



Food and Agriculture  
Organization of the  
United Nations



International  
Plant Protection  
Convention



**Survey Guidance for  
*Bactrocera* spp.**



## Survey Guidance for *Bactrocera* spp.

### Scientific Name

*Bactrocera* spp.

### Common Name

Fruit fly

### Type of Pest

Fruit fly

### Taxonomic Position

**Class:** Insecta, **Order:** Diptera, **Family:** Tephritidae

### Known Hosts

#### Preferred hosts

Fruit flies from the genus *Bactrocera* are highly polyphagous pests of soft bodied fruit. Preferred hosts vary by species.

Some major commodities targeted by this genus include *Annona* spp. (sugar apple), *Artocarpus* spp. (jackfruit), *Brassica* spp. (cruciferous vegetables), *Capsicum* spp. (pepper), *Carica* spp. (papaya), *Citrus* spp. (citrus), *Cucumis* spp. (melon), *Cucurbita* spp. (squash), *Diospyros* spp. (persimmon), *Ficus* spp. (fig), *Fragaria* spp. (strawberry), *Malus* spp. (apple), *Manilkara* spp. (sapodilla), *Mangifera* spp. (mango), *Musa* spp. (banana), *Persea americana* (avocado), *Prunus* spp. (stone fruit), *Psidium* spp. (guava), *Pyrus* spp. (pear), *Solanum* spp. (tomato), *Syzygium* spp. (roseapple), and *Ziziphus* spp. (jujube).

See [USDA National Exotic Fruit Fly Detection Trapping Guidelines](#) or [Invasive Fruit Fly Pests in Africa](#) for host lists for individual *Bactrocera* species.

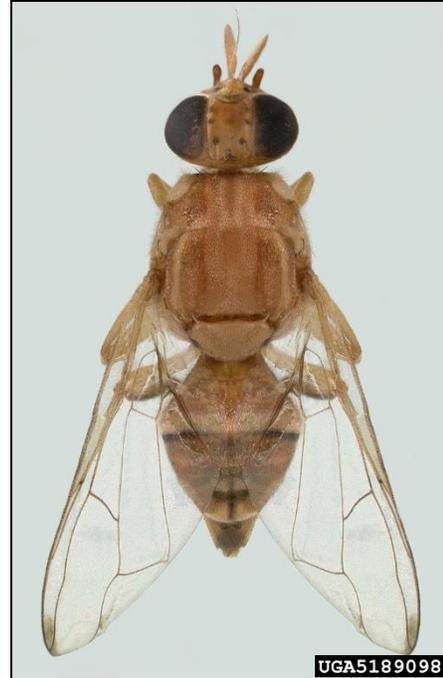
### Survey Protocol

#### Target Life Stage:

Adult flies

#### Time of year to survey:

Surveyors can trap fruit flies year-round or on a seasonal basis. Base seasonal trapping cycles on the availability of fruit on host plants. In general, fruit flies prefer mature fruits, so **placing traps near ripe fruits is critical to fruit fly detection**. Avoid trapping during times of the year when flies are not active; typically, this is during the hottest and driest parts of the year, or during cooler weather.



**Figure 1.** *Bactrocera zonata* adult (Natasha Wright, Florida Department of Agriculture, [www.bugwood.org](http://www.bugwood.org))

## Trapping

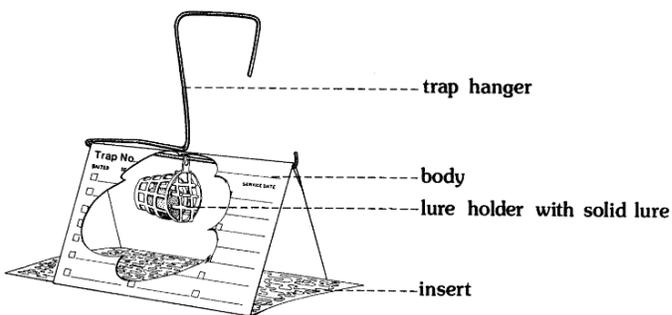
### Survey Site Selection

Surveys should target any locations where hosts are common, including farms and orchards, production areas like nurseries, and unmanaged natural and urban environments. When deciding between two or more potential trap locations, use the site with more host trees and plants, mature fruit, and suitable foliage. Surveyors should move traps to new locations when fruit at the trap site is gone.

