.
- Identify electrophysiologically active compounds.

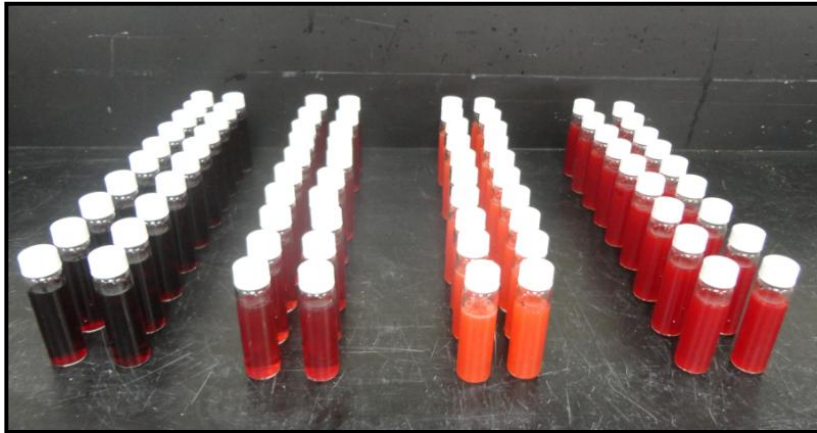


John Abraham – Free University Bolzano (Italy)

