United States
Department of
Agriculture

Animal and
Plant Health
Inspection
Service

Cooperating State
Departments of
Agriculture

ACTION PLAN

QUEENSLAND FRUIT FLY
Bactrocera tryoni (Froggatt)
(Synonym = *Dacus tryoni* (Froggatt))

September 1990

This PPQ Action Plan or New Pest Response Guideline has not been updated since its publication date. The actions or guidelines recommended may not be appropriate now, new survey tools may be available, and chemical pesticides named may no longer be registered. This documents is posted until updated versions can be drafted and as such are only guidelines that represent the state of knowledge at the time they were written. Please consult PPQ and/or your State Plant Regulatory Official prior to implementing any recommendations listed herein.

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AUTHORIZATION

This Action Plan provides guidelines and actions for the eradication of a Queensland fruit fly (QFF) infestation. This Action Plan supplements information contained in the Plant Protection and Quarantine (PPQ) Treatment, Emergency Programs, and Administrative Procedures Manuals.

It is to be used in conjunction with other manuals when conducting emergency program activities. The information and instructions contained in this Action Plan were developed with and approved by representatives of the Animal and Plant Health Inspection Service (APHIS), cooperating States, Agricultural Research Service (ARS), Cooperative State Research Service (CSRS), and affected industry.

All program technology and methodology employed are determined through discussion, consultation, or agreement with the cooperating State officials.

James W. Glosser — 3/9/90

Administrator
Animal and Plant Health Inspection Service — Date

Ron Roy Bjornson — 4/9/90

Chairman
National Plant Board — Date

NOTICE

Pesticides recommended in this Action Plan are registered or may be exempted under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended. Precautions on the pesticide label and all instructions in this Action Plan must be carefully followed.

Federal and/or State personnel may not make any warranty or representation, expressed or implied, concerning the use of these products and shall not be responsible for any loss, damage, or injury sustained as a result of the use of any product as specified in this Action Plan.

The use of trade names in this Action Plan does not imply an endorsement of those products or of the manufacturers thereof by Federal-State pest control programs. Equivalent formulations under different trade names are acceptable.

I. GENERAL INFORMATION

A. Action Statement

The information contained in this document is intended for use only when a Queensland fruit fly (QFF) infestation is known to exist. This Action Plan is to be used for guidance in implementing eradication procedures and in preventing spread to other locations. This Action Plan provides technical and general information needed to implement any phase of a QFF eradication program. Specific emergency program action is to be based on information available at that time.

B. Background Information

The QFF is a native of Australia. It occurs in Queensland, New South Wales, and Victoria. Elsewhere, it exists in Papua New Guinea, New Caledonia, Tahiti, the Austral Islands, and the Society Islands. Outbreaks on Easter Island were eradicated in 1971 and 1976. The larvae of the QFF have been recorded in the fruit of at least 125 different hosts.

Fruit injury occurs through oviposition punctures and subsequent larval feeding within the host. Damaging population levels build up in areas where the climate permits at least four generations a year. The third generation in such a climate is able to reach economic threshold levels if other factors such as lack of host fruit or dry or cold weather do not intervene. In more optimal areas, QFF can reach relatively high levels of infestation in earlier generations (i.e., coastal areas of Australia).

Parasites, while present, apparently are ineffective in lowering the level of total fruit infestation.

Development from egg to adult in an optimum temperature of 80 ^{o}F (27 ^{o}C) and 70 percent relative humidity takes approximately 16.3 days. The adult may become sexually mature approximately 8 days after eclosion. Under optimum conditions, the period of time for one generation is around 25 days. Females can live 3 to 5 months. All life stages are prolonged by cooler temperatures and other restrictive environmental factors (type of food, lack of food, etc.).

The ability of QFF to disperse, overwinter, and adapt to new situations and its wide host range make this a very serious pest. It is likely that QFF will be able to exist in most parts of the United States with tropical or temperate climates. However, it is unlikely that QFF can survive in areas that experience more than a few days with temperatures below 29 ^{o}F (-2 ^{o}C).

C. Life Cycle Information

Insect development is temperature dependent. Egg, larva, and adult development are influenced by air temperatures. Pupal development is influenced by soil temperatures. In both environments, there is a minimum temperature threshold below which no measurable development takes place. A model can be designed to use air temperature data for all insect stages and to predict the entire life cycle. Temperature data are available from the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, private, State, university, or industry sources, or are generated by strategically placed thermometers. If available, electronic temperature recording equipment should be used.

The threshold for QFF has been determined to be 52.7 ^{o}F from egg to newly emerged adult and 55.4 ^{o}F for maturation of the newly emerged female. The number of degrees accumulated above the developmental threshold during a 24-hour period is called day degrees (DD). For the model depicted in the following table, 753.4 DD must be accumulated before one life cycle has been completed.

Formula:

Minimum Daily		Maximum Daily		Total		Average Daily		Developmental Threshold Temperature		Day Degrees
Temp. ^{o}F	+	Temp. ^{o}F	=	$\frac{\text{Temp. } ^{o}\text{F}}{2}$	=	Temp. ^{o}F	-	Temp. ^{o}F	=	Temp. ^{o}F

Example: (Air model only)
From 0 to 599 DD (egg to adult)

Minimum Daily		Maximum Daily		Total		Average Daily		Threshold		Day Degrees
54 ^{o}F	+	74 ^{o}F	=	$\frac{128\ ^{o}\text{F}}{2}$	=	64 ^{o}F	-	52.7 ^{o}F	=	11.3 ^{o}F

From 599 to 753.4 DD (Maturing Female)

Minimum Daily		Maximum Daily		Total		Average Daily		Threshold		Day Degrees
54 ^{o}F	+	74 ^{o}F	=	$\frac{128\ ^{o}\text{F}}{2}$	=	64 ^{o}F	-	55.4 ^{o}F	=	8.6 ^{o}F

Periods of a week with the average daily mean below 57.2 °F (14 °C) will cause resorption of the follicles in the females and they will remain in this state until mean temperatures reach an average 55.4 °F (13 °C) or above, when DD accumulation can again began at 599 DD for adults. If temperatures remain below 55.4 °F (13 °C) for several weeks, mortality of the immature stages will reach 100 percent.

Periods of 4 or 5 days with average daily temperatures below 24.8 °F (-4 °C) will kill all immatures and cause degeneration of the ovaries in female adults. This would result in the DD accumulations being reset to 599 DD. DD accumulations would start again when average daily temperatures exceed 55.4 °F (13 °C).

The average daily upper thresholds are 78.8 °F (26 °C) for adults and 86 °F (30 °C) for immature stages. When temperatures rise above these thresholds, development rates decrease and the number of DD required to complete development significantly increases. The number of DD required increases by 5 percent for every 1.8 °F (1 °C) that the mean daily temperature is above these thresholds. Such conditions occur so rarely in the United States that for all practical purposes no change in DD calculations is needed.

Program actions are guided in part by insect life cycle data. Eradication treatments, trapping activities and regulatory functions are affected by the length of time it takes to complete each phase of the life cycle.

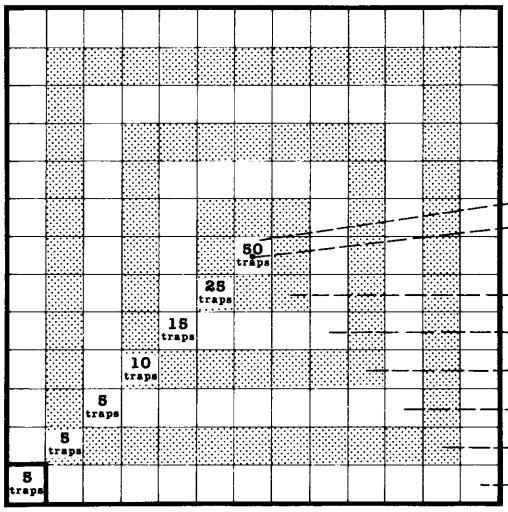
II. SURVEY PROCEDURES
(See Addendum D--Technical Survey Information)

A. Delimiting Survey

When one or more QFF are collected in an area, a delimiting survey will be implemented immediately to determine the population distribution. Using the detection as the epicenter (focal point), Jackson traps will be set out in a 50-25-15-10-5-5-5 per square mile (mi^2) trapping array. "Cue-lure" is used in the traps. The traps are serviced daily during the initial 7-day period, then serviced weekly. Traps will be maintained through three QFF generations after the last fly find.

