

Olive Fruit Fly

Paul Vossen, Lucia G. Varela, and Alexandra Devarenne

Olive fruit fly (*Bactrocera oleae*) is believed to have originated in the Mediterranean region where there are records of infestations in fruit from the third century BC. It is also found in eastern and southern Africa where wild native olive trees are found and where there are more natural enemies. It was found for the first time in the US in October

1998 in Los Angeles, California. Since then it has spread to the rest of southern California in 1999 and the Central Valley starting in 2000. It was detected in Marin, Napa, Sonoma and Solano Counties in November of 2001, in Shasta in June of 2002, and in El Dorado and Lake Counties in July 2002.

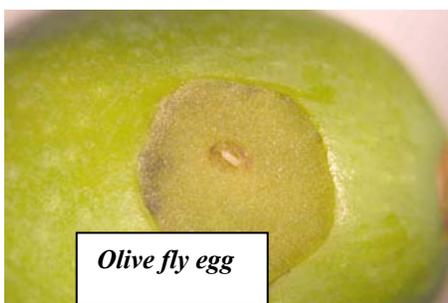


Economic Importance and damage

The adult female can lay 50-400 eggs, usually one in each fruit. These hatch into tiny larvae (maggots) that are very difficult to see until they feed for a while and get larger. While feeding, they tunnel throughout the fruit, destroying the pulp and allowing entry of secondary infestation of bacteria and fungi that rot the fruit and greatly increase the free fatty acid level (acidity) of the oil. Feeding damage may cause premature fruit drop. Oviposition stings caused by the female laying the eggs inside the fruit destroy the value of table fruit.

Description

The adult fly is approximately $\frac{3}{16}$ inch in length (4-5 mm), reddish-brown in color with large reddish eyes and small antennae. The top of the thorax (trunk) is dark brown with 2 to 4 gray or black longitudinal stripes and a white crescent-shaped spot (scutellum) located to the rear of where the wings are attached. There are also several yellow-white patches on each side of the thorax. The abdomen is brown with darker variable areas on the sides of each segment. The wings are clear with a small dark spot near the tip and can be distinguished from those of other fruit flies (e.g. walnut husk fly) that have colored wing bands or patterns. The females have a point at the tip of the abdomen (ovipositor). The larvae are white-yellow legless maggots with a point on one end (head).



Life Cycle and biology

The olive fruit fly has three, and perhaps as many as five, generations per year depending upon local conditions. It overwinters either as an adult or as pupa in the soil or in fallen fruit. Overwintered adult populations decline to low levels by February or March, however new adults from overwintered pupae begin to emerge in March and April. These females lay eggs inside last year's fruit left on the tree. The maggots feed throughout the olive and pupate in a hollow area just beneath the outer skin.



Small larval tracks in green fruit



Large larva in ripe fruit



Pupa in mature fruit

The first generation adults appear in the spring. The susceptibility of the olives increases at the time of pit hardening. There can be several generations and in some cases continuous adult emergence throughout the whole year. High populations can develop very rapidly when ideal temperature favors rapid development. In most cases, the greatest damage occurs as the fruit begins to soften and turn color (September to November).

The second generation appears in mid summer. In summer the olive fly can complete a generation in as little as 30 to 35 days at optimum temperatures. Eggs hatch in 2 to 3 days, larvae develop in approximately 20 days, and pupae in 8 to 10 days in the summer. Adult flies can live from 2 to 6 months depending on the temperature and food availability (honey dew, fruit juices, bird feces, and etc.). A female may lay from 50 to 400 eggs in a lifetime. Additional generations of flies are produced through the late summer and fall months into December depending upon fruit availability. Most of the last generation larvae abandon the fruit to pupate in the ground for several months. Adults can also overwinter in protected areas, especially in areas with mild winter temperatures. Olives left on trees after harvest can produce high populations of flies from late fall to early spring.



Yellow sticky trap

Olives are the only breeding host plants. The larger olive varieties are preferred for oviposition by the female, however, smaller oil olive cultivars are also susceptible. Flies have been trapped in other plants or crop orchards where the adults search for food or refuge.

Olive flies survive best in cooler coastal climates, but are also found in hot, dry regions of Greece, Italy, Spain, Mexico, and California. The optimum temperature for development is between 68° and 86°F. High temperatures in the 100-105° F range are detrimental to adult flies and to maggots in the fruit. However, since the flies are very mobile they have the ability to seek out cooler areas of the orchard and urban trees. Reports of fly movement range from 600 ft in the presence of an olive host to as much as 2.5 miles to find hosts. During rainy winter weather the number of flies caught in traps usually drops off significantly, but stings and damage can continue.



OLFF stuck in trap – note spot on wing tip

Trapping for detection

Yellow colored sticky traps baited with a male sex lure (spiroketal pheromone capsule) and a feeding attractant capsule (ammonium bicarbonate) are used to capture both male and female adult flies. The bait packet is inserted between the panels of the yellow sticky trap and the pheromone capsule hangs on the top outside edge. Traps are placed on the south side of the tree in winter and on the north side in the summer.

