

Update

NPMA LIBRARY UPDATE

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Fruit Fly 101: Family Drosophilidae¹

Recognizing the Fruit (small)/Pomace/Vinegar Fly

Pest management professionals in a wide variety of accounts frequently encounter small "fruit fly" infestations. These flies should not be confused with the true fruit flies of the family Tephritidae, e.g., Mediterranean fruit fly; which can be serious pests of fruit crops. Adequate knowledge of the biology of the family Drosophilidae is required to properly locate harborage sites. However, not all breeding areas are readily located. Knowing the unique sites where infestations can occur in different types of accounts helps the PMP solve the problem more rapidly. Otherwise, the result is a period of endless callbacks, frustrated technicians and dissatisfied customers, and eventual cancellation.

Recognition

Drosophila spp.² Adults are about 1/8 inch (3mm) long, including the wings. Color dull, tan to brownish yellow or brownish black, eyes usually bright red. Antennae with feathery bristle (arista). First hind tarsal segment long and slender, much longer than second segment. *Drosophila melanogaster*³ adults about 1/8 inch (3mm) long, tan with abdomen blackish above and grayish below, and bright red eyes. Adults of several other common pest *Drosophila* can be identified by using the key by D. Grimaldi on the next page.

Mature *D. melanogaster* larvae are about 1/4 to 3/8 inch (7-8mm) long, eyeless, legless, and tapering towards head from large rounded rear segment, head represented by two dark hooks. Color near white except mouth hooks black and tips of posterior terminal abdominal spiracles

(breathing pores) yellowish. Posterior spiracles at end of short stalks/fleshy tubes which are in contact or joined at their bases. Other species may have posterior spiracle stalks dark and/or have whorls of setae (hairs) at their ends, and/or have the bottom side of abdomen with darkened cross bands (setulae).

Biology

Adult females lay their eggs (average about 500) near the surface of fermenting fruits and vegetables or near any yeast-bearing material (see below for other common breeding sites). Cover cracks in imperfectly sealed containers of such materials. The eggs hatch in about 30 hours. The larvae develop in the sweet or vinegar-like liquids of the fermenting materials where they feed near the surface and primarily on the yeast, for about five to six days. Prior to pupation, the larvae crawl to drier areas of the food or elsewhere. The brown, seed-like sheath containing the pupa (the puparium) is formed from the last larval skin/exoskeleton (pupal stage lasts approximately one day). The newly emerged adults mate in about two days. The life cycle (adult to adult) may be completed in eight to 10 days at 85°F (29°C). Their reproductive potential is enormous.



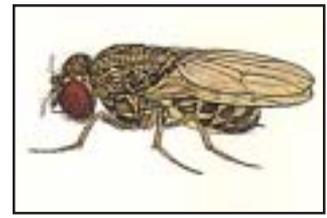
Drosophila melanogaster



Drosophila repleta



Drosophila funebris



Drosophila hydei

Annotated Key to Pest Species of Drosophilid Flies

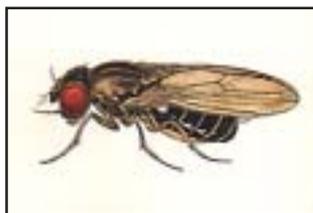
Dr. David Grimaldi, Department of Entomology, American Museum of Natural History, New York, NY (January 1994)

There are eight species of drosophilid flies ("vinegar," "pomace," or "small fruit flies") which are common household pests in North America. All are in the genus *Drosophila*, and are cosmopolitan or nearly so, but with their origins from different parts of the world as indicated for each species. Even though all have become "supertramp" commensals of man, there are distinct differences in their tastes for particular kinds of garbage, filth, and decaying and fermenting foodstuff. This key is written so as to be used with the least amount of background on fly morphology — although some will be necessary, as will a stereoscope for accurate identification. Beware that this key will not help in identifying the stray and occasional vagrant individual of a wild species, which always turn up.