TRAPPING ARRAY FOR QFF

Traps Set Per Square Mile



Core Area ; 1 sq. mile = 50 traps
Epicenter
(Focal Point)
1 Mile Buffer; 8 sq. miles = 120 traps
2 Mile Buffer; 16 sq. miles = 240 traps
3 Mile Buffer; 24 sq. miles = 240 traps
4 Mile Buffer; 32 sq. miles = 160 traps
5 Mile Buffer; 40 sq. miles = 200 traps
6 Mile Buffer; 48 sq. miles = 240 traps

McPhail traps are placed in the core area and the first buffer area at the rate of 25 in the core and 5 per mi^2 in the first buffer area. The setting of the Jackson traps has first priority.

To increase the effectiveness of the traps, place them in partial shade on the windward side of host trees or broadleaf nonhost trees. If possible, select host trees with ripening fruit.

B. Monitoring/ Evaluation Survey

A monitoring/evaluation survey will be conducted in areas where eradication treatments are applied. The Jackson trap is used at a minimum rate of five per mi^2 to monitor the wild QFF population when full coverage protein bait sprays

or male annihilation treatments are used. The traps are used to monitor the effectiveness of the treatment program.

Where a sterile fly release project is employed, a dry-type trap (either a Steiner or a Nadel) is substituted for the Jackson trap and used at the rate of five traps per mi^2.

C. Fruit Cutting — Preferred ripe or fallen host fruit within 1/4 mile (mi) of fly finds is cut and examined at the site. If fruit fly larvae are found the infested fruits are taken in a sealed container for identification by an authorized entomologist.

D. Host Collection and Holding — Collect fruit within 200 yards (yd) of a larval detection and hold for at least one QFF life cycle at optimum developmental temperatures of 80 ^{o}F (27 ^{o}C) and 40 to 70 percent relative humidity. Security of the facility where the fruit is held must be equal to those established for a quarantine insect rearing facility in APHIS publication, series 81, number 61.

E. Detection Survey — The area beyond the 6-mi buffer (up to 100 mi from the core area) is trapped at a minimum rate of one Jackson trap (using "cue-lure") per mi^2. These traps are to be serviced weekly and rebaited at a maximum of 12-week intervals. The traps are to be serviced for three generations after the last fly find and are relocated at each servicing depending on availability of preferred host.

F. Orientation of Survey Personnel — New personnel will be trained on the job by experienced personnel. Three working days will be necessary to teach the many facets of QFF survey.

G. Survey Records — Records noting the areas surveyed, sites trapped, dates, locations, and hosts in which detections were made will be maintained.

For sterile release, a Cunningham Report (CR) will be completed. The CR is a square graph that charts trap sites and gives the weekly ratio of sterile (X) to wild finds (Y) per mi^2.

X:Y	X:Y	X:Y
X:Y	X:Y	X:Y
X:Y	X:Y	X:Y
X:Y	X:Y	X:Y

III. REGULATORY PROCEDURES

Regulatory action will be required if one mated female, one larva, one pupa, or five or more adults are detected within a 169-mi^2 area during a 30-day period or estimated QFF life cycle.

A. Instructions to Officers

Regulatory actions will be required until the pest is eradicated. Officers must follow instructions for regulatory treatments or other procedures when authorizing the movement of regulated articles. Understanding the instructions and procedures will serve as a basis for explaining such procedures to persons interested in moving articles affected by the quarantine and regulations. Only authorized treatment procedures may be used.

General instructions that are to be followed in regulatory treatments may be found in the PPQ Treatment Manual.

B. Regulated Articles

1. Those fresh fruits, nuts, bolls, vegetables, and berries given in Addendum C which exist in the regulated area, will be listed as regulated articles.

2. Cannery waste.

3. Soil within the drip area of plants which produce the fruits, nuts, bolls, vegetables, or berries listed above.

4. Any other product, article, or means of conveyance of any character whatsoever when it is determined by an inspector that it presents a hazard of spread of the QFF and the person in possession thereof has been so notified.

C. Quarantine Actions

Regulatory action will be required if:

1. Five or more adults or an unmated female and a male are found within a 169-mi^2 area during a 30-day period or within one estimated QFF life cycle.

or

2. One mated female, or larva, or pupa are detected.

or

3. A single adult fly is found which is determined to be associated with a current eradication project.

When detections are made, implement the following steps:

a. Issue Emergency Action Notifications (PPQ Form 523) to all growers and establishments that grow, handle, or process regulated articles within 6 1/2 mi of the epicenter. Emergency Action Notifications and/or comparable State notifications are issued by field personnel to the property owners or managers of all establishments handling, moving, or processing articles capable of spreading the QFF. Notifications will be issued pending authoritative confirmation and/or further instructions from the Deputy Administrator.

b. If necessary, the Deputy Administrator will issue a letter directing PPQ field offices to initiate specific emergency action under the Federal Plant Pest Act (7 U.S.C. 150dd) until emergency regulations can be published in the Federal Register. For information on other legal authorities, see Section II A & B of the Federal Emergency Programs Manual.

c. The Deputy Administrator will notify State cooperators of the QFF detection, actions taken, and actions contemplated.

d. A narrative description of the regulated area with supporting documents will be developed by the U.S. Department of Agriculture (USDA) and the State cooperator and provided to the Domestic and Emergency Operations Staff (DEO), Operational Support (OS), PPQ. The regulated area will also be defined by the Universal Transverse Mercator (UTM) Grid map marking system for use by the Project Manager. The regulated area will normally be 169 mi^2.

e. APHIS will publish an interim rule covering the emergency regulations in the Federal Register. The interim rule will announce a date for submitting written comments, which shall be approximately 60 days after publication.

f. After receipt of written comments, a final determination specifying the action decided upon will be published in the Federal Register.

D. Regulated Establishments Inspection

Efforts to detect the pest within the regulated area will be made at establishments where regulated articles are sold, handled, processed, or moved. Establishments that might be involved are airports, landfill sites, fruit stands, farmers' markets, produce markets, flea markets, and any other establishment that handles regulated articles. A minimum of two Jackson traps or two dry-type traps may be deployed and serviced by survey personnel at those establishments deemed to be at risk by program management when a large QFF infestation exists.

E. Use of Authorized Chemicals

The PPQ Treatment Manual and this Action Plan contain the authorized chemicals, methods and rates of application, and any special application instructions. Concurrence by the DEO staff, OS, PPQ, is necessary for the use of any other chemical or procedure for regulatory purposes. If treatments selected or proposed, including those listed in this Action Plan, are not in conformance with current pesticide labels, an emergency exemption will need to be obtained under Section 18, or 24C, special local need (SLN), of FIFRA, as amended. For further instructions, see Emergency Programs Manual, Section V.B.

F. Approved Regulatory Treatments

1. Soil Treatment: An approved insecticide applied to within the dripline of host plants.

Diazinon--(Diazinon AG-500) 3.68 ounces (oz) (1.92 avoirdupois (avdp) ounces active ingredients (oz ai)) of 48 percent diazinon in enough water to soak soil over 1,000 square feet (ft^2) to kill larvae, pupae, and emerging adults. Adjust water hydrogen-ion concentration (pH) to 6.5 or less prior to adding insecticide. The treatment interval will be described in the exemption issued by the Environmental Protection Agency (EPA). Normally, treatments are applied at a 14-16 day interval.

2. Fumigation: The application of an approved fumigant as a treatment (methyl bromide) alone or in conjunction with cold treatment procedures.

3. Cold Treatment: The use of cold temperatures as a treatment on selected products alone or in conjunction with fumigation.

4. Bait Spray: The application of approved ground or aerial proteinaceous bait spray to commercial host properties within the regulated area, as a condition for certification and movement. Applications will be at the same prescribed intervals and dosages as given in IV.C.1 and 2, Eradication Procedures.