Hang the trap on the inside of the canopy in trees with fruit, in open shade, with 8-10 inches of clearance from foliage. Traps can last from 1 to 6 weeks depending on how dirty they get. Pheromone capsules last about 5-6 months. The ammonium bait lures last 2-6 weeks. Remove the olive flies weekly when you monitor the traps.



Glass McPhail trap

The McPhail trap is used extensively in Europe, primarily for monitoring, but in some cases for mass trapping (control) as well. They are made of either glass or plastic with a reservoir for liquid bait containing a 4% solution of ammonium salts (ammonium bicarbonate or ammonium phosphate) as bait attractants. Flies enter from below and drown in the solution. These traps also work in a non-breeding host such as citrus, cherry, plum and nectarine orchards. You can also examine fruit for oviposition stings, maggots or tunneling and decay.

Damage Thresholds

For commercial table fruit orchards in Europe, the damage threshold is 1%, but California table fruit processors have zero tolerance for olive fruit fly damage. For back yard olive producers wanting to make a few table olives the damaged fruit can be sorted out by hand, therefore the damage threshold level (tolerance of some olive fruit fly damage) can be greater.

A European damage threshold level for oil production is 10%. Research in Spain showed that, even with 100% of the fruit showing stings, high quality extra virgin olive oil could be produced as long as the fruit was not rotting. The real problem for oil producers is when larval feeding introduces fruit rotting organisms that create off flavors. This usually happens toward the end of the larval feeding cycle when the maggots get quite large; consequently earlier harvest may be one of the options for dealing with this new pest. When olives are damaged by olive fruit fly, the fruit is more sensitive to oxidative and microbial breakdown, therefore the time from harvest to milling should be kept as short as possible. There is no threshold level based on stings alone, because “olive fruit fly damage” includes stings, small and large larvae, pupae, and rotted fruit. The amount of this damage that actually alters the flavor of the oil is probably much less than the total percentage but is not well defined. Research is being conducted in California to establish specific damage threshold levels.



Sting damage on fruit

In order to maintain threshold levels at less than 1% damage for table fruit and at 10% damage for oil production, certain monitoring thresholds have been established in Europe, but these are based on the use of conventional insecticides usually applied with bait sprays. The yellow sticky trap is currently the monitoring standard in California, but the McPhail trap catches may actually be higher and more indicative of early season population numbers.

Control

Some people choose to spray the trees with a hormone that will stop the flowers from developing fruit. There are several registered materials for this use including: Florel (ethephon); Fruit Stop, Fruit Fix, and Olive Stop (Ammonium 1- naphthaleneacetate).

For those wishing to harvest and use the fruit, management of olive fruit fly in the future will depend on a combination of tactics including bait sprays, attract-and-kill trapping of adult flies, harvest timing, fruit sanitation after harvest, and biological control. Presently the only insecticide registered in California is GF-120 (Naturalyte), a bait containing the insecticide spinosad. It is only available under a section 18, special local needs permit, for commercial growers. There is currently nothing available for back yard orchards or landscape trees. The United States Department of Agriculture (USDA) - Organic Materials Review Institute (OMRI) standards board has approved the active ingredient, spinosad, for organic orchards. Spinosad is a fermentation by-product from the actinomycete bacteria called *Saccharopolyspora spinosa*. The bait is a formulation of hydrolyzed protein.

GF-120 is diluted (1:4) and applied at a rate of 50-100 ounces of diluted material per acre or 1-3 fluid ounces per tree (26-52 fluid ounces actual ingredient per acre) in a course spray or stream to a small portion of the tree. There is no need to cover the whole tree, because the adult flies are attracted to the bait, feed on it and die. It should stay wet as long as possible, so very early morning or very late afternoon application timing is best. A maximum of 19 applications can be made per acre per year. In order to achieve adequate control in heavily infested orchards it is possible that growers will have to apply the material every week from late spring to harvest. If treatments with GF-120 are being used to control the olive fruit fly and-fruit damage levels are high, then additional applications (up to the maximum) might be warranted. The current recommendation is 14 oz./acre, treating alternate rows every 7 days. Light infestations might get by with applications every two weeks.



Close up of plastic McPhail traps used for mass trapping

Plastic McPhail traps have been used in large numbers to reduce damage levels in organic olive oil orchards in Europe. They are difficult to manage and keep filled with the ammonium bait attractant, because they dry out quickly in hot weather.



Attract-and-kill trap with pheromone and ammonium bait capsules

An attract-and-kill trap is currently under review for registration in California and for organic certification. It consists of a semi-porous cardstock material soaked in a conventional insecticide. Attached are an ammonium bait capsule and a spiroketal pheromone capsule. Flies attracted to the trap are killed when they contact the insecticide. No chemical residue is left on the fruit or in the orchard environment.



hanging in a tree

A low-cost trap called the OLIFE (Olivarera los Pedroches) trap was recently developed in Spain for organic (ecological) production. It consists of a 1 – 2 liter bottle hung in the shade of the tree. Our research in California indicates that if filled about ½ full with water and three *Torula* yeast tablets the olive fly catch will be substantial.

