



Tephritidae Fruit flies



- Olive fly is a Tephritid fruit fly
- Related to other notorious economically important pests including Mediterranean fruit fly, oriental fruit fly, melon fly, etc.
- North American species include apple maggot, western cherry fruit fly and blueberry maggot
- Walnut husk fly (California)

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Olive Fruit Fly - Life Cycle

- Several (3-5) overlapping generations per year
- Pupae of early generations pupate in olives, later generations pupate in the soil
- Overwinter as adults and pupae



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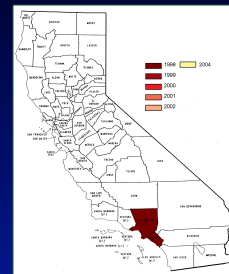
Olive Fruit Fly - Sexing Flies



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Olive fruit fly (*Bactrocera oleae* (Rossi)) in California

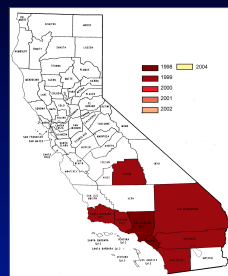
- The olive fruit was first detected in California in 1998 in the Los Angeles Basin
- Detected in all olive growing regions of the state by 2002



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Olive fruit fly (*Bactrocera oleae* (Rossi)) in California

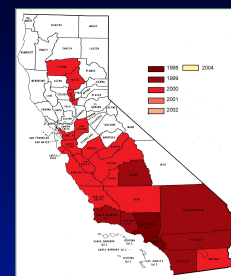
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Olive fruit fly (*Bactrocera oleae* (Rossi)) in California

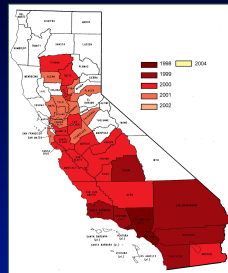
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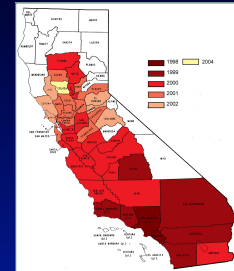
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Olive fruit fly (*Bactrocera oleae* (Rossi)) in California

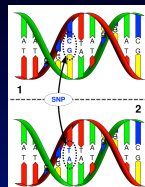
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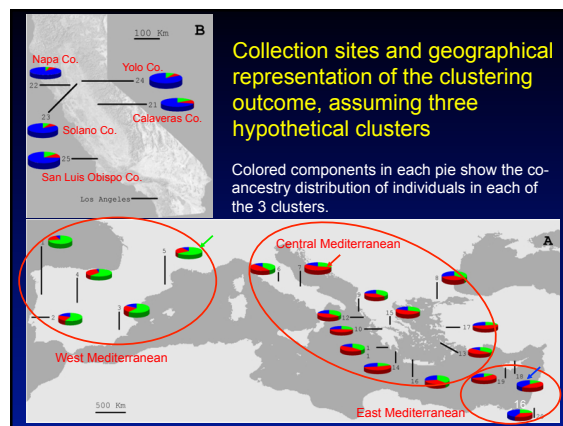
Olive Fruit Fly - Origin

Study of California and European populations using 10 microsatellite markers including genes for organophosphate resistance.



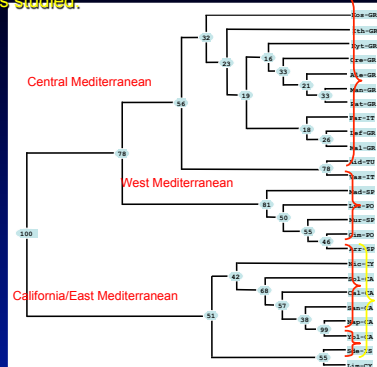
Zygouridis, N.E., A.A. Augustinos, F.G. Zalom, and K.D. Mathiopoulos. 2009. Analysis of olive fly invasion in California based on microsatellite markers. *Heredity* 102(4): 402-12.

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Dendrogram showing the relationships among the twenty-five samples studied.