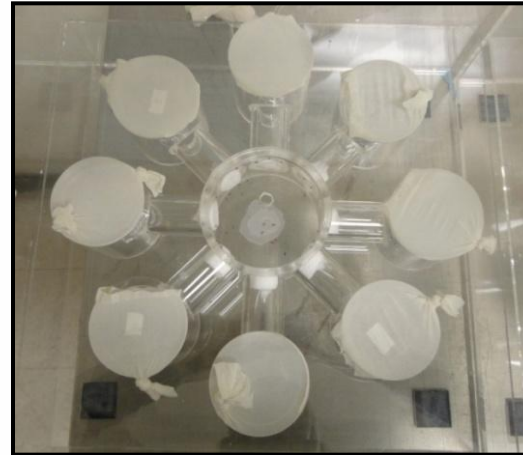


Aijun Zhang – USDA-ARS

Materials & Methods

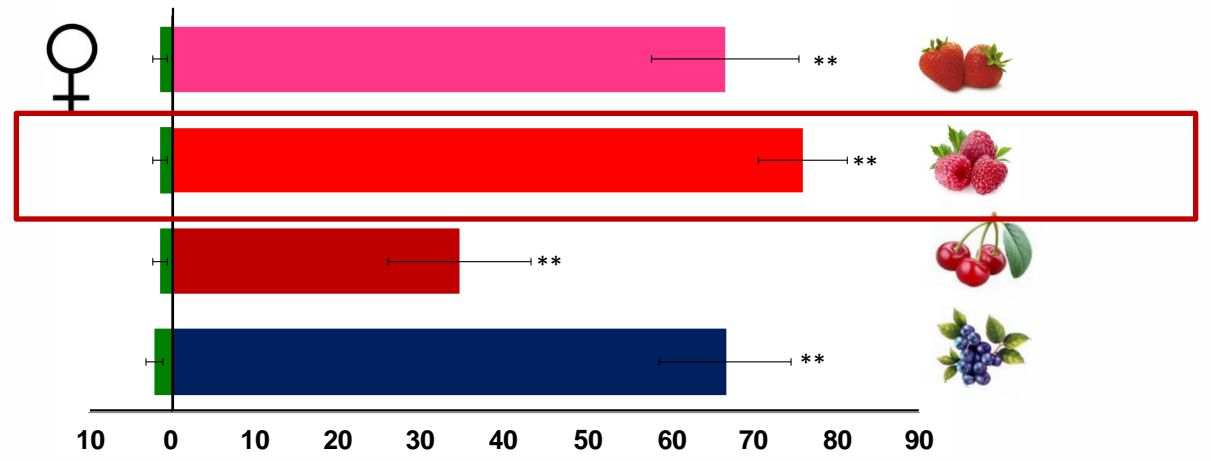


**Extract Fruit
Juices**

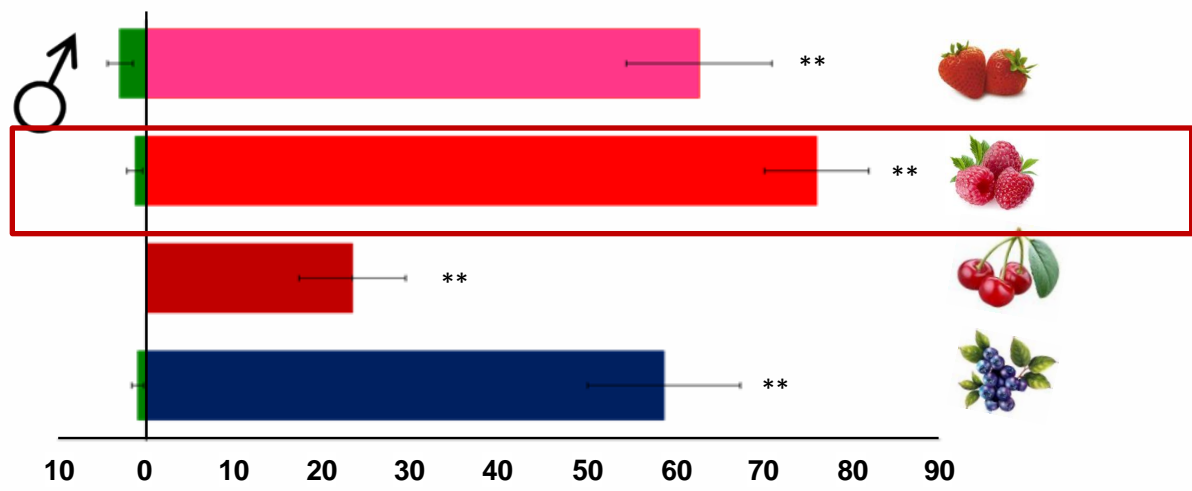


**Test Extract
Attractiveness**

Fruit Extract vs Control

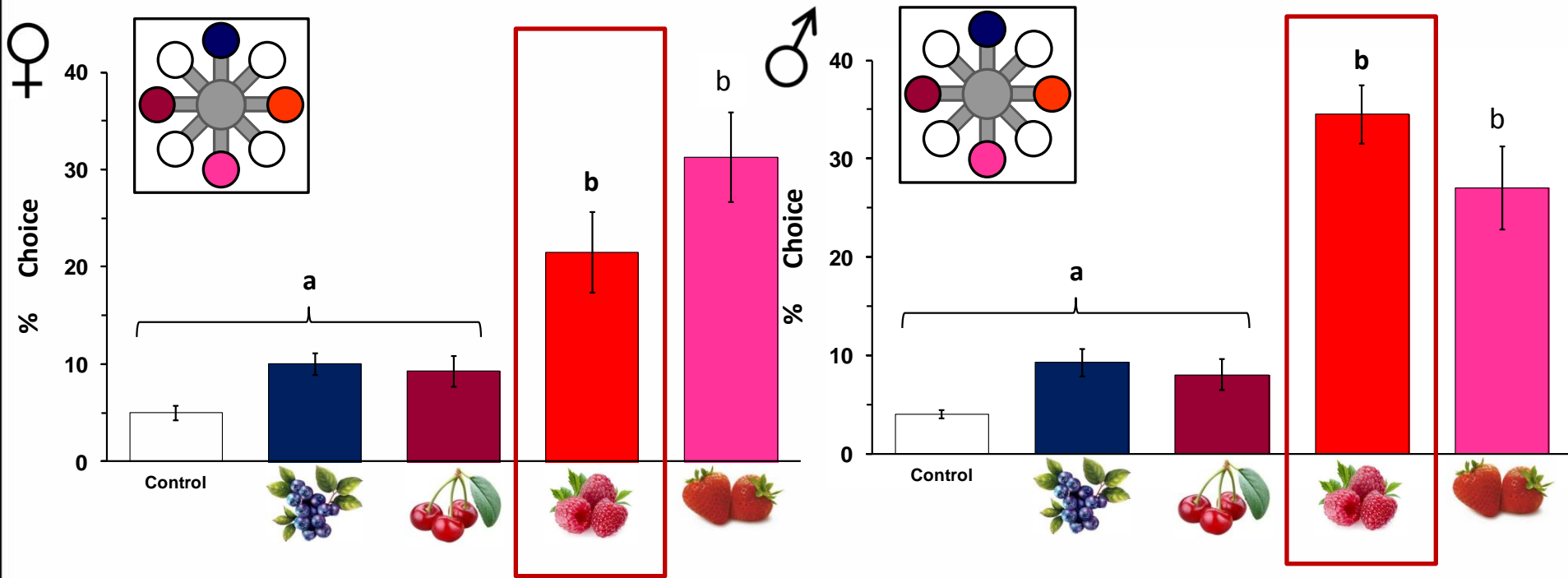


