

Production Methods for Fruit Fly Parasites*

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In this short paper, I will try to summarize the methods used at the Hawaii State Insectary for the propagation of fruit fly parasites. Several parasites mentioned here have become established in the Hawaiian Islands.

To mass produce fruit fly parasites in the insectary a large stock of the host fly, *Dacus dorsalis* Hendel, is maintained in the laboratory.

Adult flies: About 2,000 flies are held in a rectangular, wooden cage measuring 30 inches long, 17 inches wide and 18 inches high. The top is constructed of glass for light and the upper half of the back wall is made of plastic screen for ventilation. Two circular openings 6 inches in diameter are provided in the front of the cage and each of these is secured with a long cloth sleeve and through these openings the fruit, pupae, food and water are introduced into the cage. The flies are fed with powdered soy bean hydrolysate and cube sugar. Water is provided in a glass dish holding a pad of absorbent cotton. When provided with this diet under laboratory conditions, *D. dorsalis* begins to oviposit on the 5th day at the very earliest, but 8 to 10 days is more usual (Christensen and Foote, 1960). To maintain a healthy colony, the cage is cleaned weekly when all dead flies are removed and food and water replenished.

Eggs: The host fruit used in the insectary is *Carica papaya* L. which is available locally throughout the year. Only firm mature green papayas are selected for this purpose. To facilitate oviposition and for even distribution of eggs in the fruit, we puncture the skin of the fruit many times with a large needle. Eight to ten papayas, averaging one pound each, are placed in a cage. Generally, the fruit is left exposed to the flies for 3 days before they are removed and a new lot is substituted.

Larvae: The infested fruit is removed from the fly cage and placed in a holding cage until the larvae are ready for exposure to the parasites. One species of parasite oviposits in the egg of the fruit fly, while others attack the larvae in various stages of development and still others attack the pupae.

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THE PARASITE STOCK

1. Braconids of the *Opius longicaudatus* complex, including *O. formosanus* Fullaway, *O. compensans* Silvestri, *O. longicaudatus* var. *taiensis* Fullaway and *O. longicaudatus* var. *novocaledonicus* Fullaway will be considered first.

Eggs: Infested papayas which have been removed from the fly cage about 4 days previously are placed on a piece of hardware cloth over a glass dish half filled with sand and placed in a screen cage (14" × 14" × 14") with a removable glass front. One hundred parasites are introduced into the prepared cage. The parasites are fed daily with pure honey streaked across the inside surface of the glass front with a camel's hair brush. Water is afforded the parasites by means of saturated cotton pads in small shallow glass dishes.

Larvae: When exposure to the parasites has been completed, which takes from 3 to 4 days for the *O. longicaudatus* varieties, the fruit is removed and placed in a tray containing sand. To prevent the escape of the host larvae and to prevent entrance of secondary breeders such as *Drosophila*, *Carpophilus*, etc., the tray is covered with a fine mesh screen.

Pupae: After the larvae are fully developed in 10 to 12 days under insectary conditions, they leave the fruit to pupate in the sand. The sand is sifted with a fine mesh screen approximately 2 weeks following removal of the fruit from the parasite cage. The pupae are put into a wide mouth gallon jar which is covered with a piece of white organdy cloth secured with a rubber band. The jar is set aside for the emergence of adults which begins about 18 to 19 days following exposure to the parasites. Approximately 300 parasites may be obtained from each infested fruit. The parasites are collected, fed and later released in fruit fly infested areas.

2. *Opius oophilus* (Braconidae), an egg-larval parasite. The female of this species inserts its ovipositor into the oviposition puncture of *D. dorsalis* and deposits its eggs on the host eggs (Van den Bosch, *et al*, 1951). *O. oophilus* larva develops in the larva of its host and completes its development in the host pupa.

The fruit is prepared and exposed to the gravid *D. dorsalis* flies in the same manner as that used for the *O. longicaudatus* varieties. However, we expose the fruit to the gravid flies for only 1 day. After the fruits containing *D. dorsalis* eggs have been exposed to *O. oophilus* for 1 to 2 days, they are removed from the cage and are held for larval and pupal development in the same manner as the fruits exposed to the *O. longicaudatus* varieties. This species of parasite requires more sunlight and greater circulation of air in the breeding cage and less crowded condition (Hagen, 1951) than any of the other parasite species.

3. *Dirhinus giffardii* Silvestri (Chalcidae), a pupal parasite. *D. giffardii* parasitizes *Dacus dorsalis* and *Ceratitidis capitata* Wied. and is the easiest parasite to propagate. The adults are hardy, live for 3 or 4 weeks, and require very little attention. *D. giffardii* is able to parasitize all stages of fruit fly pupae except those of older than eight days (Dresner, 1954).

About 100 *D. giffardii* are used with several hundred fresh pupae of *D dorsalis* in a gallon jar (a large test tube may be used instead of a gallon jar). Fly pupae are exposed to the parasites for 5 to 6 days. The parasite stock are provided with honey and water daily.

4. *Syntomosphyrum indicum* Silvestri (Eulophidae), a larval parasite. A parasite of *D. dorsalis*, and *C. capitata*. *S. indicum* deposits several eggs in each host larva. (Noble, 1942). In the laboratory we have reared as many as 30 individuals from one *D. dorsalis* pupa.

Several thousand mature fly larvae are placed in a gallon jar with honey and water placed on the inside surface of the jar with a small camel's hair brush. From 1,000 to 2,000 *S. indicum* are used for each placement. The larvae are exposed to the parasites for 2 or 3 days or longer. Generally only one placement is made with each lot of breeding stock. The emergence of adults begins anywhere between 15 and 19 days depending on the temperature.

All parasite species mentioned here except the *Opius oophilus* male and *Syntomosphyrum indicum* are sexually mature 3 days after emergence. *O. oophilus* males take about 6 days to become sexually mature while *S. indicum* may be used for breeding 1 day after emergence.

By the routine procedures described, the State Insectary, Honolulu, produces about 50,000 parasites per month, utilizing 75 to 80 pounds of fruit, some honey, sugar and soy bean hydrolysate. It requires practically the full time of one trained employee during the week, but the weekend essential tasks can be performed in an hour or two.

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