### Recommended Traps

There are three types of traps recommended to effectively capture *Bactrocera* fruit flies:

#### 1. Jackson traps



**Figure 2. Jackson trap diagram and placement in a host tree** (adapted from California Dept. of Food and Agriculture (CDFA) insect trapping guidelines)

**Note for Jackson traps:** These cardboard traps require the addition of a sticky insert to catch any flies that are attracted to the lure. Typically, the lure acts as a pheromone, which attracts male fruit flies, and it contains some pesticide to stun the fruit fly and cause it to fall to the sticky insert.

## 2. McPhail traps

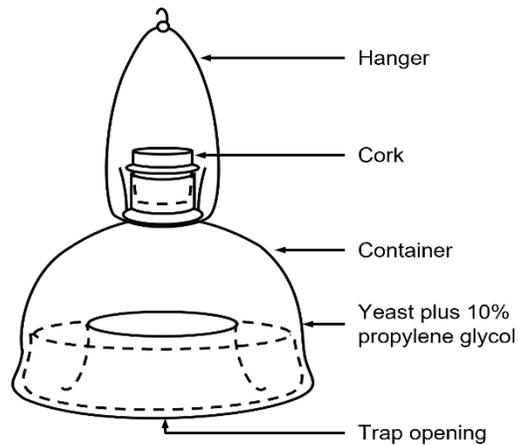


Figure 3. McPhail trap diagram and placement in a host tree (adapted from USDA, 2015).

## 3. Multilure traps



Figure 4. Multilure trap in a host tree and view of the trap interior (adapted from CDFA and USDA trapping guidelines)

**Note for McPhail and Multilure traps:** These two traps contain a liquid reservoir to trap and drown flies. A 10% solution of propylene glycol diluted with water is recommended for the reservoir. It evaporates slowly and may enhance the attractiveness of the lures. Surveyors should replace the propylene glycol solution every 6 weeks or sooner if heavy evaporation occurs. Propylene glycol is toxic: wear gloves when changing it and pour the leftover liquid in a bucket for proper disposal. Do not pour it on the ground or near the roots of the host plant.

See **Table 1** for species specific guidance on trap and lure choices.

While these three traps are recommended, there are other options to capture fruit flies, including homemade traps using everyday items such as plastic water bottles (see [How to build a fruit fly trap](#) by the FAO).

### Recommended Lures

The effectiveness of these lures will vary across the genus, but many *Bactrocera* species are attracted to the following compounds:

- Methyl Eugenol (4-allyl-1,2-dimethoxybenzene)
- Cuelure (4-(p-acetoxyphenyl)-2-butanone)
- Torula Yeast
- Trimed

Select the best lure to use for the target fruit fly species, as different fruit fly species react with varying intensity to different lures. See **Table 1** for species specific guidance on trap and lure choices.

<b>⚠CAUTION</b>
Surveyors should follow all product labels and handle all lures, insecticides, and traps with the proper protective equipment. Place traps in areas that will minimize interactions with other people, children, or animals.

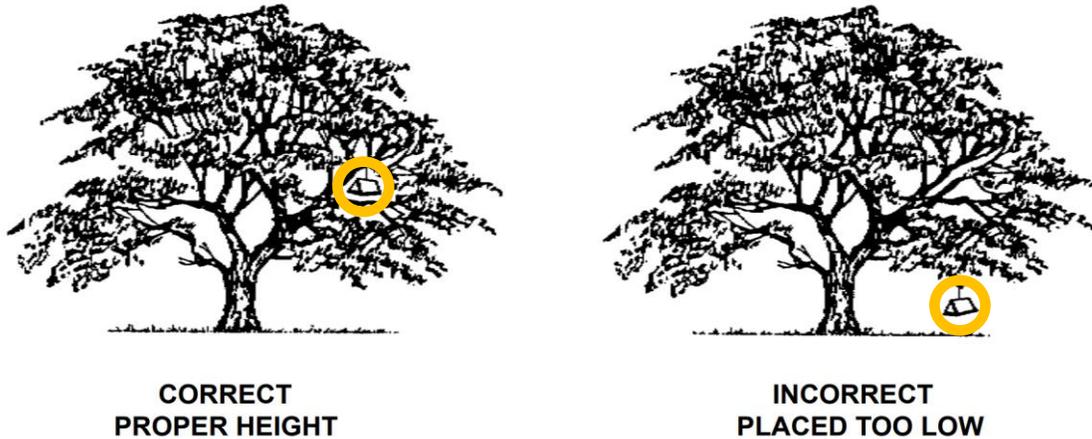
**Table 1. Recommended trap and lure combinations for some species of *Bactrocera* fruit flies** (adapted from USDA fruit fly trapping guidelines).