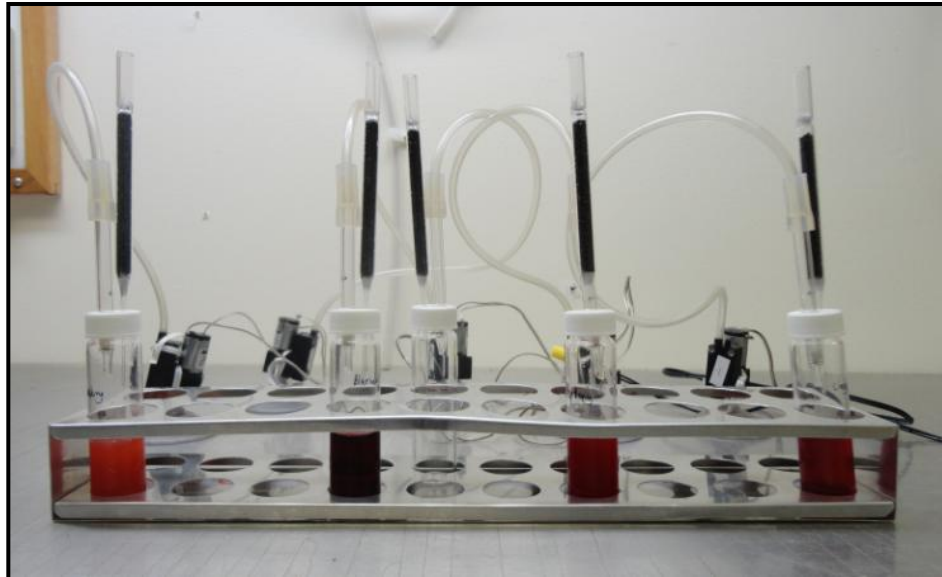
% Female Choice ** P < 0.001



% Male Choice ** P < 0.001

Fruit Extracts vs Control





**Collect Fruit
Volatiles**

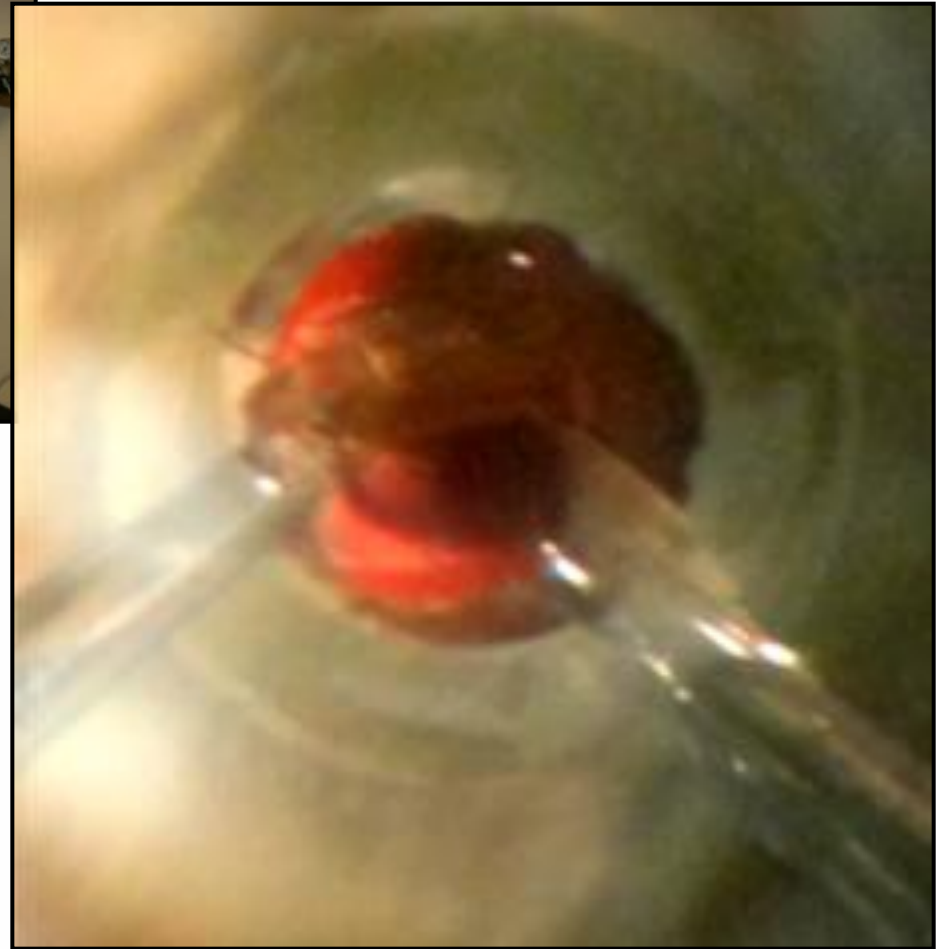
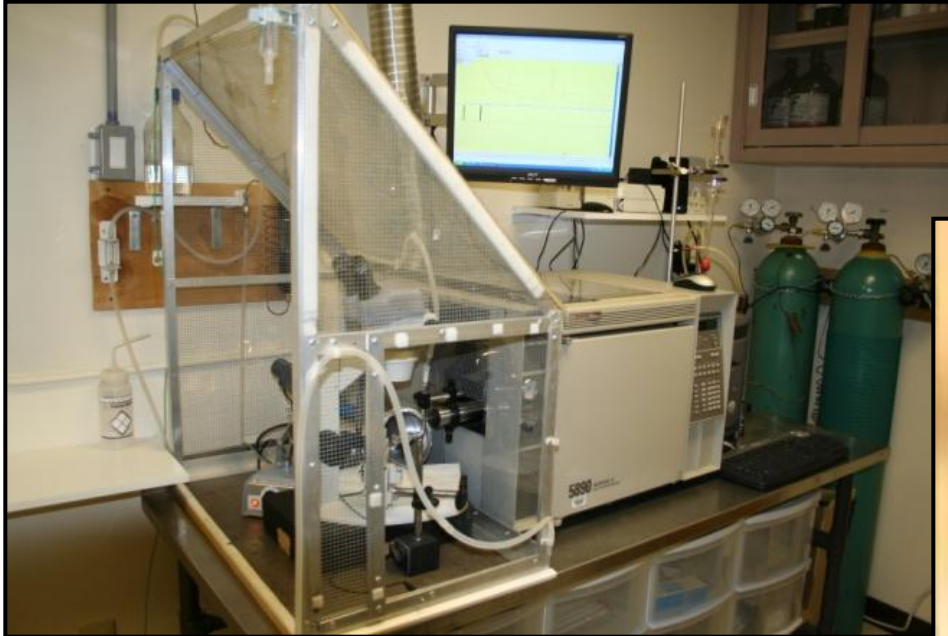
**Identify
Volatiles**



