Olive Fly Management

Olive Production for Oil
UC Davis Short Course
Lodi 2008

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Olive Fly
*Bactrocera oleae* (Gmelin)

Contributing to olive fly research efforts in California are:

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- Susan Opp, CSU Hayward
- Russell Messing, U of Hawaii
- Alan Kirk, USDA - ARS
- Charlie Pickett, CDFA
- Frank Zalom, UCD
- Hannah Burrack, UCD
- Louise Ferguson, UCD
- Judy Stewart-Leslie, PMA
- Tim Ksander, Ag Advisors
- Hannah Nadel, UCR
- Kris Lynn-Patterson, UC KAC
- Mary Bianchi, UCCE
- Paul Vossen, UCCE
- Joe Connell, UCCE
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- Vickie Yokoyama, USDA ARS
- Joe Zermeno, CSU Hayward
- Melanie Durbin, CSU Hayward
Adult female

Egg laying punctures

Photo: R. Copeland
Olive fly biology

- Olive fly egg
- 1st instar
- 3rd instar
- Feeding tunnels
- Adult fly emerging from fruit
- Emergence hole
- Puparia
Schematic of fly movements
Presentation Topics

• Timing and application of GF-120
• Current management alternatives
• Impact of summer heat on fly numbers
• The need to control black scale
• Biological control efforts underway
Application of Bait Spray

GF-120 NF Naturalyte Fruit Fly Bait Approved for organic use
Application of Bait Spray

- Aerial applications not recommended
- Use alternate row coverage
- Treat north or east sides of trees

- Direct spray into upper half of tree
- For low OLF numbers use dilutions from 1:1.5 to 1:4 parts GF-120 to water
- 4 - 5 mm droplets are best
GF-120 Residue Longevity Studies

Tags indicating field exposure periods

Bait droplets on leaf

Flies were exposed to aged residues for 4 hours & then held 72 hours to record mortality

Lab test units
Percent Mortality 72 hrs After Treatment vs Days Exposure of GF-120 Residue.

- 4 Water : 1 GF-120
- 1.5 Water : 1 GF-120

Legend:
- Red: 4 Water : 1 GF-120
- Green: 1.5 Water : 1 GF-120

Data points:
- 21 Aug – 11 Sept 2004
- 047 1 4 2 1
- 010
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100
- 110

Significance:
- a
- b
Days Exposure of GF-120 Residue

Percent Mortality 72 hrs After Treatment

12 Oct – 1 Nov 2004

4 Water : 1 GF-120
1.5 Water : 1 GF-120
What about high numbers of Olive Fly?

- No registered insecticide gives quick knock-down against high numbers of olive fly adults.
- Use of the “recommended” rates of GF-120 under conditions with high olive fly numbers results in depletion of the GF-120 residues before all the flies are killed.
- To knock down high olive fly populations, use a dilution of 1 part GF-120 to 9 parts water and apply the recommended rate (14 fluid oz) per acre (R. Van Steenwyk). Even though less active ingredient is present in the droplet residues, it is enough to kill olive fly adults that feed on it.
- Once the olive fly population is knocked down (after 1 to 2 treatments), then drop the application rate back to the lower rates (1:1.5; 1:4).
- Presently, the product Danitol® (fenpropathrin) in combination with a fruit fly attractant (Nulure) has been submitted to the IR-4 program for registration for olive fly control. However, registration is probably a few years away.
Timing and Use of Bait Sprays
As recommended by the Olive Advisory Group / 2006

- Control of olive fly is essential because of the possible reductions in fruit yield possible due to olive fly infestation
- When fruit will be pressed for oil, the damage levels can be greater than in table olives, but best to keep fruit infestations below 10%
- A safe guideline is to initiate treatments near June 1 or two weeks before olive pit hardening
- If spring conditions are warm, a couple of earley sprays may be warranted in March or April to knock down the population. If populations are high, use a dilution ratio of 1 part GF-120 to 9 parts water to bring high populations down.
- GF-120 is the only sprayable bait legally available for use
- It cannot be applied more than once every 7 days
- Use rates vary from 10 oz. to 20 oz. active ingredient per acre
- 14 oz. a.i. per acre is currently being recommended
Presentation Topics

- Timing and application of GF-120
- Current management alternatives
- Impact of summer heat on fly numbers
- The need to control black scale
- Biological control efforts underway
Management Alternatives

- **Mass Trapping / Attract & Kill Traps.** No commercially available product is available. A homemade trap (OLIPE) may be employed, but is not recommended for large plantings and sites with high olive fly populations.

- **Post-harvest Sanitation.** Remove remaining fruit on trees from last harvest and destroy them on the ground by mulching or disking. Fruit must be buried at least 4 inches deep. Remove fruit from trees at least ½ mile from the orchard. High densities of olive fly in nearby orchards will overcome the benefits of post-harvest sanitation.

- **Soil Cultivation.** Many olive flies overwinter as pupae in the soil. Cultivation before the main spring and late summer flights can reduce fruit fly stings. Must disk 4 inches deep to have maximum effect.