G. Principal Activities

The following identifies principal activities necessary for conducting a regulatory program to prevent the spread of the QFF. The extent of regulatory activity required is dependent on the degree of infestation. For example, safeguarding fruit stands throughout the entire regulated area which are only engaged in local retail activity may not be necessary when the regulations that are imposed are based on a limited and light infestation. On the other hand, mandatory checks of passenger baggage at airports and the judicious use of road patrols and roadblocks may be necessary where general or heavy infestations occur.

1. Advising regulated industry of required treatment procedures.

2. Supervising, monitoring, and certifying treatments of regulated articles.

3. Contact visits with:

   a. Security and airline personnel
   b. Fruit stands
   c. Local growers and packers
   d. Farmers, produce, and flea markets
   e. Commercial haulers of regulated articles
   f. Public transportation and
   g. Post office contacts.

4. Visiting canneries and other processing establishments.

5. Monitoring the movement of waste material to and from landfills to ensure adequate disposal of regulated articles.

6. Monitoring the movement of regulated articles through airports and other transportation centers.

7. Observing major highway and quarantine boundaries for movement of host materials.

H. Removing Areas from Quarantine

Areas placed under regulation may be removed from quarantine requirements after the QFF has been declared eradicated. Program management will identify areas to be removed at such time that three QFF life cycles have been completed since the last specimen recovery. One life cycle must have elapsed since the cessation of control activities. APHIS will publish a Notice of Quarantine Revocation in the Federal Register when areas are removed from quarantine requirements.

I. Orientation of Regulatory Personnel

Only trained or experienced personnel will be used initially. Replacement personnel will be trained by the individual being replaced. A training period of up to 3 working days is necessary for the orderly transfer of these functions.

J. Regulatory Records

Records will be maintained as necessary to carry out an effective, efficient, and responsible regulatory program. See Addendum G of this Action Plan for detailed instructions.

IV. ERADICATION PROCEDURES

The DEO staff, in consultation with methods and research agencies, will outline treatments to be used and must be notified of all treatment plans. If treatments selected or proposed are not in conformance with current pesticide labels, an emergency exemption will need to be obtained under Section 18, or 24C, special local need (SLN), of FIFRA, as amended. For further instructions, see Emergency Programs Manual, Section V.B.

Eradication of a QFF infestation in the continental United States is essential. The following provides approved procedures available for use in most situations. These procedures include mechanical, chemical and biological control (e.g., sterile flies). Local conditions will determine the most acceptable procedure or combination of procedures to achieve eradication.

A. Eradication Method Selection

The following criteria will provide guidance for the selection of appropriate treatments to achieve eradication. Treatments suggested are the minimum recommended response to the criteria. Additional treatment actions can be applied if mutually agreed upon by cooperating agencies. Eradication measures will continue for at least two QFF generations. Trapping to verify that eradication has been accomplished will continue for at least three life cycles after the last fly find.

1. If two to four immature and/or unmated adults are detected in an area involving less than 1 mi^2, ground-applied male annihilation treatments and bait spray will be the minimum response.

2. If the infestation criteria requiring regulatory action is met within approximately a 10 day period in an urban/residental area, the minimum recommended response will be ground-applied male annihilation treatments, soil treatment, and host stripping, with the addition of ground applications of bait spray. Similar fly detections in a commercial area are treated as above with the addition of aerial applications of bait spray. If sterile insects are available, Sterile Insect Release (SIR) may be used as an optional treatment, after reducing the pest population.

B. Recommended Pesticides

1. Diazinon
2. Malathion

Some pesticide and bait formulations can damage painted surfaces, plastics, and some uncoated metal surfaces. Care must be exercised when formulating and applying these compounds. Possible damage caused by accidental contamination can be eliminated or minimized by promptly cleaning the affected surface.

C. Approved Eradication Treatments

1. Male Annihilation Option

Spot Treatment: Apply the lure/insecticide to utility poles, trees, fences, etc., by using a hydraulic oil squirt can or pressurized spot applicator. Apply up to 2,500 evenly distributed "spots" per mi^2 or 600 to 800 to a city block. Apply treatment every 2 weeks.

The area of male annihilation spot treatments will extend a minimum of 4 1/2 mi beyond any known fly detection. After an estimated two QFF generations of negative trapping, treatments can be discontinued. Weather conditions may dictate changes in treatment schedules.

Male Annihilation Formulation (formulated by weight)

Malathion-----30 percent technical malathion (91 percent)
Min-U-Gel®-----23 percent Min-U-Gel 400®
Male Lure-----47 percent 4-(p-acetoxyphenyl)-2-butane ("cue-lure")

The proper viscosity of the formulation must be maintained to avoid splashback, runoff, and possible ineffective treatments on nonporous surfaces. This is done by adjusting the amount of Min-U-Gel so that the surface of "spots" will hold an indentation.

The male annihilate is squirted on tree trunks, fences, utility poles, etc., out of the reach of children, at the rate of 0.1 to 0.2 oz (3 to 5 mL) per spot.

Do not apply treatment to surfaces that appear greasy, wet, or stained with other substances which might interfere with the effectiveness of the bait.

Jackson Traps: If, in the opinion of program management and (if applicable) the relevant technical advisory committee, the use of spot treatments would prevent future detection trapping or contaminate the environment, Jackson traps could be used in lieu of the spot treatments. Such traps need not necessarily be equipped with inserts and could be serviced only to check on the condition of the trap and lure.

Generally, it will be difficult, if not impossible or impractical to set out 2,500 traps per sq mi (the bait spot density). Program management, considering all relevant factors and information, may need to settle for a lower density. From experience, a minimum of 1,000 traps per sq mi is necessary. Jackson traps, used in this manner for male annihilation, are considered a control devise by the EPA, and therefore requires an emergency exemption.

2. Aerial Proteinaceous Bait Spray Option

Treatment or retreatment should not be considered if weather reports indicate a 50 percent or greater chance of precipitation within 48 hours. The objectives are to eradicate the pest and minimize environmental contamination. Any treatment or retreatment recommendations must consider these objectives.

Full-coverage aerial application of protein bait spray will be initiated as soon as possible. The recommended number of applications of protein bait spray will be applied at the prescribed intervals.

The area of full-coverage bait spray will extend a minimum of 4 1/2 mi beyond any known fly detection.

After an estimated two QFF generations of negative trapping, spray operations may be discontinued. Apply full-coverage bait spray on a 7- to 10-day schedule. Protein bait spray for aerial application is applied at the rate of 2.4 oz of 91 percent technical grade malathion plus 9.6 oz of Staley's protein bait per a.

3. Supplemental Eradication Methods

a. Soil Treatment: Properties with confirmed larval infestations and the environs within 200 yd will have approved soil treatments applied within a minimum of 1-yard (yd) outside the drip line of all host plants and a minimum of 1-yd radius around any spot where host fruit may have dropped or rolled. Take particular care to soak cracks or crevices in or next to barriers to horizontal movement of larvae (i.e., sidewalks, stones, etc). Apply prescribed treatments at intervals stated in the specific exemption or SLN, as appropriate. Normally the interval is 14-16 days.

Diazinon--(Diazinon AG-500) 3.68 oz of 48 percent diazinon in enough water to soak soil over 1,000 ft^2 to kill larvae, pupae, and emerging adults. Use enough water to soak 2 in of soil. Adjust pH of water to 6.5 prior to adding insecticide.

Diazinon--Work Diazinon 14G 2 in into soil at the rate of 35 pounds (lb) per a or 1.45 oz per 12 feet (ft) diameter drip circle (113 ft^2). The area should be treated with water that has been buffered (6.0-6.5) to enhance percolation of the material into the soil.

b. Ground Applied Proteinaceous Bait Spray: Application of protein bait spray will be initiated immediately. All plants or trees which provide for reproduction or shelter for the QFF on the infested property and within 400 yd of the known infestation will be sprayed at the prescribed intervals. A minimum of 40 bait treatments per acre (a) will be maintained within this area so that a treatment is within the daily wandering range of each fly. Ground spraying may be discontinued after an estimated two generations of negative trapping or after the initiation of aerial bait spray treatments.

Ground Foliage Bait Spray Application

Malathion 50 WP------1 pound (lb)
Protein (Miller's)---2.5 gallons (gal)

Plus sufficient water to meet application equipment requirements.