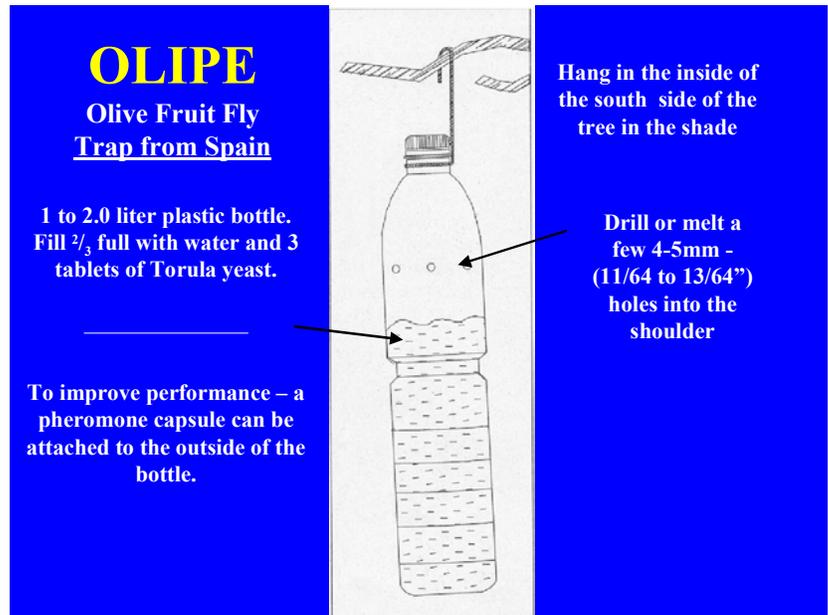
The spiroketal pheromone can be added to the outside of the bottle to improve attractiveness to male flies. For mass trapping, OLIPE traps can be placed at a high density (up to one per tree). The yeast solution should be changed periodically.

The California Department of Food and Agriculture released the parasitic wasp, *Psytalia concolor*, native to Tunisia, in Los Angeles and Santa Barbara in 1999 and Riverside County in 2000 and 2001. Studies are ongoing to assess recovery of the released parasitoids. They are preparing for releases in Yolo County. USDA ARS

is conducting foreign exploration and has found several promising parasitoids in South Africa. Other research investigations include the study of entomogenous nematodes for winter control of pupae in the soil and spraying botanicals such as rotenone and pyrethrum with protein bait as an alternative to conventional insecticide.

This article has been partially adapted from Dr. Richard Rice “Bionomics of the Olive Fruit Fly *Bactrocera (Dacus) olea*, published in UC Plant Protection Quarterly, 2000, Volume 10, Number 3 available online at <http://www.uckac.edu/ppq> and “Olive Pest and Disease Management” by Manuel Civantos López-Villalta. More information is available from:

<http://www.ipm.ucdavis.edu/PMG/r583301311.html>
<http://www.cdfa.ca.gov/phpps/pdep/oliveffprofile.htm>
<http://ucce.ucdavis.edu/counties/cesonoma/index.cfm>



Paul Vossen, Lucia Varela, and Alexandra Devarenne
University of California
Cooperative Extension
133 Aviation Blvd. Suite 109
Santa Rosa, CA 95403
(707) 565-2621

pmvossen@ucdavis.edu

lgvarela@ucdavis.edu

akicenik@ucdavis.edu

April 2004

Sources of Products for Olive Fly Control

Rev. 3/18/04

Better World Manufacturing Inc.

5690 E. Dayton
Fresno, CA 93727
(599) 291-4276

bettertrap@aol.com

Multilure (McPhail-type) trap; Torula yeast tablets (by the lb.)

Irv Boxer

ERA International Ltd.
PO Box 7329
Freeport, NY 11520
(516) 379-5579

Torula yeast tablets (50 lb. drum)

Great Lakes IPM

10220 Church Rd.
Vestaburg, MI 48891
(989) 268-5693

www.greatlakesipm.com

Liquibator (McPhail-type) fruit fly trap; Torula yeast tablets (sold individually); yellow sticky traps

ISCA Technologies Inc.

2060 Chicago Avenue, Suite C2
Riverside, CA 92507
(909) 686-5008

www.iscotech.com

McPhail traps, yellow sticky traps, Torula yeast tablets (by the lb.)

Scentry Biologicals

610 Central Avenue
Billings, MT 59102
(406) 248-5856

www.scentry.com

Pheromone/bait lures

Suterra

213 SW Columbia St.
Bend, OR 97702
(541) 388-3688

www.suterra.com

Yellow sticky traps (sold in cases of 100).

John Taylor Fertilizers-Dixon

(707) 678-2358

NuLure fruit fly bait (2-1/2 gal containers)

Trécé Inc.

P.O. Box 129,
Adair, Oklahoma 74330
(866) 785-1313

www.trece.com

Yellow sticky traps

Wilber Ellis Co.

(800) 426-3491
NuLure by mail

Dow AgroSciences

<http://www.dowagro.com/prod/index.htm>

Sources for Naturalyte (GF-120)