- **Kaolin clay.** Protective barrier film (Surround WP®) made of highly refined Kaolin clay. Changes insects preference to lay eggs. More work is needed for practical application of method.
OLIPE
Olive Fruit Fly Trap from Spain

1.5 to 2.0 liter plastic bottle. Fill \( \frac{2}{3} \) full with a 3-5\% (30-50 grams per liter) solution of di-ammonium phosphate or ammonium bicarbonate and water. Sometimes vinegar and protein hydrolysate bait is also added.

If stings exceed 3\% - one mg of microencapsulated liquid spiroketal pheromone is added.

Hang in the inside of the south side of the tree in the shade.

Three to six 4-5mm (\( \frac{3}{16} \) – \( \frac{1}{4} \) inch) holes drilled or melted into neck.

June – Sept.  
8-10 traps/acre

Sept. – Dec.  
16-20 traps/acre

From Varela & Vossen 2002
Presentation Topics

• Timing and application of GF-120

• Current management alternatives

• Impact of summer heat on fly numbers

• The need to control black scale

• Biological control efforts underway
Some factors that potentially influence the impact of summer temperatures on olive fly

- Intensity of daily maximum temperature*
- Duration of daily highs (e.g., > 100°F for 4 days)*
- Relative humidity*
- Olive fly’s access to water (availability of irrigation sources, morning dew, ponds, creeks, etc.)
- Olive fly’s access to a carbohydrate source (e.g., honeydew)
- Olive fly’s ability to seek refuge from the heat by dispersal
- Stage of insect (egg, larva, adult)

* Highly dependent on location in state
Average Adult Olive Fly Trap Counts in Tulare & Fresno Counties

Survey Date 2003

Mean No. Total Flies / Trap / Week

- Treated Commercial Orchards
- Untreated Urban Sites

No olive fruit
Olive fruit present
Average Adult Olive Fly Trap Counts in Tulare & Fresno Counties

Mean No. Total Flies / Trap / Week

Survey Date 2003

- No olive fruit
- Low trap catches due to heat
- Temperature drops, OLF increases

Treated Commercial Orchards
Untreated Urban Sites

Survey Date 2003

10 April 17 April 24 April 1 May 8 May 15 May 22 May 29 May 5 June 12 June 19 June 26 June 3 July 10 July 17 July 24 July 31 August 7 August 14 August 21 August 28 September 4 September 11 September 18 September 25 October 2 October 9 October 16 October 23 October 30 November 6 November 13 November 20 November 27
Why do we see a drop in trap catches?

• The flies appear to alter their behavior patterns so that they are only active during cooler periods (i.e., early morning), thus less chance to be trapped.

• Extreme heat (greater than 95°F) can kill: 1) adult flies that cannot obtain enough water and sugar sources; and 2) eggs and 1st instars within the fruit. However, death may require 3 to 5 consecutive days of high temperatures.

• Flies with plenty of water and food can survive the entire summer (at least under field test conditions).

• The flies may leave the olive grove to seek out cooler, more humid places to sit out the extreme heat (e.g., citrus trees, low vegetation, etc.).
Days Exposure to Various Temperature Regimes

Percentage Survival of OLF Females

- W + H 95°F
- W + H 100°F
- W + H 105°F
- W 95°F
- W 100°F
- W 105°F
- N 95°F
- N 100°F
- N 105°F
Tree Cage
San Joaquin Valley: Parlier, CA

Days Exposure in Field in 20-25 Sept 2005

Days Exposure in Field in 9-14 Sept 2005

Days Exposure in Field in 15-20 Aug 2005

Days Exposure in Field in 28 Sept - 3 Oct 2005

Percentage Survival of OLF Females

Temperature in °F:

- Olive / W+H
- Olive / W
- Olive / Nothing

83       82        82      84        84   ºF
92        97        93      92       94 ºF
87        91        92      80       84  ºF
95        95        93  82       76   ºF
87        91        92  80       84  ºF
Survival of Caged Adult Female Olive Flies in Parlier, San Joaquin Valley, California

When water and honey were provided, olive fly adults survived over 8 months (Feb to Oct) in field cages.
When water and honey were provided, olive fly adults survived over 8 months (Feb to Oct) in field cages.
What is the impact of high temperatures on olive fly eggs and first instars?
Mortality of OLF stages after 0 to 5 Days Exposure to 100ºF

Duration of Exposure within Olive

Proportion Dead

- Egg
- 1st Instar
Flies were tested using a flight mill to see if high temperatures impacted their ability to fly. Flies were tested at 2 temperature regimes (75°F and 75/100°F) and given different diets.
Effects of Temperature on Olive Fly Flight Abilities

Olive fly adults must seek out water and food to survive.

- Flies that are well fed and watered can fly on average 6,502 feet in 1.54 hours.
- Flies that received both food and water and were then exposed to 100°F for 3 days could only fly 1,486 feet in 0.38 hours.
- Flies that only received food (and no water) and were then exposed to 100°F for 3 days could only fly 662 meters in 0.18 hours.
- Flies that received no food or water upon emergence from the pupae and exposed to 100°F for 3 days could only fly 49 feet in 0.014 hours.
Other Factors to Consider

• Based on historical temperature data from the Central Valley, the frequency at which 3 to 5-day periods of 100 to 105°F occur vary dramatically between the olive production areas of the San Joaquin Valley versus the Sacramento Valley.