TU=Turkey,
IS=Israel,
CY=Cyprus,
GR=Greece,
IT=Italy,
SP=Spain,
PO=Portugal,
CA=California



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Olive Fruit Fly – Early research

Monitoring
Insecticides
Biology (temperature limits)
Biological control (*ongoing*)
Cultural control


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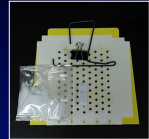
Olive Fruit Fly Management Guidelines

http://www.uckac.edu/ppq/PDF/jul2006-v16_03_.pdf


Marshall Johnson
Frank Zalom
Bob Van Steenwyk
Paul Vossen
Kent Daane
Joe Connell
Vicki Yokoyama
Barat Bisabri
Janet Caprile



Torula Yeast and Borax in Solution
IMPT, Multilure, and McPhail traps




Ammonium Bicarbonate and Spiroketal Pheromone
ChamP traps

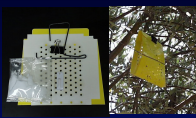


Ammonium Bicarbonate and Spiroketal Pheromone
Trece AM traps


Olive fruit fly monitoring - trap comparison




AM1 Trap, AM4 Trap



ChamP Trap



AM2 Trap



Plastic McPhail (IMPT) Trap

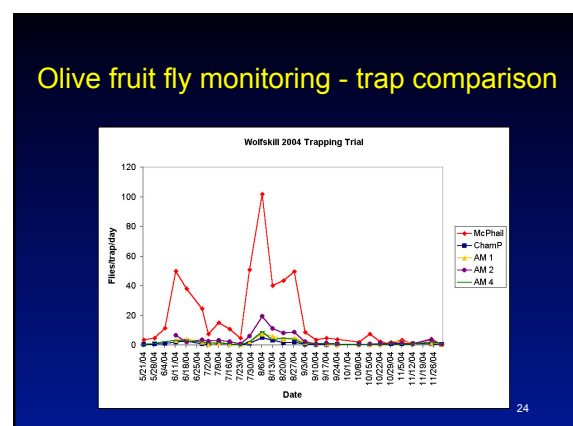
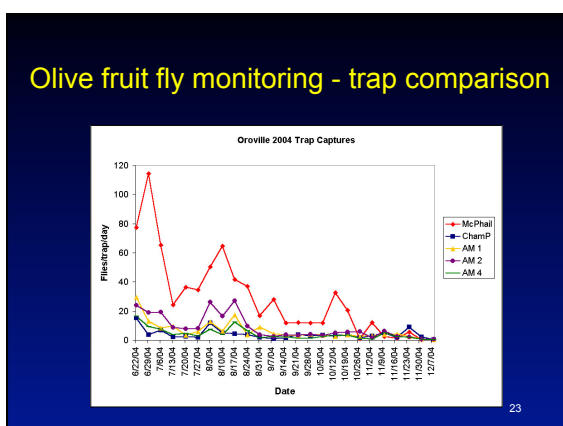
Monitoring - Plastic IMPT Trap



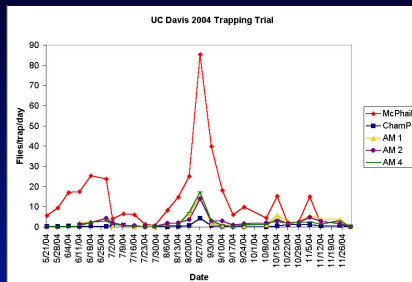
Torula yeast bait in water

Consistently greater fly captures, but messier to use





Olive fruit fly monitoring - trap comparison



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Insecticides

- GF-120 - The only insecticide registered from 2004 until 2012 was GF-120 NF Naturalyte Fruit Fly Bait from Dow Agrosciences (spinosad is its active ingredient).
- Kaolin clay - Surround WP Crop Protectant from Engelhard Corp. Fine film of clay covers plant and changes olive fly attraction or behavior towards plant host. It is not used commercially as it is applied at many pounds per acre, and requires washing fruit and disposing of the wastewater.
- Magnet OL – attract and kill
- Danitol - a pyrethroid insecticide registered in 2012 (request initiated in 2006!)