The bait spray will be applied by means of a backpack sprayer or equivalent unit that has constant agitation. It is applied in the shady area on the windward side of fruit and ornamental trees and shrubs (nonhosts as well as hosts). Spray both inside and outside of foliage from near center to outside. Each host shall be given a spray sufficient to cover a minimum 1/2 square yard (yd^2) of foliage. Applications are sprayed out of reach of children or pets. When applied as a full-coverage foliar spray, mist blowers or similar units can be used. Treatments are to be applied 1 week apart.

The bait may be applied as a limited coverage application to hosts and plants providing shelter or resting areas by means of a backpack sprayer or equivalent unit. Applications are sprayed out of reach of children or pets. If full coverage application is desired, a mistblower or similar unit can be utilized. Treatments are to be applied 7 to 10 days apart.

Subsequent applications, if in orchards or groves, may be decreased by treating every other tree.

Ground application of protein bait spray formultions historically have not significantly reduced infestations in urban areas. This failure has been attributed to the inablility of crews to gain access to all sites requiring treatment, equipment constraints and timeliness of applications. Hence, this treatment should not be considered as a primary option for eradication in urban areas.

c. Fruit Stripping: All ripe host fruit within 400 yd of a larval find which has dropped or which is ripe and still on the tree or bush will be stripped. Stripped fruit is to be taken away in securely tied plastic bags and disposed of by deep burial in an approved landfill.

Green or ripening fruit is deliberately left on the host at the site. This will reduce the tendency of mature mated females to leave the area in search of suitable fruit for oviposition.

d. Sterile Insect Release: In situations where SIR is the most appropriate response to eliminate small incipient QFF populations, the technique may be employed. It may also be used after initial male annihilation spot treatment and protein bait spray and soil treatment have reduced pest population densities.

It may be used in conjunction with fruit stripping, ground application of protein bait spray, and soil drench.

Sterile QFF should be available from Melbourne, Victoria, Department of Agriculture or Brisbane, Queensland, Department of Primary Industry, but it may take more than 3 months to arrange a contract and increase production for shipment of sterile flies.

A trap array of five traps per mi^2 using Steiner or Nadel traps will be utilized in a monitoring survey throughout the area where sterile flies are released. The traps will be baited with "Cue-lure" and serviced on a 1-week schedule. In addition, a special QFF identification laboratory will be set up near the sterile release area for rapid identification of sterile flies.

Sterile release can be achieved using two methods. These methods are utilized to ensure that no less than 1/2 million adult flies are dispensed in the core area per week and no less than 250,000 adult flies per mi^2 are to be dispensed in the 6-mi buffer zone completely surrounding the core area. Additional flies are to be released in any mi^2 where monitoring surveys indicate that the overflooding ratio is less than 100 sterile flies to 1 native fly.

The following methods will be utilized to achieve sterile fly distribution:

(1) Roving Sterile Release: This release system involves the release of adult flies from a moving vehicle. Use of this system permits rapid dispersal of large volumes of adult flies under various favorable biological and environmental situations.

Roving sterile release is generally utilized within the core area or 1/2 mi beyond all positive detections. The roving sterile release method also may be used to distribute the 250,000 sterile flies per mi^2 per week within the minimum 6-mi buffer zone surrounding the core area.

Quality control data secured from the Rearing Supervisor will be used to determine how many flies to release.

(2) Aerial Sterile Release: This method of releasing sterile QFF provides better general distribution over an area than roving sterile release.

Fly distribution should be accomplished over the entire aerial release zone for any day aerial operations are conducted. It will be necessary to conduct additional aerial release flights over the core area to maintain the 2:1 ratio of populations (i.e., core area versus buffer zone) when aerial sterile release is the only method of release being utilized.

Either system (i.e., roving sterile release, aerial sterile release, or a combination of roving and aerial sterile release) is a satisfactory method of achieving desired sterile QFF distribution. Infestation size and location will influence the release method selected. This selection is to be made by control personnel.

D. Orientation of Eradication/ Control Personnel

Only trained and experienced personnel will be utilized initially. Replacement personnel will be trained by the individual being replaced. A training period of up to 3 working days is necessary for the orderly transfer of these functions.

E. Eradication/ Control Records

Records noting the locations, dates, number and type of treatments, and materials and formulations used will be maintained for all areas treated. See Action Plan Addendum G for detailed instructions.

F. Monitoring

An effective monitoring program will be implemented to aid in the evaluation of program efforts and environmental impact. The application of pesticides or release of sterile insects will be assessed through the use of appropriate monitoring program criteria. The evaluation must effectively address Agency, cooperator, and public concerns.

The monitoring program will include at least the following elements:

1. Determine efficacy of the pesticide against the target pest.

2. Evaluate dye cards to monitor aerial bait application.

   a. Droplet size information
   b. Droplet distribution information
   c. Bait deposition information
   d. Identification of wind drift components
   e. Verification of spray block boundaries
   f. Identification of skips and
   g. Weekly evaluation of "Cunningham Report" (SIR only).

3. Sampling to evaluate effect on environmental components.

   a. Water sampling to detect insecticide levels through direct application, leaching, and runoff

   b. Soil sampling to determine insecticide levels and residues

   c. Foliage sampling to identify residues

   d. Biological organism sampling during applications and posttreatments to determine impact of insecticides and

   e. Air sampling to determine presence of pesticides in respirable air.

The monitoring program is to be a combined effort between the State in which the emergency program is being conducted and PPQ. Specific plans will need to be developed for monitoring activities and the DEO staff will request assistance and guidelines from the Policy and Program Development (PPD) Staff.

V. REARING AND STERILIZING PROCEDURES

The logistics of supplying, equipping, irradiating, packaging, and monitoring sterile fly releases is a program within itself. For detailed information involving supplies, equipment, packaging, monitoring, and quality control, see the Emergency Programs Manual.

VI. CONTACTS

When a QFF eradication program has been implemented, its success will depend on the cooperation, assistance, and understanding of many involved groups. The following is a list of groups which must be kept informed of all operational phases of an emergency program.

1. Other Federal, State, county, and municipal agricultural officials

2. Grower groups

3. Commercial interests

4. Universities

5. State and local law enforcement officials

6. Public health

7. Foreign agricultural interests

8. National, State, and local news media and

9. The general public.

VII. ADDENDA

Addendum A--Definitions

Aerial Proteinaceous Bait Treatment:	Applying an insecticide and a protein hydrolysate bait by aircraft over a treatment area.
Aerial Sterile Release:	Releasing sterile QFF over a designated area by aircraft.
Aerial Release Area:	The core area and all areas up to 6 mi beyond each known infestation or to a suitable natural barrier within the 6-mi peripheral area.
Array:	The trapping pattern in a 1-mi^2 area.
Array Sequence:	The trapping pattern (array) beginning with the core area and continuing outward through each buffer area ending with the outer buffer area.
Bait:	An attractant and food source mixed with an insecticide for treating QFF infestations.
Buffer Area:	The area extending beyond the boundary of the core--1-, 2-, 3-, 4-, 5-, and 6-mi buffer.
Cold Treatment:	The use of cold temperatures as a treatment on selected products alone or in combination with fumigation.
Commercial Production Area:	An area where host material for commerce is grown.
Confirmed Detection:	A positive laboratory identification of a submitted life form (specimen) as QFF.
Core Area:	The area up to 1/2 mi from any confirmed QFF detection.
Dacus tryoni (Froggatt):	The scientific name for QFF.
Day Degrees:	An accumulation of heat units above a developmental threshold.
Delimiting Survey:	Determining whether an infestation exists and if so, the extent of the infestation in an area where the QFF has been detected.
Detection:	The collection of any life stage of QFF.
Detection Survey:	An activity conducted in a susceptible area not known to be infested with the QFF.