• The San Joaquin Valley has longer and more frequent periods of high temperatures than the Sacramento Valley.

• Irrigation methods vary between the regions with the San Joaquin Valley having dryer orchards with little ground cover within orchards to provide moisture, shade, and high humidity for OLF adults.

• Black scale, *Saissetia oleae*, is common throughout the Central Valley and produces honeydew that flies may potentially use as a carbohydrate source.
Average Adult Olive Fly Trap Counts in Tulare & Fresno Counties

Must protect crop from this increase in olive fly

No olive fruit

Survey Date 2003
Number of Years with Maximum Temperatures Greater Than or Equal to 100 deg F
For Three Consecutive Days

- Ending on July 15

*The olive orchard locations were obtained from county landuse data obtained from the State of California Department of Water Resources for the period 1993 to 2003 inclusive.

Temperature data were from 1992 to 2001, inclusive.

Number of Years with Maximum Temperatures Greater Than or Equal to 100 deg F
For Three Consecutive Days

- Ending on August 15

*The olive orchard locations were obtained from county landuse data obtained from the State of California Department of Water Resources for the period 1988 to 2003 inclusive.

Temperature data were from 1992 to 2001, inclusive.
Number of Years with Maximum Temperatures Greater Than or Equal to 100 deg F
For Three Consecutive Days
Ending on August 15

* The olive orchard locations were obtained from county landuse data obtained from the State of California Department of Water Resources for the period 1990 to 2003 inclusive.

Temperature data were from 1982 to 2001, inclusive.

Number of Years with Maximum Temperatures Greater Than or Equal to 100 deg F
For Three Consecutive Days
Ending on September 15

* The olive orchard locations were obtained from county landuse data obtained from the State of California Department of Water Resources for the period 1993 to 2003 inclusive.

Temperature data were from 1982 to 2001, inclusive.
University of California Kearney Agricultural Center
Geographic Information Systems Facility

Go to webpage at:
http://gis.uckland.edu/
Number of Years with Maximum Temperature Greater Than or Equal to 100°F for Three Consecutive Days

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Number of Years with Maximum Temperature Greater Than or Equal to 100°F for Three Consecutive Days
Number of Years with Maximum Temperature Greater Than or Equal to 100°F for Three Consecutive Days
CIMIS Station
Click here for maximum temperatures for last 5 days
Number of Years with Maximum Temperature Greater Than or Equal to 100°F for Three Consecutive Days

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Percentage Survival of OLF Females

Days Exposure to Various Temperature Regimes
Average Adult Olive Fly Trap Counts in Tulare & Fresno Counties

Mean No. Total Flies / Trap / Week

Survey Date 2003

Treated Commercial Orchards
Untreated Urban Sites

Must protect crop from this increase in olive fly

No olive fruit
Aerial traps attract adult flies with the help of food & sex lures
Placement in Trees

- Place on north side of tree in spring / summer
- Place on south side of tree in fall / winter
- Place in upper one third of tree
- Allow clear space around trap
- At least one trap per 5 - 10 acres of olives
- At least 2 traps per olive block; use more if possible
- Traps should be placed in trees no later than March 1

Remember:
No fruit; no flies on trap!!
Simple Yellow Panel Trap

- Easy to assemble
- Commercially available

Ammonium bicarbonate packets

Male Sex Lure Dispensers

Suppliers:
- Trece
- Suterra

Ammonium carbonate is recommended
McPhail Trap

Torula Yeast & Borax
Presentation Topics

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- The need to control black scale
- Biological control efforts underway
Black scale, *Saissetia oleae*

- Black scale is common throughout the Central Valley and produces honeydew that flies may potentially use as a carbohydrate source.
- Does honeydew consumption enable flies to survive periods of extreme heat?
Provision of water with honey or honeydew enables olive fly adults to survive short periods of high temperatures.
Presentation Topics

- Timing and application of GF-120
- Current management alternatives
- Impact of summer heat on fly numbers
- The need to control black scale
- Biological control efforts underway
Potential for control using biocontrol agents

Working in Quarantine

Non-target effects?

Beneficial on Star Thistle
Biocontrol Agents Under Consideration for Release

- *Utetes africanus* (Africa)
- *Bracon celer* (Africa)
- *Psyttalia concolor* (Southern Africa)
- *Psyttalia lounsburyi* (Southern Africa)
- *Fopius arisanus* (SE Asia)

KM Daane

MW Johnson
Summary

- GF-120 is the only insecticide that is registered to control olive fruit fly adults
- Depending on the size of the olive fly population, the ratios of GF-120 and water should be varied to obtain the best control
- An understanding of the impact of extreme summer temperatures is necessary to avoid unnecessary losses due to olive fly infestations
- A website at the UC Kearney Agricultural Center is available to help estimate the possible influences of summer heat on olive fly survival
- Control of black scale may reduce survival of olive fly adults due to removal of a potential food source
- Biological control is poor at this time, but new exotic natural enemies are being released to improve levels of biological control
Questions?