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Bait Spray Application of GF-120



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Bait Spray Application of GF-120

- Apply by ground
- Spray alternate rows - every other tree is OK
- Treat north or east sides of trees
- 10-20 oz./acre, 14 oz is recommended
- Spray into upper 1/2 of tree
- Dilutions from 1:1.5 to 1:4 parts GF-120 to water
- Recommend large (4 - 5 mm) droplet size

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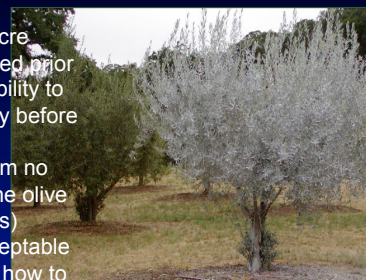
Bait Spray Application of GF-120

- On table olives (olives tend to be large), timing of first spray is about June 1 or two weeks before olive pit hardening
- Applied no more than once every 7 days, and efficacy is about 14 days (maybe 21 days when it is not hot and dry)
- Smaller oil olives may not become susceptible as early in the season as table olives

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Surround Barrier Spray

- Kaolin clay
- 12.5 to 50 lbs/acre
- Should be applied prior to fruit susceptibility to olive fly, typically before the end of June
- Repeat when film no longer covers the olive fruit (5 - 6 weeks)
- Organically acceptable
- Works well, but how to clean fruit...



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Attract and Kill Traps

- Magnet OL
- Marketed by Suterra LLC
- Adult olive flies are attracted by food and sex lures, and die after contacting insecticide impregnated trap surface
- Active ingredient is lambda cyhalothrin (a synthetic pyrethroid insecticide)



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Attract and Kill Traps

OLIFE Trap

- 1- to 2-liter plastic bottle
- 5 mm size holes melted into the shoulder
- Baited with torula yeast tablets dissolved in water
- Hang traps in the shade on the south side of tree



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Danitol - fenpropathrin

- First registered in 2012
- 10.67 to 16 fl. oz./acre
- Minimum dilution = 100 gpa
- A pyrethroid insecticide
- Best used for quick knockdown of high populations and in late summer/fall when populations start to increase rapidly
- Use with a fruit fly attractant?? Check label...
- Very disruptive of natural enemies and will likely result in secondary pest outbreaks (e.g. scales and mites)

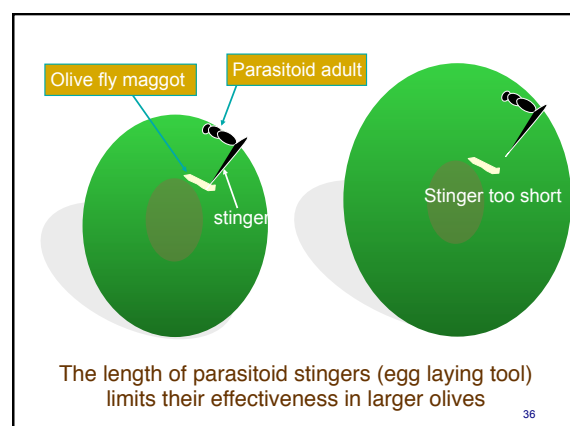
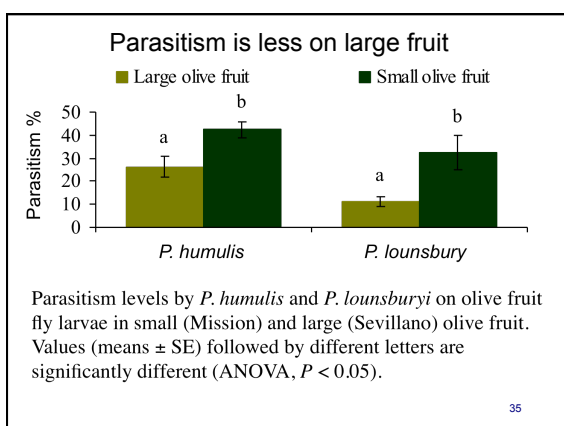
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Biological Control

Exotic agents undergoing colonization



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Olive Fruit Fly - Olive Cultivars

Preference and larval performance - Wolfskill



Hannah Burrack, currently Associate Professor of Entomology, North Carolina State University

Burrack, H. J. and F.G. Zalom. 2008. Olive fruit fly (Diptera: Tephritidae) ovipositional preference and larval performance in several commercially important olive varieties in California. J. Econ. Entomol. 101(3): 750-758.