Scientific Name	Common Name	McPhail Trap baited with Torula Yeast	Multilure Trap baited with Torula Yeast	Jackson Trap baited with Methyl Eugenol	Jackson Trap baited with Cuelure
<i>B. albistrigata</i>	White striped fruit fly	X	X		X
<i>B. correcta</i>	Guava fruit fly	X	X	X	
<i>Zeugodacus</i> (formerly <i>Bactrocera cucurbitae</i> )	Melon fruit fly	X	X		X
<i>B. dorsalis</i> complex	Oriental fruit fly	X	X	X	
<i>B. facialis</i>	Tonga fruit fly	X	X		X
<i>B. latifrons</i>	Solanum fruit fly	X	X		
<i>B. tryoni</i>	Queensland fruit fly	X	X		X
<i>B. zonata</i>	Peach fruit fly	X	X	X	

### Trap Placement and Spacing

Follow the guidance below when placing traps:

- Hang traps on branches in foliage that offers shade (i.e., no full sunlight at any time).
- Place traps in the upper 1/3 to 1/2 of the tree canopy and 1/2 to 2/3 the distance from the trunk to the outer edge of the foliage.
- **Surround the trap with foliage and ripening fruit** but maintain open space of 30 to 46cm around the trap (i.e., Do not place traps in dense foliage).
- Do not hang traps below the foliage canopy or closer than 1.2 m to the ground (Fig. 5).



**Figure 5.** Jackson trap diagram and placement in a host tree (adapted from CDFA)

## Trap Servicing

### *Trap Inspection*

#### **Jackson traps**

- Inspect every 1 to 3 weeks, depending on season.
- Examine the sticky insert for captured flies.
- If suspect flies are captured remove sticky insert and bring in for confirmation identification. See **Fig. 6** for collection technique.
- If no flies detected, remove any leaves or debris from the insert.
- Replace the insert if it is no longer sticky to ensure the trap will continue to capture flies.

#### **McPhail or multilure traps**

- Inspect weekly.
- Pour trap liquid into a bucket through a strainer to collect any drowned insects.
- Place any possible detections in 70% alcohol for future identification.
- Replace the trap liquid and dispose of used liquids safely.

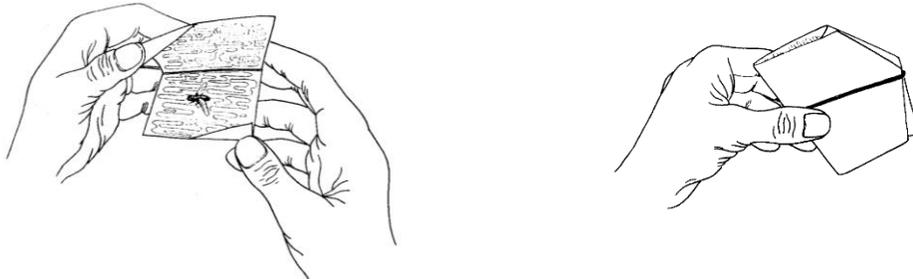
## Replacing Lures

**Jackson trap** lure dispensers for methyl eugenol and Cuelure will need to be changed every four to six weeks, depending on temperature. Daytime highs of 32°C or higher or periods of high winds require more frequent replacement.