Developmental Threshold:	The minimum (or maximum) temperature below (or above) which physiological development stops (peaks).
Epicenter/Focal Point:	The initial site of an infestation.
Eradication:	The confirmed removal of all QFF life forms in a specified geographical area, as determined by the completion of three life cycles without pest specimens being recovered.
Fruit Collection Survey:	The collection of fruit to determine the extent and nature of an infestation.
Fruit Cutting Survey:	Cutting fruit and examining for larvae.
Fumigation:	The application of an approved fumigant as a treatment (methyl bromide, Phostoxin®) alone or in conjunction with cold treatment procedures.
Generation: (Life Cycle)	The period of time for the pest to complete all stages of development.
Ground Proteinaceous Bait Spray:	Using ground equipment to spray host vegetation in a QFF infested area with an insecticide and a protein hydrolysate bait.
Host:	A plant species that provides for reproduction of the QFF.
Host Collection/Holding:	The collection and holding of host material to determine the extent and nature of an infestation.
Infestation:	The collection of a larva, pupa, mated female, or five or more QFF adults within one estimated life cycle in an area determined by program officials to be infested and based on finds believed to be associated with an infestation, or the detection of a single adult determined to be associated with a current infestation.
Infested Area:	A distance of 4 1/2 mi from all detection sites.
Lure Bait: (Cue-lure)	A male lure/bait with a thickening agent and insecticide.

Male Annihilation Procedure:	An eradication procedure that is designed to kill the adult male QFF. Bait spots which consist of a lure, thickening agent and an insecticide are ground applied.
Monitoring/Evaluation Survey:	Using interdependent visual and trapping surveys in an area where an insecticide treatment is in progress to evaluate the effectiveness of the application.
PPQ-APHIS-USDA:	Plant Protection and Quarantine, Animal and Plant Health Inspection Service, U.S. Department of Agriculture.
Regulated Area:	An area that extends a minimum of 6 1/2 mi in all directions from an infested property.
Regulated Articles:	All known or suspected hosts of QFF, also cannery waste, soil and any other suspected product or article.
Regulatory Survey:	Trapping conducted around establishments where regulated articles are sold, handled, processed, or moved.
Roving Sterile Release:	The release of sterile QFF from a motor vehicle.
Soil Treatment:	The application of an approved insecticide to the soil of nursery stock and within the dripline of host plants.
Static Sterile Release:	Placing pupae in protective stations for the emergence of sterile QFF.
Sterile Release:	Releasing sterile QFF in an area as a method of eradication or as one of several methods in an integrated eradication program.
Ultralow-Volume Bait Spray:	A mixture of an insecticide with protein hydrolysate. This mixture is applied as droplets by aircraft.
Urban/Residential Area:	An area containing multiple- or single-family dwellings.

Addendum B--Safety

Personnel and public safety must be a prime consideration at all times. Safety practices should be stressed in preprogram planning and through the duration of actual program operations. Supervisors must enforce on-the-job safety procedures. For complete instructions, see V, D, in the Emergency Programs Manual.

Addendum C--Hosts

The QFF host list has been separated into preferred and other hosts. The hosts are listed by common and scientific names. The common names of a particular group or family of hosts are listed first. In all instances, an attempt has been made to select the most widely recognized common name. Where a common name includes more than one word, the host may be listed more than once; first under the first common name, and second under the popular common name in the title, if one is given. This follows the practice given in USDA Agriculture Handbook Number 505, "A Checklist of Names for 3,000 Vascular Plants of Economic Importance". Thus, a host with the word "apple" in its common name will be listed under "Apple" as well as under its first common name. Some species which have no accepted or approved common name but are identifiable as a particular kind of plant, are designated by (ncn) = no common name. Other species without an accepted or approved common name are given at the end of the appropriate catagory. There are a total of 141 hosts in this list. Grapes, while not favored, are attacked in years and areas of high fruit fly activity, resulting in cases of incomplete development in adult flies.

PREFERRED

Common Name	Scientific Name
Almond, tropical	Terminalia catappa
Apple, crow's	Owenia venosa
black	Sideroxylon australe
Chinese	Zizyphus mauritiana
domestic	Malus domestica
Apricot	Prunus armeniaca
Banana, common	Musa x paradisiaca
dwarf	Musa nana
Black apple	Sideroxylon australe
Blackberry	Rubus fruticosus
Black mulberry	Morus nigra
Bluebelly sapsucker	Rauwenhoffa leichhardtii
Boxwood, grey	Hemicyclia australasica
Brazilian cherry	Eugena uniflora
Burdkin's plum	Pleiognium cerosiferum
Cherry, Brazilian	Eugena uniflora
sweet	Prunus avium
Cherry guava	Psidium cattleianum
Chinese apple	Zizyphus mauritiana
Cockspur, Indian	Cydrania javanensis
Crow's apple	Owenia venosa
Date palm	Phoenix dactylifera
Dwarf banana	Musa nana
English walnut	Juglans regina
Eugenia	Eugenia spp.
Feijoa	Feijoa sellowiana
Fig, common	Ficus carica

Garden plum	Prunus domestica
Glochidion	Glochidion ferdinandii
Granadilla, (ncn)	Passiflora quadrangularis
purple	Passiflora edulis
Grape	Vitis spp.
Grapefruit	Citrus paradisi
Grey boxwood	Hemicyclia australasica
Guava, common	Psidium guajava
cherry	Psidium cattleianum
Indian cockspur	Cydrania javanensis
Ivorywood	Siphonodon australe
Japanese persimmon	Diospyros kaki
Kumquat	Fortunella japonica
Lemon	Citrus limon
Loquat	Eriobotrya japonica
Mandarin orange	Citrus reticulata
Mango	Mangifera indica
Myrobalan, (ncn)	Terminalia melanocarpa
(ncn)	Terminalia muelleri
Mulberry, black	Morus nigra
white	Morus alba
Nectarine	Prunus persica var nectarina
Orange, mandarin	Citrus reticulata
sour	Citrus aurantium
sweet	Citrus sinensis
Palm, date	Phoenix dactylifera
Peach	Prunus persica
Pear, common	Pyrus communis
Persimmon, Japanese	Diospyros kaki
Plum, Burdkin's	Pleiognium cerosiferum
garden	Prunus domestica
ornamental	Prunus cerasifera
Pomegranate	Punica granatum
Purple granadilla	Passiflora edulis
Quince	Cydonia oblonga
Sapsucker, bluebelly	Rauwenhoffa leichhardtii
Sour orange	Citrus aurantium
Sweet cherry	Prunus avium
Sweet orange	Citrus sinensis
Tomato	Lycopersicon esculentum
Tropical almond	Terminalia catappa
Walnut, English	Juglans regina
White mulberry	Morus alba

OTHER RECORDED

The literature indicates these hosts will permit QFF development but does not disclose all the conditions under which the host/pest relationship occurs. In addition, known oriental fruit fly (Dacus dorsalis) hosts should also be suspect. This statement is based on similarities between the two species and the currently

limited geographic range of Dacus tryoni. Oriental fruit fly host lists are available in the action plan under that species. QFF larvae cannot complete development in unripe avocado but oviposition scars result in downgraded fruit, and thin-skinned varieties are plagued by QFF. If favored hosts are absent, QFF will oviposit into previously unacceptable fruit after 4 days without access to suitable hosts. It is possible that some unacceptable hosts will permit completion of development.

Common Name	Scientific Name
Apple, custard	Annona reticulata
kei	Davyalis caffra
rose	Eugenia jambos
sugar	Annona squamosa
vi-	Spondias cytherea
Ash, white (Australian)	Schizomeria ovata
Avocado	Persea americana
Baei fruit	Aegle marmelos
Beech, canary	Polyalthia nitidissima
Berry, blackberry	Rubus spp.
Cape gooseberry	Physalis peruviana
Chinese gooseberry	Actinidia chienensis
loganberry	Rubus ursinus
mulberry	Morus spp.
Blackapple	Planochonella australis
Blackberry	Rubus spp.
Blush walnut	Beilschmiedia obtusifolia
Boxthorn	Lycium spp.
Boxwood, yellow	Planochonella pohlmaniana
Brazilian nightshade	Solanum seaforthianum
Bryoni, native	Bryonopsis laciniosa
Canary beech	Polyalthia nitidissima
Cape gooseberry	Physalis peruviana
Caper	Capparis lucida
Carambola	Averrhoa carambola
Cashew	Anacardium occidental
Ceriman	Monstera spp.
Chain fruit, (ncn)	Alyxia ruscifola
Cheesewood tree	Acronychia laevis
Cherry penda	Eugenia kuranda
Cherry, sour	Prunus cerasus
	Eugenia corynantha
Chinese gooseberry	Actinidia chienensis
Citron	Citrus medica
Coffee	Coffea arabica
Cotton	Gossypium hirsutum
Creek lilly pilly	Syzygium paniculatum