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Olive Fruit Fly - Olive Cultivars

Preference and larval performance - Wolfskill

USDA-NCGR - 7 varieties

Koroneiki
Arbequina
Frantoio
Leccino
Manzanillo
Mission
Sevillano



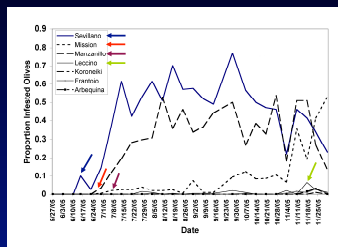
1 month



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Olive Fruit Fly - Olive Cultivars

Natural field infestations



Proportion of olives with stings at USDA-NCGR throughout the 2005 field season.

Conclusion: infestation related to fruit size, ~ 1.4 mm

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Olive Fruit Fly - Olive Cultivars

Laboratory infestations for performance - measurements

- Proportion of eggs developing to pupae (survival)
- Pupal mass (related to adult fitness)
- Developmental time

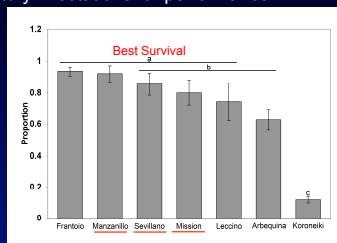
2005 - Four replicates of 25 olives of each of the varieties were infested by 100 gravid female *B. oleae* over the course of 1 week

2006 - Four replicates of 50 olives of each of the varieties were infested by 100 gravid female *B. oleae* over the course of 1 week

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Olive Fruit Fly - Olive Cultivars

Laboratory infestations for performance

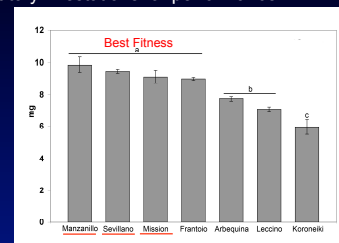


Proportion of eggs developing to pupae in laboratory performance assay, 2006.

41

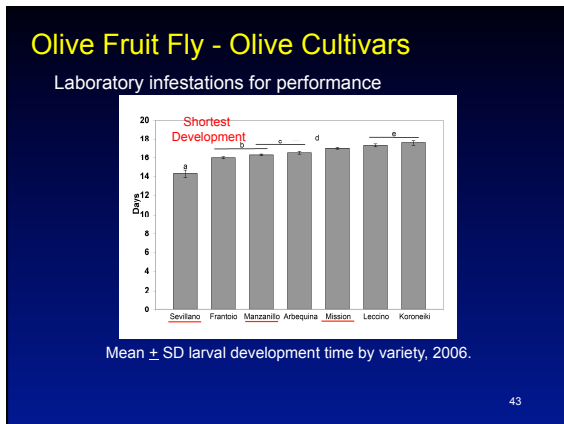
Olive Fruit Fly - Olive Cultivars

Laboratory infestations for performance



Mean \pm SD pupal mass by variety, 2006.