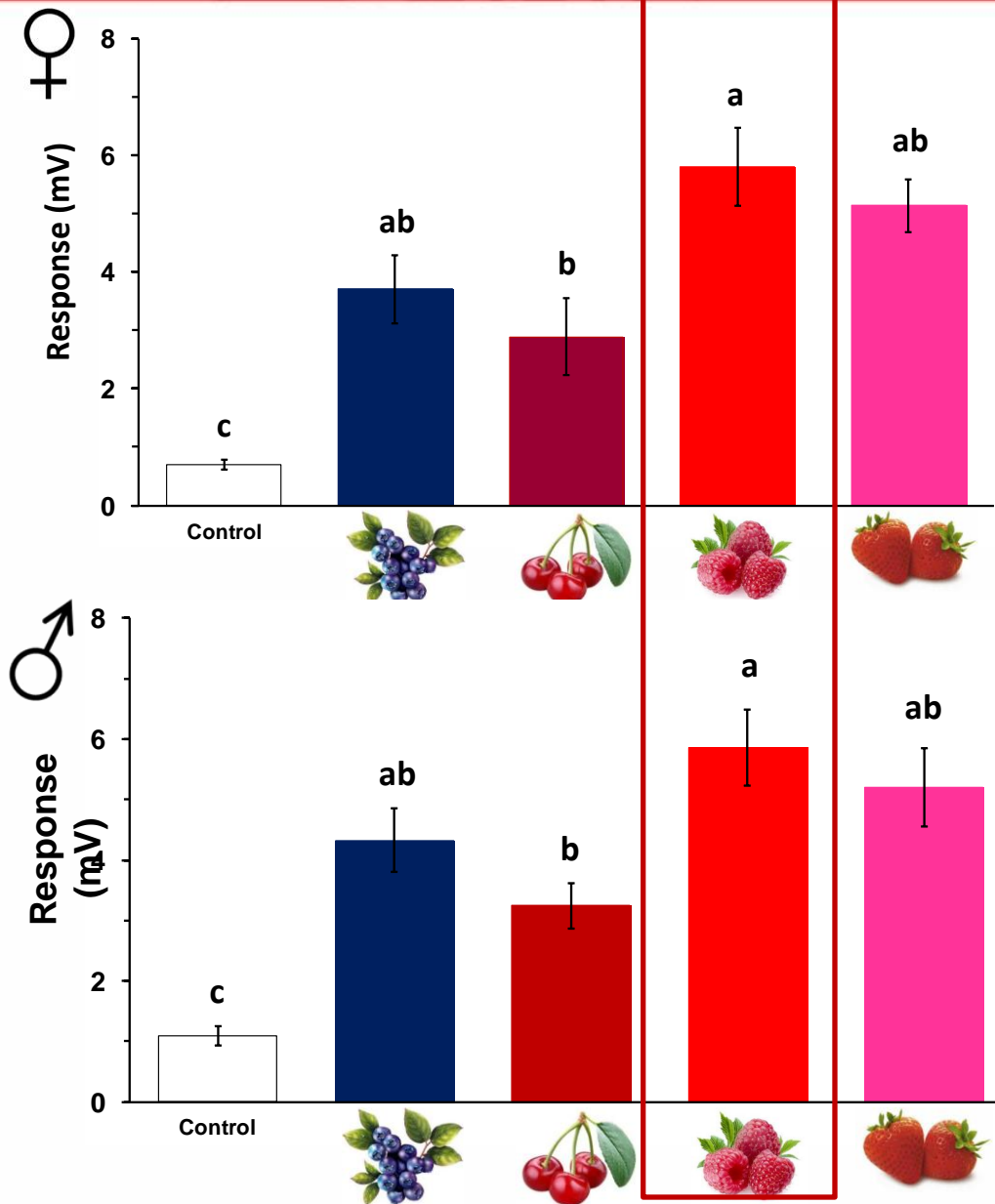
Volatile Compounds

Compounds	Blueberry	Cherry	Raspberry	Strawberry
ethyl acetate	-	-	-	+
acetic acid	-	-	-	+
hexanal	-	-	+	+
2-hexanol	+	+	+	+
<i>E</i> -2-hexenal	+	+	-	-
2-heptanol	-	-	+	-
<i>Z</i> -3-hexenyl alcohol	+	-	+	-
hexyl alcohol	-	-	+	-
2-butoxy ethanol	-	-	+	+
<i>Z</i> -3-hexenyl acetate	-	+	+	+
benzaldehyde	+	+	+	+
linalool	+	+	+	+
nonanal	+	+	+	+
decanal	+	+	-	+