Cucumber	*Cucumis sativus*
Currant bush	*Carissa ovata*
Custard apple	*Annona reticulata*
Davidsonian plum	*Davidsonia pruriens*
Eggplant	*Solanum melongena*
Fig, a cluster (ncn)	*Ficus glomerata*
green-leaved Moreton Bay	*Ficus watkinsiana*
Indian	*Opuntia ficus-indica*
moreton bay	*Ficus microphylla*
wild black	*Ficus stephanocarpa*
Giant Burmese honeysuckle	*Hemicyclia australasica*
Giant honeysuckle	*Lonicera hildebrandiana*
Gooseberry, Cape	*Physalis peruviana*
Chinese	*Actinidia chienensis*
Granadilla, sweet	*Passiflora ligularis*
Grape, a native (ncn)	*Cissus* sp.
Gum, small-leaved water	*Eugenia luehmannii*
Hemicyclia	*Hemicyclia australiensis*
Honeysuckle, giant	*Lonicera hildebrandiana*
giant Burmese	*Hemicyclia australasica*
Indian fig	*Opuntia ficus-indica*
Kei apple	*Davyalis caffra*
Kiwi fruit	*Actinidia chienensis*
Leichhardt tree	*Nauclea orientalis*
Lemon, scrub	*Acronychia acidula*
Lilly pilly	*Acmena smithi*
Lime bush	*Eremocitrus glauca*
Loganberry	*Rubus ursinus*
Maple, southern	*Cryptocarpa erythroxylon*
Mock olive	*Notelaea longifolia*
Mulberry	*Morus* spp.
Nightshade, Brazilian	*Solanum seaforthianum*
Olive, common	*Olea europaea*
mock	*Notelaea longifolia*
Papaya, common	*Carica papaya*
Passion-flower	*Passiflora* spp.
Passion-flower, tagua	*Passiflora foetida*
Pear, prickly	*Opuntia tuna*
Pearwood, brown	*Amorphospermum antilogum*
Pepino	*Solanum muricatum*
Peppers	*Capsicum* spp.
Persimmon	*Diospyros* spp.
Plum, Davidsonian	*Davidsonia pruriens*
ornamental	*Prunus cerasifera*
Pogada	*Mimusops parvifolia*
Pomegranate, native (ncn)	*Capparis michellii*
(ncn)	*Capparis nobilis*
Pomelo	*Citrus grandis*
Pricklypear	*Opuntia tuna*
Queensland greenheart	*Endiandra compressa*

Rose apple	Eugenia jambos
Rose walnut	Endiandra discolor
Sapote, white	Casimiroa edulis
Scrub lemon	Acronychia acidula
Snail flower	Vigna caracalla
Sour cherry	Eugenia corynantha
Southern maple	Cryptocarpa erythroxylon
Sugar apple	Annona squamosa
Vao	Bleekeria elliptica
Vi-apple	Spondias cytherea
Walnut, Blush	Beilschmiedia obtusifolia
Rose	Endiandra discolor
Water gum, (ncn)	Acmena macrocarpa
White ash (Australian)	Schizomeria ovata
White sapote	Casimiroa edulis
Whitewood	Atalaya hemiglauca
Yellow boxwood	Planochonella pohlmaniana
Ylang-ylang	Cananya odorata

The following do not have common names. They are mostly rain forest trees and shrubs endemic to Australia and the Pacific islands.

Aglaia sapindina	Eugenia comiflora
Castanospora alphandii	Eugenia pendula
Chrysophyllum chartacea	Eugenia suborbicularis
Chrysophyllum pruniferum	Ganophyllum falcatum
Dallachya vitiensis	Mimusops elengi
Diospyros australis	Planochonella spp.
Elaeodendron australe	Rhipogonum papuanum
Endiandra cowleyana	Rhodamnia sessiliflora
	Solanum auriculatum

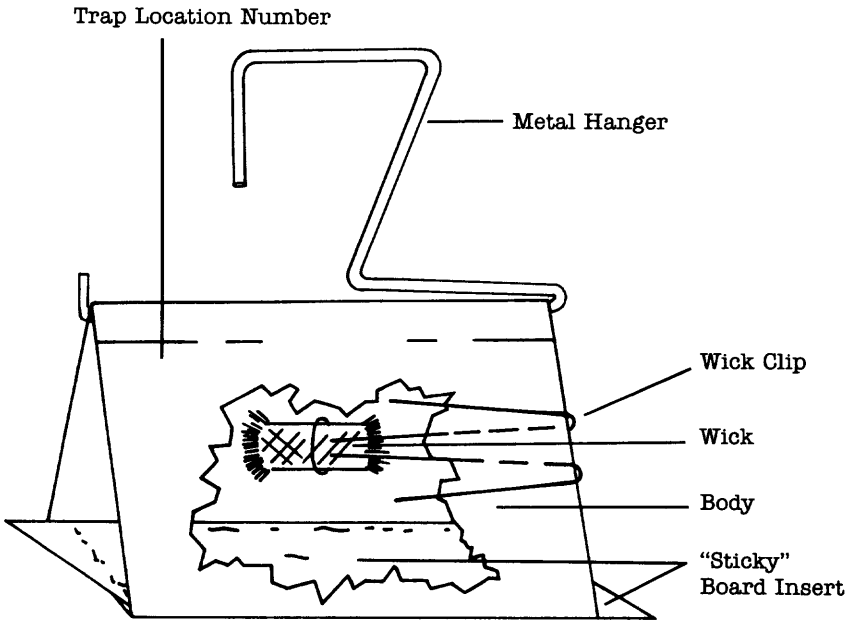
Addendum D--Technical Survey Information

1. Jackson Trap

A Richmond dental wick 3/4 inch in diameter and 1 1/2 in long will be installed in the trap. The wick will be baited with a mixture of 8 parts "Cue-lure" and 1 part technical malathion (91 percent). The initial baiting will require 6 milliliter (ml) of lure. Subsequent rebaiting will require adding sufficient lure to saturate the wick without dripping. Due to cue crystallization a period of 12 weeks between wick replacement is optimum but will depend on lure evaporation and crystallization caused by existing weather conditions.

If a blowing rain should occur, all traps should be replaced as soon as possible due to contamination.

Jackson Trap

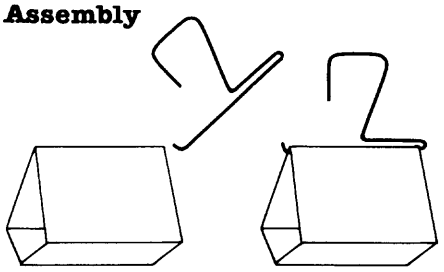


The Jackson trap consists of five parts:

- trap body
- insert
- wick holder
- wick
- trap hanger

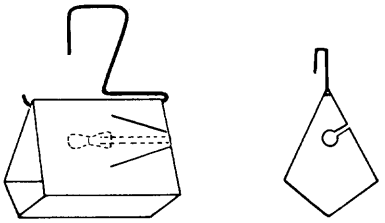
Jackson Trap

Assembly



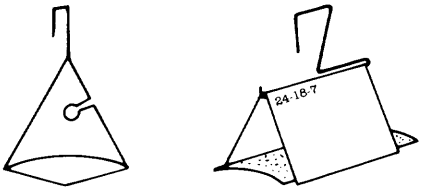
Insert trap hanger at top of trap. Do not bend hanger. It is brittle and will break easily.

Put a 90° bend in wick holder one inch from end. Insert the wick.