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Olive Fruit Fly - Spinosad resistance

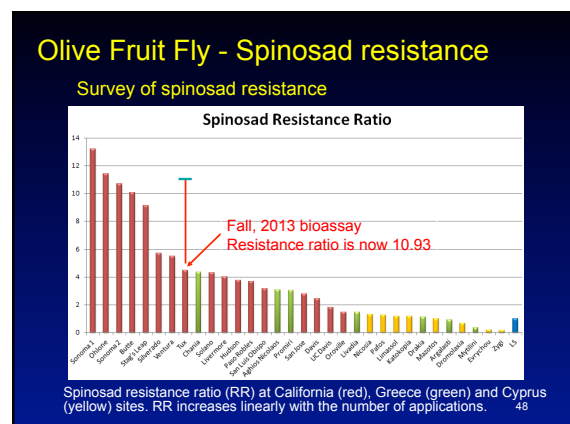
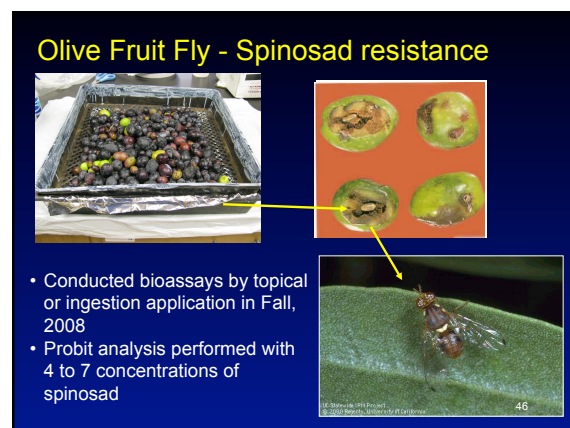
Topical Bioassay - 2007
Ingestion bioassay - 2008

Comparison of flies reared from field infested olives from sites in Greece, Cyprus and California to a susceptible control = Demokritos laboratory strain (has not been exposed to insecticides for 40 years)

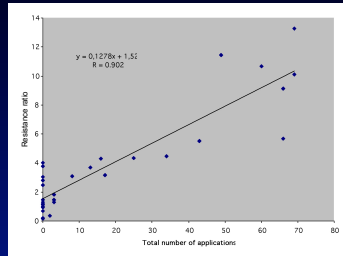
* Probit analysis with 4 to 7 doses.

Kakani, E.G., N.E. Zygouridis, K.T. Tsoumani, N. Seraphides, F.G. Zaloni and K.D. Mathiopoulos. 2010. Spinosad resistance development in wild olive fly populations in California. Pest Management Science. 66(4): 447-453.

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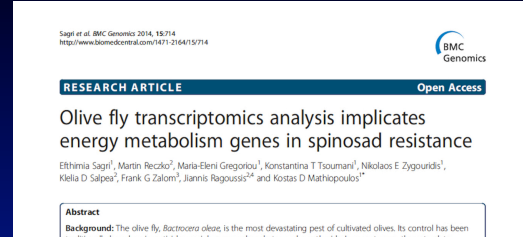
Olive Fruit Fly - Spinosad resistance



Correlation between number of spinosad applications (total number of bait sprays in each orchard) and resistance development (resistance ratio)

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Olive Fruit Fly - Spinosad resistance



Genomics study included flies from Sonoma County, CA

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Olive Fruit Fly Management - Yeast

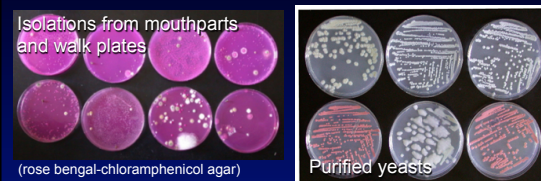
Studies of *Drosophila*/yeast ecology has shown that flies are significantly more attracted to yeasts of familiar species.

If this is true for Tephritids also, then yeasts associated with flies or infested olives may be superior baits.

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Olive Fruit Fly Management - Yeast

Collaboration with Kyria Boundy-Mills, UC Davis



We have isolated and identified over 300 yeasts belonging to 40 different species from olive flies and infested olives, demonstrating that yeasts are abundant in larvae and adults

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Olive Fruit Fly Management - Yeast

Choice test methods

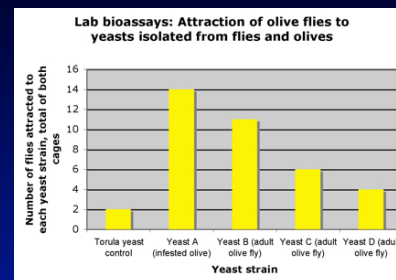
8 mL of 4- to 5-day yeast cultures were placed in a cup, covered with a mesh cone with a 1-cm hole in the center.