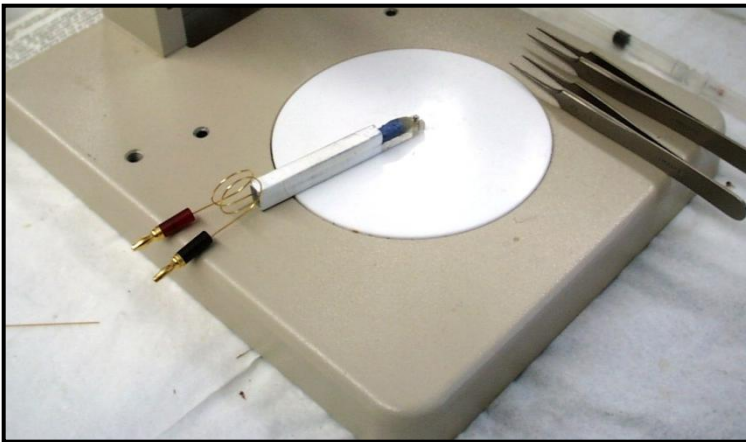
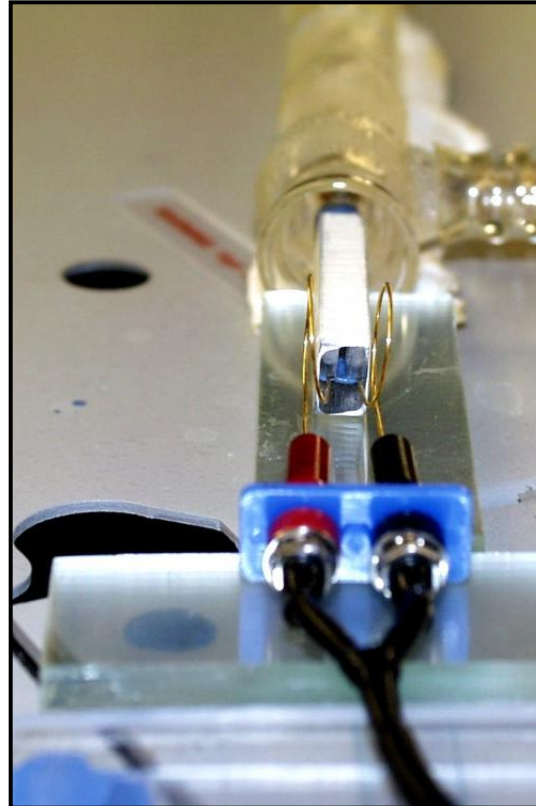
Antennal Response to Fruit Extracts