**McPhail or multilure trap:** For traps using lure dispensers, replace the lures at the recommended intervals and replace the trap liquid at the same time. McPhail traps using torula yeast as an attractant will need to be changed every week.

## Sample Collection

Place any captured fruit flies from McPhail or Multilure traps in at least 70% alcohol for future identification. Removing flies captured on the sticky trap will damage them and make it difficult to identify. A suggested method for collecting flies from a Jackson trap insert is depicted below (**Fig. 6**). Bend the long corners of the insert inward, fold the insert and use a rubber band to hold it closed. Check first to see that the specimen will not be damaged using this method. Put the insert in a plastic bag before sealing in a box for mailing. Alternate methods (such as covering with plastic wrap) may be necessary, depending upon the location of the specimen on the insert. Be sure insert is dry before putting in plastic bag or covered with plastic wrap.



**Figure 6. Folding technique for Jackson trap sticky insert if it needs to be shipped for identification** (Adapted from California Department of Food and Agriculture Insect Trapping Guidelines)

## Pest Identification and Diagnostics

Identifiers with expertise in the Tephritid fruit flies should verify morphological identification. Species from the *Bactrocera dorsalis* complex are morphologically indistinguishable and require DNA analysis to confirm identification.

## Pest Description

*Bactrocera* fruit flies range in length from 5 to 8 mm, with various color patterns on the body and wings. **Fig. 7** shows adults of several prominent *Bactrocera* species that may be of interest for survey. These images are meant to be a helpful guide, but taxonomic keys or other confirmatory tools will be necessary to properly identify the genus or a species. See the *Identification Resources* section below for keys and ID methods.



*Bactrocera albistrigata*



*B. correcta*



*Zeugodacus* (formerly *Bactrocera*) *cucurbitae*



*B. dorsalis*



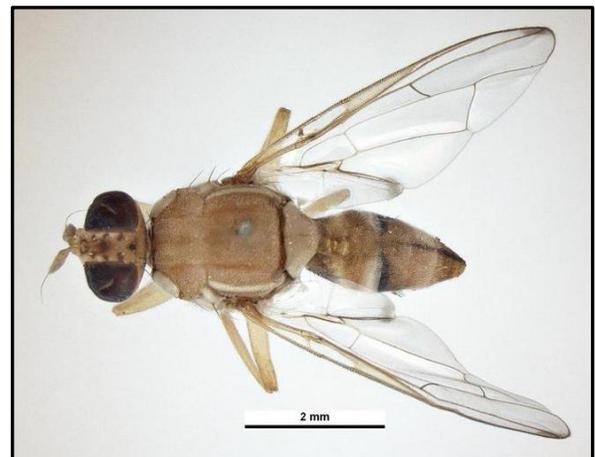
*B. facialis*



*B. latifrons*



*B. tryoni*



*B. zonata*

Figure 7. Images of adult flies from eight species of the genus *Bactrocera* (Source: all from Bugwood.org except *B. facialis* which is from CABI Bioscience)

### **Identification Resources**

De Meyer, M., S. Mohamed, and I. M. White. 2014. [Invasive Fruit Fly Pests in Africa \(africamuseum.be\)](http://africamuseum.be)

Ekesi, S. and M.K. Billah. 2006. A Field Guide to the Management of Economically Important Tephritid Fruit Flies in Africa. [Link](#)

Hancock, D. L., Freidberg, A., Friedman, A.-L.-L. 2021 Tephritidae. *In*: Manual of Afrotropical Diptera, Volume 3 Brachycera - Cyclorrhapha, Excluding Calyptratae - Higher Diptera. Series: Suricata Volume: 8. South African National Biodiversity Institute (SANBI Publishing), Pretoria, 1669-1734.