Five experimental yeast cultures and one control yeast culture (torula yeast *Candida utilis* strain 75-33) were randomly placed in two population cages, each containing 40 male and 40 female olive flies; counted hourly for 7 hours.

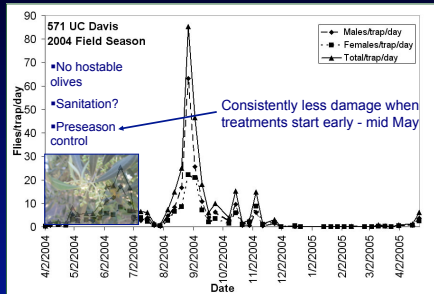
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Over 130 yeast species were tested in choice tests for attraction of olive flies. Of these, 15 yeast strains appeared to attract flies as well or better than torula yeast.



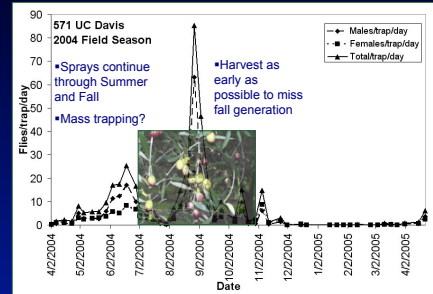
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Olive Fly Seasonal Cycle and Control?



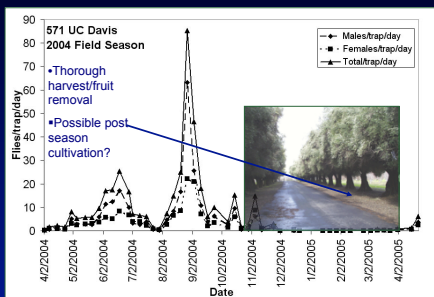
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Olive Fly Seasonal Cycle and Control?



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Olive Fly Seasonal Cycle and Control?



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COOC Webinar – Olive Fruit Fly
Davis, CA, August 19, 2015



Overview of the Olive Fruit Fly Species and Related Research

Frank Zalom
Dept. of Entomology and Nematology
University of California
Davis, CA 95616



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Questions?



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Olive Fruit Fly A Local Perspective

Jim Allan
Solano County
Agricultural Commissioner

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Changes since 2013 season

- Regional Meeting on 2/28/14
- Better Awareness of Pest
- Better use of tools available
- Coordination by processors
- Improved Orchard Sanitation
- New Pests may be on Horizon

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Post Regional Meeting Developments

- Network enlarged for growers, processors and industry groups
- Pest Control Advisors understand issues
- Research Priorities
 - BioControl
 - Use of existing Tools
- New Tools Available

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Pest Awareness

- Improved Monitoring
 - Earlier Trapping
 - Better Treatment Timing
- Management of Pest Reservoirs

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Available Tools

- Spinosad (GF 120)
- Barriers (Surround)
- Conventional (Danitol)
- Trap and Kill (Magnet OL Suterra)

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New Threats

- *Xylella fastidiosa* – Killing trees in Italy
 - Same Organism as Pierce's Disease, Almond Leaf Scorch, Oleander Leaf Scotch
 - Apparently different Biovar
 - Vectored by leafhoppers
 - Native sharpshooters Phloem Feeders
 - GWSS Xylem Feeder

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New Threats Continued

- Other Fruit Flies
 - Worst Year ever for Tephritidae
 - Queensland Fruit Fly
 - Olives are host
 - Previously eradicated in CA
 - Not detected this year

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Personal Observations

- Olive Growers could often better manage Vertebrate Pests
 - Meadow Voles, *Microtus* spp
 - Pocket Gophers *Thomomys* spp

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Rodent Damage

- Meadow Voles
 - Shallow runways
 - Girdle trees
- Gophers
 - Subterranean
 - Feed on roots
 - Reduce tree vigor
 - Damage irrigation

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Questions?