EAG Results

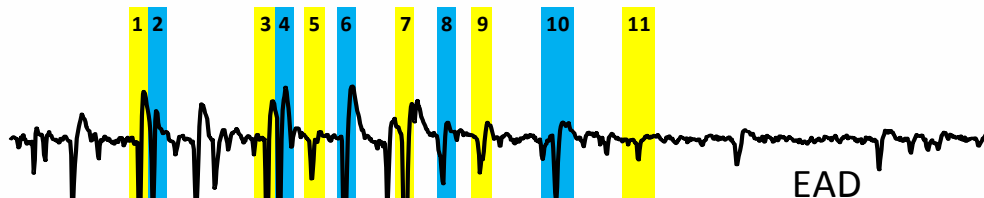


- **GC-EAD responses to fruit Volatiles**

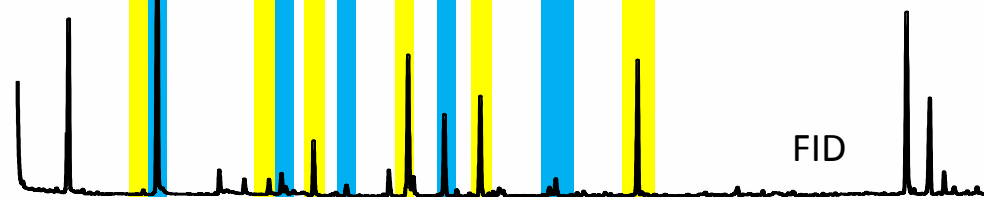




Volatile
extract of
raspberry

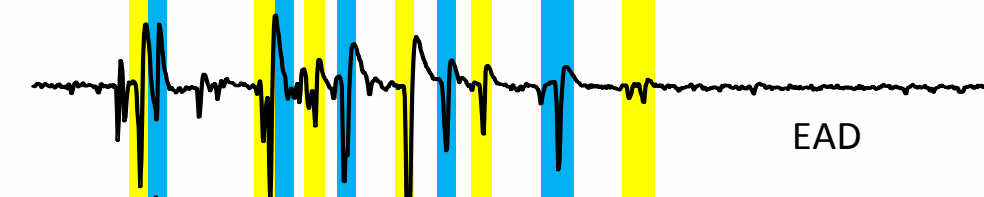


EAD

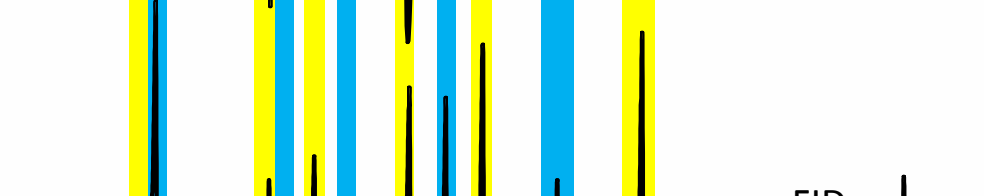


FID

Synthetic
chemical
blend



EAD



FID

6

8

10

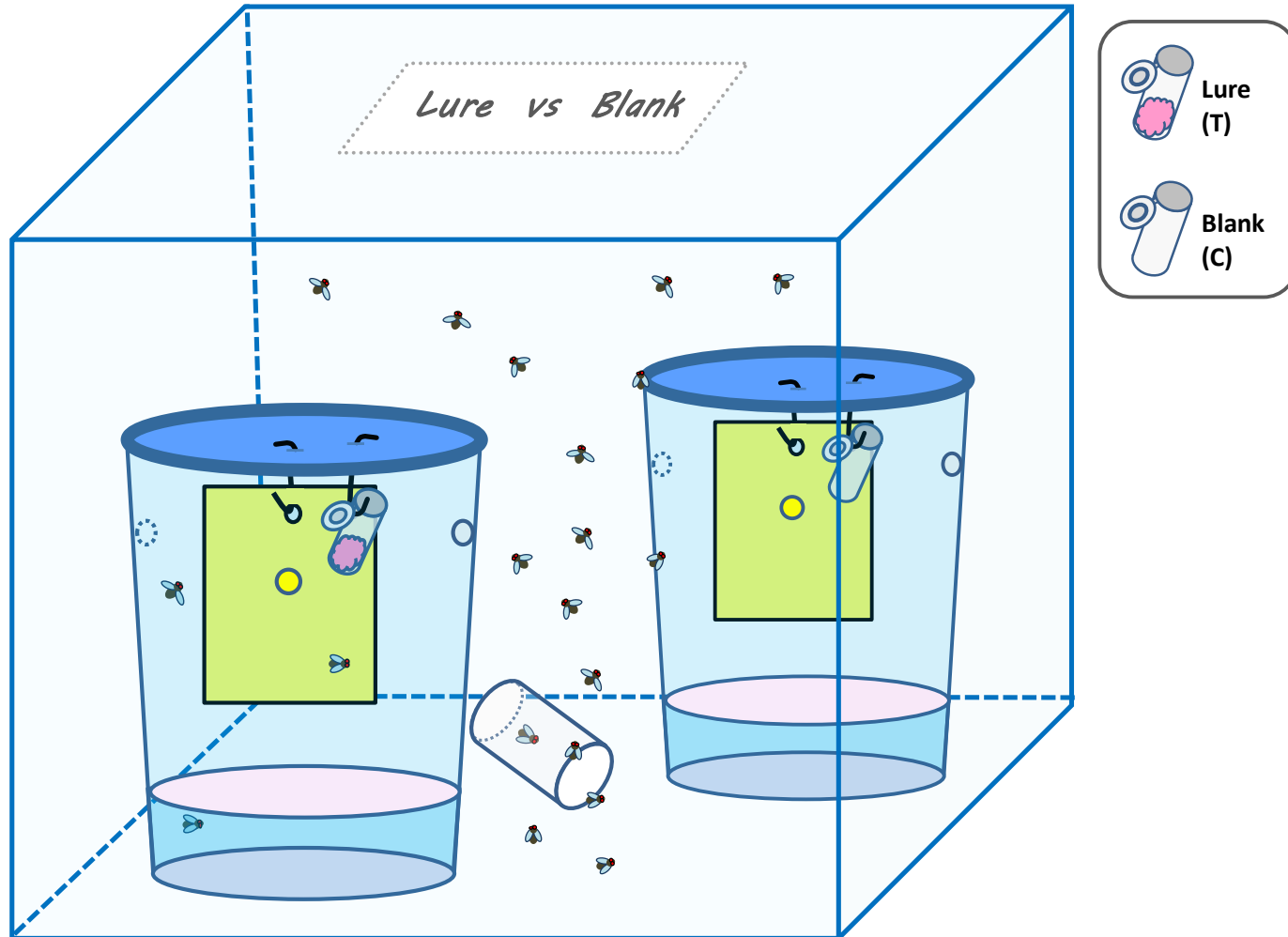
12

14

Time (min)

- 1) Butyl acetate
- 2) Hexanal
- 3) 2-heptanone
- 4) 3-methyl-1-butanol
- 5) *Trans*-2-hexenal
- 6) 3-methyl-2-butenyl acetate
- 7) 2-heptanol
- 8) Hexanol
- 9) *Cis*-3-hexenol
- 10) 6-methyl-5-hepten-2-ol
- 11) Linalool