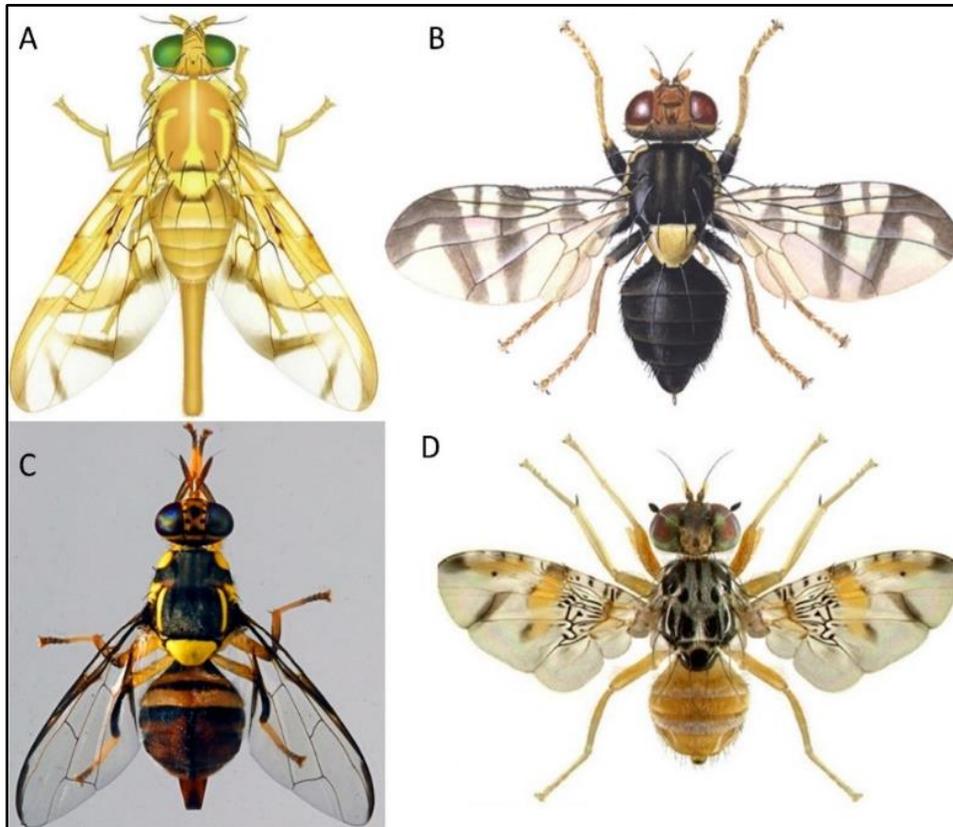
International Plant Protection Convention (IPPC). 2019. ISPM 27. Diagnostic protocols for regulated pests. DP 29: *Bactrocera dorsalis*. [DP 29 2019 En Bactrocera 2019-03-11.pdf \(ippc.int\)](https://www.ippc.int/publications/2019-03-11.pdf).

Doorenweerd, C., Anderson, C. T., Leblanc, L., San Jose, M., Rubinoff, D., Geib, S., Barr, N. 2022. Adult fruit fly identification of *Bactrocera* and allied genera using the Lucid multi-entry key platform (Diptera: Tephritidae: Dacinae: Dacini). USDA-APHIS-PPQ) [The Adult \*Bactrocera\* fruit fly ID Tool](#)

White, I. M., and M. M. Elson-Harris. 1994. Fruit Flies of Economic Significance: their identification and bionomics. CAB International, Wallingford, UK. 608 pp.

## Easily Mistaken Species

Species of *Bactrocera* can be easily mistaken for other fruit fly genera, including *Anastrepha*, *Ceratitis*, and *Rhagoletis*. See **Fig. 8** for basic morphological differences across the different genera of fruit flies.



**Figure 8. General appearance of four fruit fly genera; A. *Anastrepha ludens*; B. *Rhagoletis cerasi*; C. *Bactrocera dorsalis*; D. *Ceratitis capitata*. Note the differences in the wing banding among major genera (Source: Taina Litwak, USDA-ARS, Bugwood.org; Arthur D. Cushman, USDA; IAEA imagebank; G. Georgen, IITA).**

## References

This survey protocol was adapted from United States Department of Agriculture and California Department of Food and Agriculture guidelines for trapping. If you require additional information regarding fruit fly surveys or how to deal with fruit fly infestations after detection, there are resources available, including [ISPM 26](#), [ISPM 35](#), the [USDA National exotic fruit fly detection trapping guidelines](#), and the [CDFA Insect Trapping Guide](#).

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