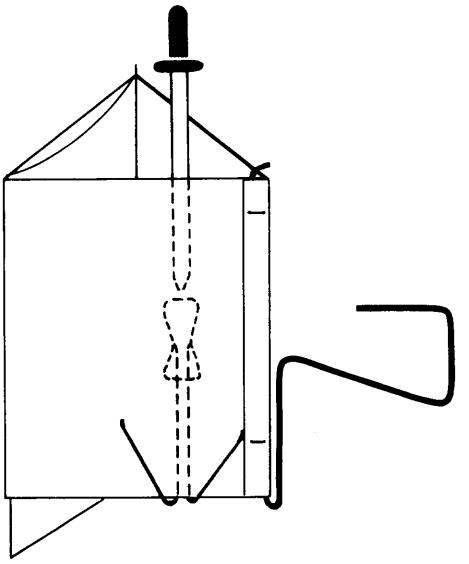
Insert wick holder on side of trap, ensuring that the wick does not touch the side wall, and the wick is midway inside trap.

Put trap number on non-sticky side of insert. Make sure that the stickum is good.



Bow sticky side upward and insert in trap. Number trap body before hanging.

Baiting



NEVER bait a trap over trapping supplies.
ALWAYS bait over an absorbent material.

Each trapper can service 20 to 50 traps per day, depending on density.

a. When baiting traps, turn trap on end and add 3 ml of cue-lure + malathion to the end of the wick. Then turn the other end of the trap up and add 3 ml to the other end of the wick. This will total 6 ml. Take extreme care not to drip any of the lure on the insert or trap body, or the efficiency of the trap will decrease. If lure is on the outside, the flies will mill around and may not enter the trap at all.

Take care not to saturate wicks to the point that they will drip sometime after the trap is placed in the host.

Care must be taken when baiting the trap. An accidental spill, even a few drops, will cause a decrease in the effectiveness of the trap or may make it totally ineffective.

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b. Once a trapper selects a trap site, the location will be plotted on a map which has been sectioned or gridded into 1 square mile blocks. In addition, a trap location record (normally a file card), with a rough drawing or sketch of the specific trap location, will be prepared to document trapping activities such as dates of placement and servicing. Periodically, the trap should be moved to other hosts of equal or greater preference.

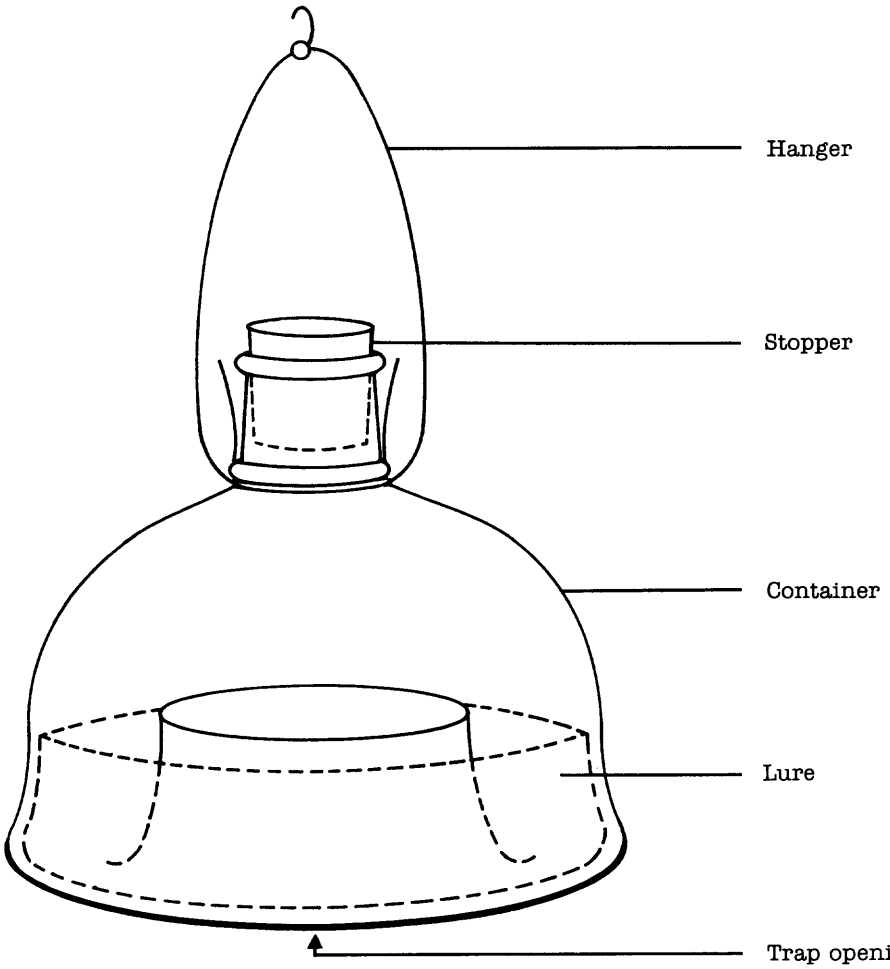
2. The McPhail Trap

a. Concentrate Solution: 1 gallon (gal) of water
4.23 avdp oz of ammonium chloride
10 fluid oz of Millers NU-LURE ®

This solution is best prepared with warm water and stirred. Adjust hydrogen-ion concentration (pH) to 8.5 by varying the amount of ammonium chloride.

Mix concentrate solution with warm water (50/50) before use. Stir again before adding solution to trap. Approximately 200 mL per trap is recommended. Trap should be filled 1/4 to 1/2 in below lip.

McPhail Glass Trap



3. Quality Control

Field supervisors oversee each trapper's work. In addition to arranging schedules, helping with problems, and overall direction, the following quality control items are carried out:

a. Evaluation. The field supervisor periodically checks a number of traps run by each trapper. On an evaluation sheet the supervisor lists the trap number, location, description, and date and notes the condition of the wick, trap placement, and trapping schedule. Trappers are advised of results and problem areas are worked out.

b. Trapping Directory--Map Requirement

(1) Trap Location Directory. A list of all trappers, traps, servicing dates, field supervisors, and a copy of each trap card giving the exact location of each trap is maintained in a directory.

(2) Map. A large-scale master map, gridded to the coordinates used in the survey, will be maintained and updated each day. The map will show the location of all traps and finds throughout the regulated area.

c. Initial Trap Training and Public Relations

New trappers will be given individual instruction on proper trap placement.

(1) Trap placement

(a) Selection of trapping sites. In selecting possible trap sites, consideration should be given to the availability of food and shelter near hosts, with fruit, in which to place the trap. If two or more possible trap locations meet this criteria, preference should be given to the site that has a greater variety of hosts and shelter. In many cases, single trees will be the only host available and should be utilized. Never pick a location solely because it will look good on a map. For QFF, traps placed in plants providing food and shelter have a higher likelihood of catching specimens. Placing a trap in a poor or second rate host, or even in a prime host without fruit when food and shelter or hosts with mature fruit are available, has the effect of making the lure compete with natural attractants. In some cases, a very desirable host may be lacking in mature fruit or have insufficient shade for trap placement. In such cases, a nearby honeydew source is a desirable trap location. Generally, it is not advisable to place a trap in a host without fruit unless it shows evidence of abundant honeydew or sooty mold. Both serve as a food source. Honeydew is a sweetish, clear excretion produced by certain insects such as aphids, scale insects, mealy bugs, and whiteflies. It is a good food source for adult fruit flies. A fungus called sooty mold lives on the honeydew. This mold makes the leaves appear blackish. The presence of sooty mold is an indication that the host is infested with insects that produce honeydew.

Those hosts which are likely to bear mature fruit and/or be attractive feeding/shelter sites for most of the year should form the bulk of the trapped hosts. The common guava and the mango are choice honeydew sources.