Lab Bioassay

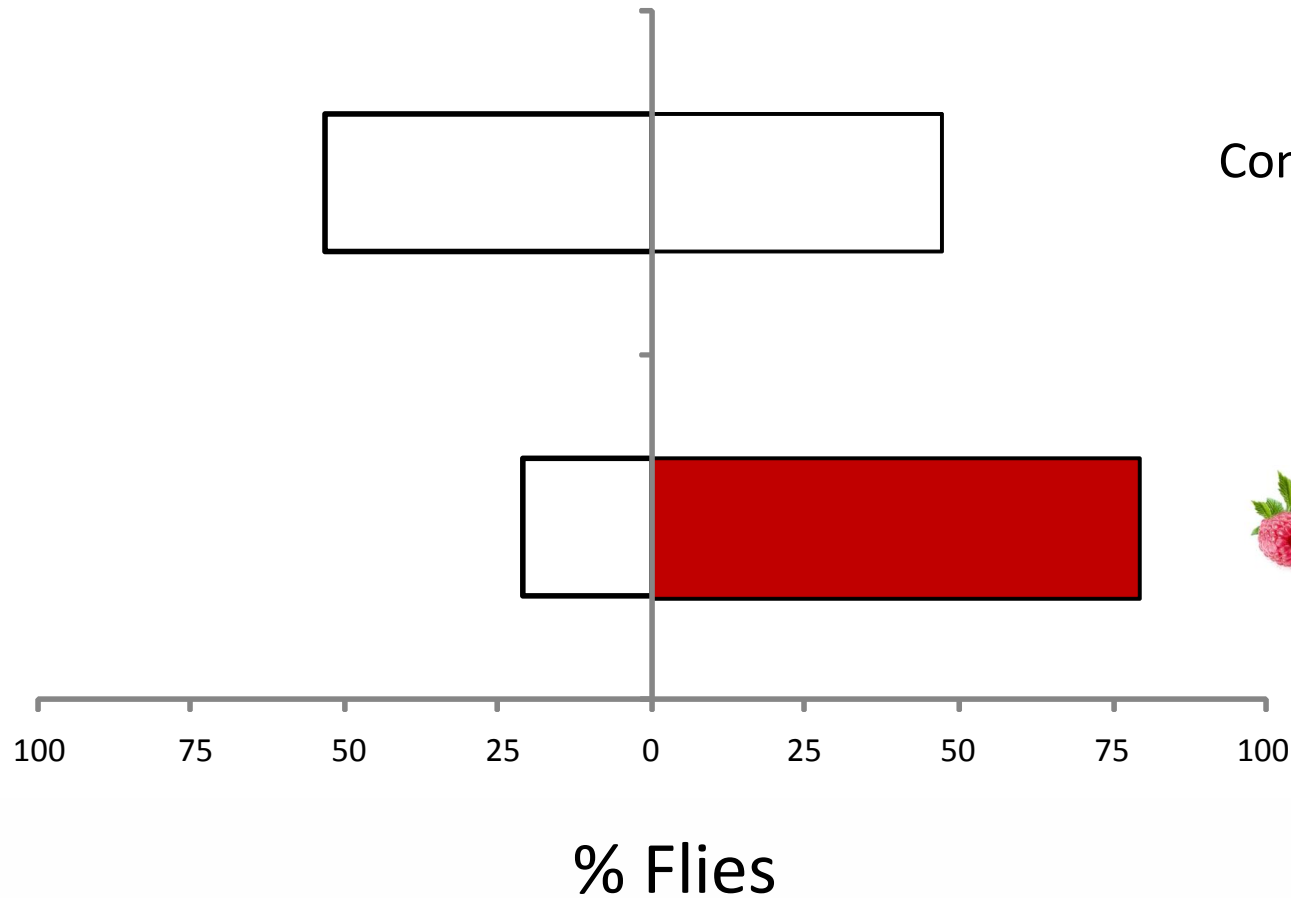


Choice Tests - Blends

Control

Treatment

G-test



Control

$P = 0.82$



$P < 0.001$

- Limited chemical control options of few classes (rotation).
- Restrictions based on Pre-Harvest Intervals (PHIs) and Maximum Residue Limits (MRLs) or tolerances.
- Need of an integrated management approach.



Semi-Field Experiment

- Insecticides applied to single bushes using an R&D backpack sprayer.
- 8 insecticides + control
With and Without Sugar
(2lbs per 100 gal).
- Residue efficacy tested:
1 & 3 days after treatment.