Description	Name
<p>1 Body yellowish, with black longitudinal stripes on thorax; movements are quick and jerky; larva distinctive, with stubby, hairy processes over most of body. Probably a native to Asia; very polyphagous, but rarely extremely abundant; not so much attracted to fermenting fruits as to rotting and molding vegetables; recently reported as a serious pest in mushroom houses in California.</p> <p>Body yellowish or largely dark brown, without longitudinal stripes on thorax; movements typical of most fruit flies; larva a typical maggot.</p>	<p><i>busckii</i></p> <p>see #2 below</p>
<p>2 Thorax dark brown to light brown, with many small, dark spots, one at base of each fine seta.</p> <p>Thorax yellow or evenly brown, without small spots.</p>	<p>see #3 below</p> <p>see #4 below</p>
<p>3 Forecoxae darker brown than rest of forelegs. One of two household species in the large species group [ca. 85 described species]; native to New World, breeding in rotting fruits and necrotic cacti.</p> <p>Forecoxae yellowish, lighter than rest of forelegs. (Also in the <i>repleta</i> group, prefers filth, such as sewers and drains; reports exist of this species being a pest in hospitals.)</p>	<p><i>Drosophila repleta</i></p> <p><i>hydei</i></p>
<p>4 Body entirely dark brown; males without small black combs on foretarsi.</p> <p>Body yellow, with black on parts of abdomen; males with small black combs on foretarsi.</p>	<p>see #5 below</p> <p>see #6 below</p>
<p>5 Male with "anal plates" (cerci) having heavy spines; costal vein of wing with setae of uniform size. (Native to Europe; can be confused with <i>subfunebris</i> in North America [<i>funebris</i> has the male spines curved slightly upward; in <i>subfunebris</i> they are curved slightly downward and are smaller]; a large, slow fly.)</p> <p>Male without spines on "anal plates;" part of third costal section with heavy setae. (Native to North America; members of the <i>virilis</i> group naturally breed in sap fluxes of trees.)</p>	<p><i>funebris</i></p> <p><i>virilis</i></p>
<p>6 Male with small, hooked process on epandrium or "genital arch."</p> <p>Male with much broader, rounded process on epandrium. (Both <i>melanogaster</i> and <i>simulans</i> are closely related species, in the <i>melanogaster</i> subgroup; native to central Africa; can be extremely abundant around rotting fruits, in wineries, and in tomato fields. They prefer fermenting fruits and vegetables, and can tolerate rather high levels of alcohol where they breed. In the northeast U.S. they are most abundant in the late summer and early fall. Females of the two species are difficult to distinguish, but are most reliably differentiated based on the depth of the eye relative to the cheek.)</p>	<p><i>melanogaster</i></p> <p><i>simulans</i></p>



Drosophila robusta



Drosophila virilis

Inspection

Larval development sites are commonly found in fermenting fruits and vegetables and in their by-products, such as cider. The larvae can also be found in sweet or vinegar-like liquids where they feed near the surface primarily on yeast. Pupal cases are usually located in drier areas on or near the infested food source. Adults are often seen flying or resting on surfaces close to breeding areas. Due to their rapid life cycle, fruit flies can exploit numerous areas of temporary occurrence. Specific examples are as follows:

- **Residences:** Look for fermenting grapes, potatoes, onions, bananas, tomatoes, and other fruits and vegetables. Soiled trash compactors, trash chutes, garbage disposal units, compost piles, dirty garbage cans, and bottles and cans being saved for recycling are common breeding sites. Some species develop in animal and human excrement.
- **Food Service Facilities:** Food debris under equipment, in dumbwaiter and elevator pits, and in drains are prime breeding areas. Soiled linens, soured mop heads, beer taps, liquor-storage areas, containers in recycling bins, refrigeration drip pans, and spilled soda syrup are possible locations. Food debris that accumulates under trashcan liners is often overlooked. Food particles in mop water can wash into cracks and crevices to provide larvae developmental sites, as can standing water on kitchen, bar, and bathroom floors. Inspect locker rooms for food left in lockers by employees. Check food storage areas for overripe fruit.
- **Food processing/Industrial Facilities:** Inspect for many of the same areas as mentioned under food service facilities. In addition, check food and product waste disposal systems, pallets and trash dumpsters. Small accumulations of food debris on surfaces and in cracks around equipment are common problem areas. Leakage from sink drains and debris clinging under sink edges are potential areas. Wall/floor junctions often are not properly sealed, creating prime breeding sites for the larvae. In processing areas that are frequently hosed down, look for plastic material, which often traps and holds moisture or food debris.
- **Health Care Facilities:** Small fruit fly infestations often originate in dietary preparation areas and can be found along distribution paths throughout the facility. Look for similar larval developmental sites as noted under food service facilities. The adult flies are attracted by odor cues to fruit in patient rooms and employee lockers, food carts, pantries, hairdresser shops, break areas, trash receptacles, and janitorial closets.
- **Commercial/Office Facilities:** Inspect break rooms and vending areas for breeding sites. Many buildings now have recycling programs that include the placement of collection bins within the facilities. Often the bins are not emptied frequently enough and/or are not thoroughly cleaned when they are emptied. This also applies to trash receptacles throughout a facility. Sometimes food debris that falls under trash can liners is a source of infestation.
- **Animal Research Facilities/Zoos:** Pay particular attention to the areas where the food for animal consumption is held and prepared. Floor drains in the animal quarters can be excellent harborage sites. Often these areas are washed down daily and any cracks or crevices present allow organic matter to accumulate in them. Certain types of animal bedding (especially rabbit) are particularly attractive as larval development sites to small fruit flies.