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Panel Discussion



Thom Curry
Temecula Olive Oil



Albert Katz
Katz Farm



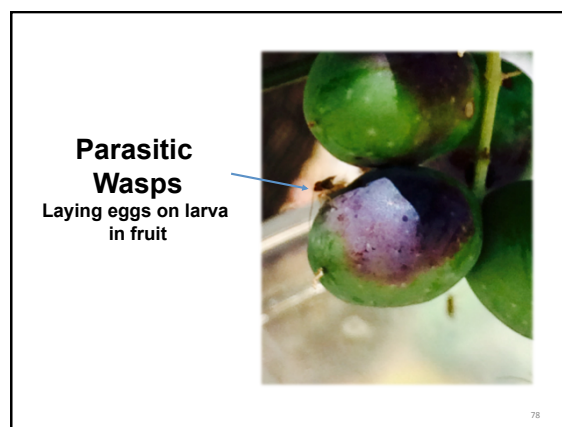
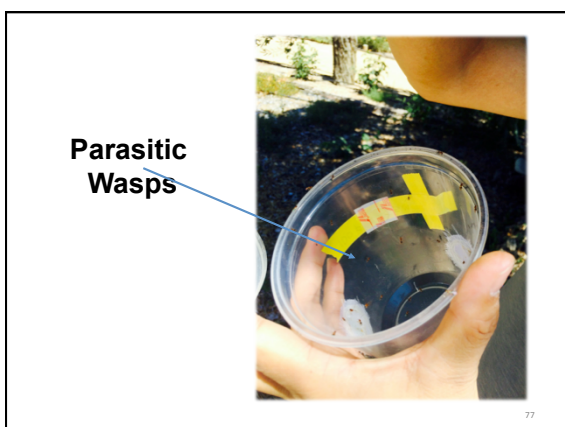
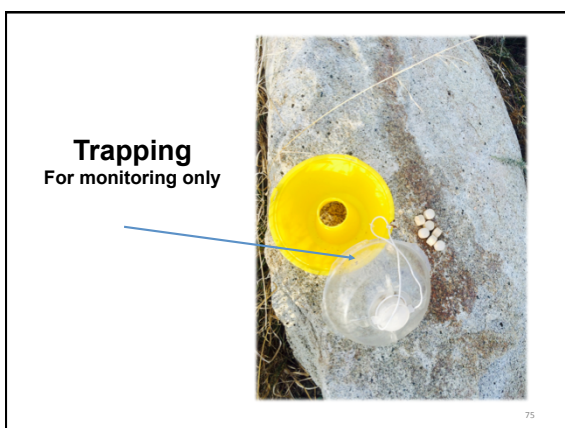
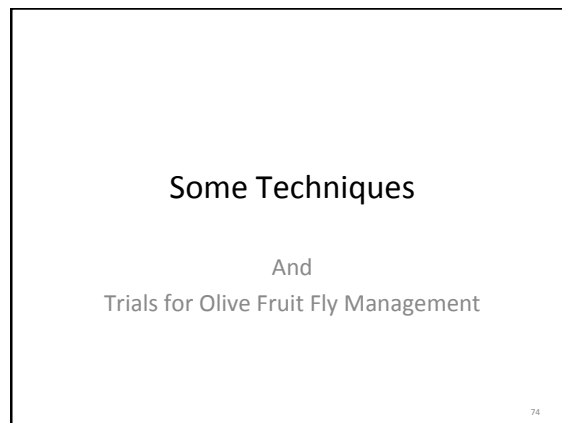
Brian Mori
California Olive Ranch



Richard Wolf
Winterhill Farms



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Continue to use known methods

- *Surround
- *Attract and kill traps
- *GF - 120

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Albert Katz
KATZ Farm
Suisun Valley



80

Brian Mori
California Olive Ranch
Sacramento Valley



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Richard Wolf
Winterhill Farms
Sacramento Valley



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Questions?



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Thank You

The California Olive Oil Council is delighted to be your resource for olive oil education.





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