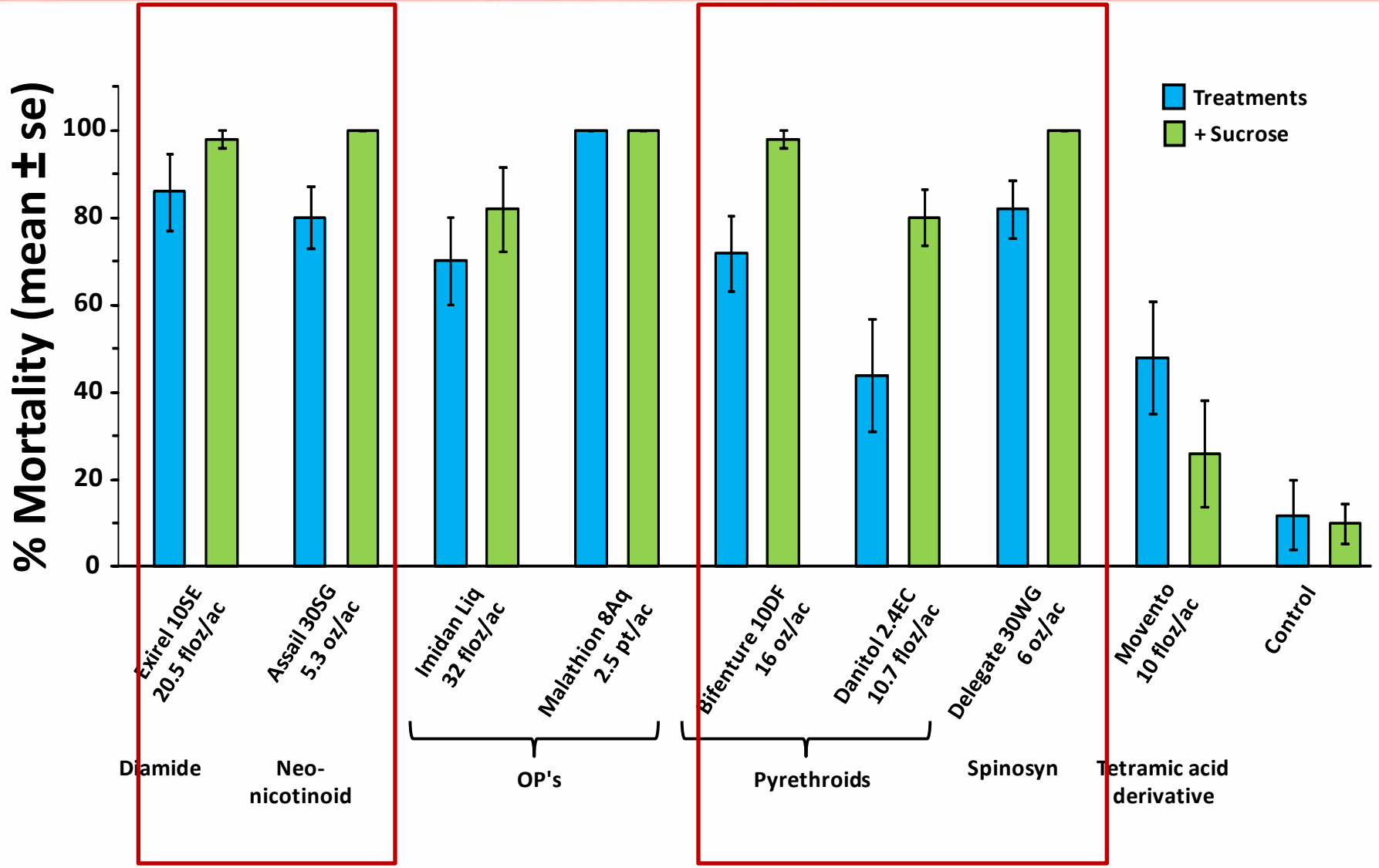


Semi-Field Experiment

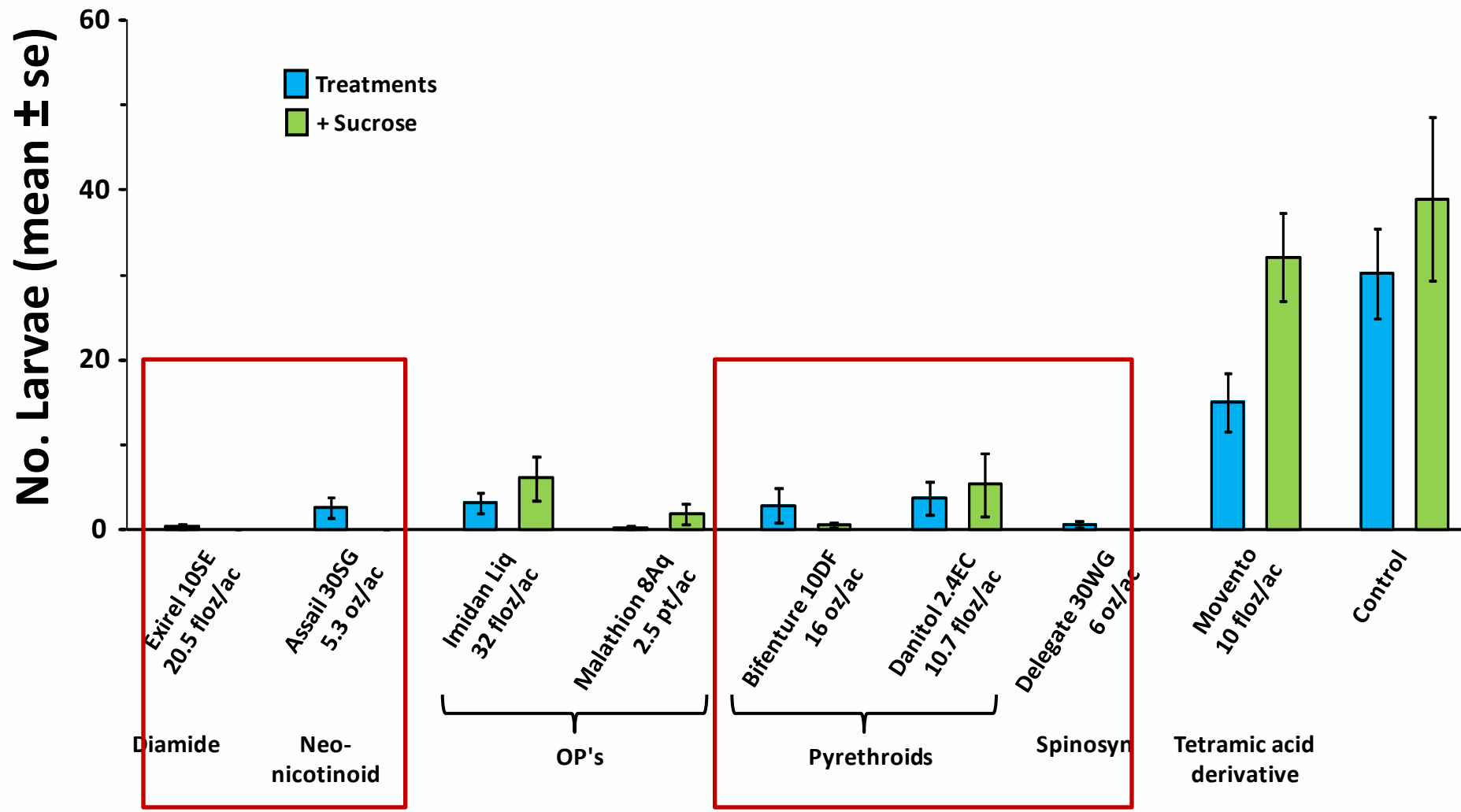
- Branch with approx 20 berries in 32oz deli container.
- Checked adult mortality at 24 & 72 hrs.
- Checked larval numbers with salt extraction method after 10 d.



Fly Mortality 1 DAT



Larvae in Fruit



Conclusions

- SWD is attracted to volatiles from fruit extracts.
- Raspberry and strawberry volatiles are very attractive and elicit strong EAG responses.
- 11 antennally-active compounds identified from raspberries that are attractive to SWD.
- Sugars (phagostimulants) increase efficacy of insecticides against SWD.
- Future Directions: Develop attract&kill approaches with attractant+phagostimulant+toxin

Acknowledgements

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- 2 technicians (Rob & Vera)
- 4 summer workers
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