Control

Applying integrated pest management (IPM) principles to small fruit fly infestations is required professional must aggressively recruit the customer's cooperation, both verbally and in writing. The customer must agree to make the necessary sanitation and structural modifications to eliminate larval breeding sites. Specific control recommendations are as follows:

- **Cultural:**
 - Clean thoroughly and frequently floor areas under food preparation surfaces, fixtures, and equipment.
 - Use a brush to clean and flush floor drains and debris traps weekly.
 - Eliminate standing water.
 - Repair leaking plumbing or beverage lines.

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- Hang up mops and brooms to dry after each use.
 - Have soiled linens removed and cleaned at least twice a week.
 - Move dumpsters and trash containers as far away from entrances as possible.
 - Thoroughly wash containers destined for recycling before placement in a bin and have the bins emptied and cleaned at least twice a week.
 - Discard residential organic waste in tightly sealed plastic bags or compost it. When composting, the waste material should be turned daily or at least every other day the first week to significantly reduce fly breeding.
 - Wash or launder mop heads weekly.
- **Mechanical/Exclusion:**
 - Seal cracks and crevices where food particles can accumulate with an appropriate material.
 - Clean accessible floor drains of organic scum using an electric drill fitted with a 12-inch extender and a 3-inch diameter wire-sanding wheel. This setup is aided by running tap water into the drain during and following the procedure to flush away debris.
 - Install air doors/curtains at exterior entrances.
 - Place flying insect jar traps (commercially available) baited with fruit juice, vinegar, or beer in strategic locations.
 - Replace window or door screening with a fine mesh to deny small fruit fly entrance since they often can penetrate ordinary screening. While a minimum size of 20 mesh is required to keep out small fruit flies, 32-mesh screening will also keep out most other flies.
 - Use carefully placed insect light traps to attract and remove small fruit flies.
 - To eliminate adults, use a vacuum cleaner as an economical, practical, non-chemical alternative to ULV treatments. It's not practical under high ceilings, but works very well for restaurant staff to perform morning "clean-ups" until the problem is located and eliminated.
 - To keep small fruit flies from salad bars, use a fan that blows across the salad bar.
- **Chemical:**
 - Adult flies can be killed using aerosol or ULV space treatments.
 - Where the label allows, a borate material may be applied in stagnant drains that are difficult to access mechanically, or as a final rinse for tile or cracked floors (e.g. at least once weekly).
 - The use of commercially prepared disks that have been treated with a residual insecticide are placed in small fruit fly resting areas may be used and can later be removed with no residual application on the surface.
 - Add biocides for drains and as a mopping solution for deteriorating tile floors.

Conclusion

Long-term control of small fruit flies is only achieved by identifying and eliminating larval development sites. Because good sanitation practices are absolutely necessary to control these flies, obtaining customer cooperation is of paramount importance for a successful program.

References

1. Grimaldi, D. Annotated Key to Pest Species of Drosophilid Flies. Personal communication. This key was first published in 1994.
2. Smith, E. H. & R. C. Whitman. 1992. *NPCA Field Guide to Structural Pests*. National Pest Control Association, Fairfax, Virginia.
3. National Pest Control Association. 1992. *Insect Light Traps: Recommended Use, Placement and Maintenance*.
4. National Pest Control Association. 1992. *Caulking Materials for Integrated Pest Management*.

Acknowledgements

¹ Dr. Gerald Wegner provided significant assistance in developing this Library Update.

² Colored illustrations are from: Patterson, J.T. 1943. Studies of the Genetics of *Drosophila*. III. Univ. of Texas Publ. No. 4313; and Patterson, J.T. 1944. Studies of the Genetics of *Drosophila*. IV. Univ. of Texas Publ. No. 4445. (Illustrations prepared by Mrs. S.L. Martin).

³ *Drosophila melanogaster* and *D. virilis* are both typical "red-eyed" species which breed in fruit juices and syrup; all other species shown are "dark-eyed" and breed in decaying proteins as well. ●