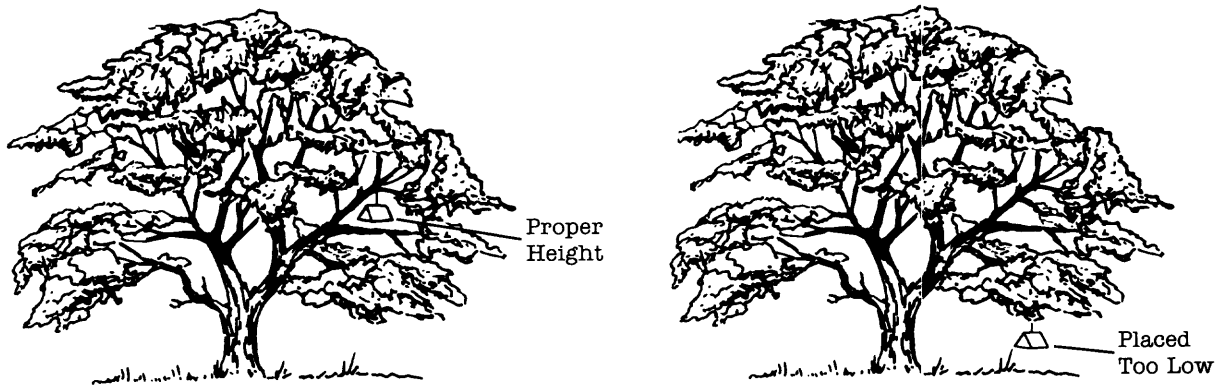
Trees having sparse foliage should be avoided when other protection is available. This is true especially during the summer months, since these trees do not produce enough shade. When a tree does not have sufficient shade, the trap should be placed in some other host or nonhost nearby.

Desirable trap sites should be noted on the Trap Location Record to facilitate future trap locations. This may be done at the time of initial trap placement or as the sites are noted during trap servicing.

(b) Placement of trap in host. Generally, it is not advisable to place a trap in a host without fruit except when the tree is being used as a trap site adjacent to a host which has insufficient shade.

The trap should be placed in the windward side of a host or nonhost at a point high enough to be out of reach of children, livestock, or pets. It should be secured in a manner to prevent it from being blown down. During the summer or warmer portions of the year, the trap must be placed in open shade; whereas, in the winter or cooler time of the year, it should be placed in a southern exposure, but not in direct sunlight. It is preferable to place it 1/2 to 2/3 the distance from the trunk to the outer edge of the foliage. The trap should not hang below or outside the foliage of the tree. The trap should not be placed in dense foliage that may protrude into the trap or give the fly a resting place that would prevent it from entering the trap.

It is desirable to have foliage below the level of the trap but not necessarily directly beneath the trap. A pole with a metal hook attached to one end can be used to place the trap sufficiently high in the host to be out of easy reach of children and curious adults.



Correct **Incorrect**

(2) Public Relations

Good public relations are an important part of the survey specialist's duties. They are constantly in view and frequently in contact with the public. They should be courteous at all times. Prolonged conversations should be avoided, but short, cordial conversations concerning work are desirable. Do not be drawn into arguments concerning program activities.

Survey Officers represent the Department of Agriculture and form an image of that Agency in the eyes of the public. Dress, personal appearance, and actions should be appropriate to make a good impression with the general public.

Shorts and tee-shirts may not be worn. Long pants or slacks and shirts or blouses with sleeves are prescribed for comfort and protection.

Shoes must be worn. Leather shoes with heavy soles help prevent nail and glass cuts.

Identification badges must be worn every workday at chest level for easy identification.

When entering a property for the first time, always attempt to contact the property owner or caretaker, explain the work briefly, and ask permission to place the trap. In conversations with the public, traps should be referred to as "insect survey traps." If no one is home a "Memorandum to Property Owner or Tenant" should be left.

(3) Preliminary Training

A vial of five dead, marked QFF (wing-clipped and color-marked) is sent to each field supervisor by registered mail. These are randomly placed on a Jackson trap insert and shown to all trappers. As part of the demonstration, the flies will be submitted for identification as described in normal operational procedures.

d. Quality Control Advisors

In a large program, quality control advisors may be employed. These personnel will monitor the trapping program. The advisor works with trappers, assisting with proper trap location, baiting, host selection, trap deployment, and recordkeeping. Deficiencies and recommended improvements in the trapping district are reported to the field supervisor. Such reports are also given to the program manager. Periodic staff meetings of advisors are held to exchange viewpoints and discuss improvements.

e. QFF Quality Control Trapping Test Program

During the course of a large eradication program, it may be advisable to bait a selected number of traps with marked, dead QFF. This would maintain a high level of trapping awareness as well as ensure trapper recognition of and standardize reporting and trapping procedures. Previously killed, marked QFF will be obtained elsewhere and handled at project headquarters. The following procedure is suggested to minimize risk but actual procedures may vary, depending on agreement with State cooperators. Project managers will contact DEO staff for procedures to implement this test program.

(1) Trap Selection

Each field supervisor will randomly select 5 to 15 traps per trapper to be tested and provide all data to the program office at least 1 full week in advance of test date.

(2) Preparation

The field supervisor will be notified of the approximate delivery time of the specimens. Specimens will be selected and checked for color markings. As a precaution, the color will be changed each month, and the right or left wing will be clipped. Only the program office will be aware of the color and clipping schedule.

(3) Mailing

Each marked specimen will be placed in its own vial with a quality control identification number. The number will be recorded in a quality control log. The marked flies will then be sent by registered mail to the field supervisor. The field supervisor will send the program office a list of the traps to be baited for logging by specimen number. Specimens will be placed in traps no earlier than 1 day before normal servicing.

(4) Return

When a marked specimen is detected, standard trapping procedures are followed. However, the specimen is returned in the original vial, the pest detection report slip is given the quality control number under remarks, and the specimen is returned to the program office via registered mail.

(5) Oral Tests

To maintain trapper awareness, an occasional test may be given. General discussion may follow each test so that all concerned will benefit.

Addendum E--Life History

1. Systematic Position

Queensland Fruit Fly, Bactrocera tryoni (Froggatt) (Diptera, Tephritidae).

Class : Insecta
Order : Diptera
Family: Tephritidae

Drew (1989) revised the Dacinae, raising Bactrocera to full generic rank. Bactrocera and Dacus are now in the Dacini. Most of the species, including Dacus tryoni are now in Bactrocera.

One of about 300 species of the genus Bactrocera, ranging from the Middle East to Australia. Most of these species are found in Southeast Asia, New Guinea, and other South Pacific islands. The other major economic species of Bactrocera are:

Oriental fruit fly, B. dorsalis (Hendel); Melon fly, B. cucurbitae (Coquillett); Peach fruit fly, B. zonatus (Saunders); Philippine oriental fruit fly, B. occipitalis (Bezzi); Jarvis' fruit fly, B. jarvisi (Tryon); Cucumber fly, B. cucumis (French); Lesser Queensland fruit fly, B. neohumeralis (Hardy).

A number of other species are recognized as potential major pests but, at present, have restricted distribution and/or a limited number of known economic hosts.

2. Identification Characters

Larvae: A typical headless maggot, creamy white; attains length of 10 millimeters (mm); 11 segmented; very similar to other Bactrocera. Larvae feed inside host material in large numbers. There are three instars; third instar larvae have the ability to flip.

Puparium: Brown; 5- to 6-mm long. Larvae normally pupate in the soil 2 to 3 centimeters (cm) under the surface.

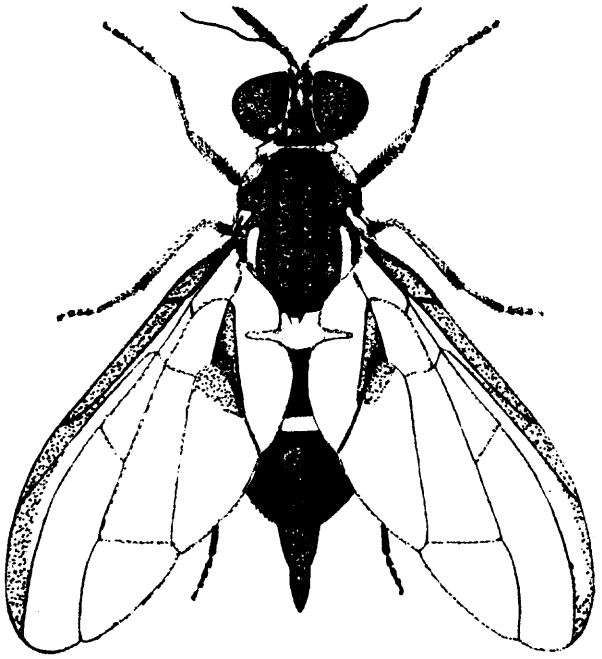
Adults: 6- to 8-mm long; slightly larger than a house fly. Color overall reddish brown, thorax red brown with dark markings and two lateral yellow stripes between wings, a yellow scutellum, a yellow swelling (notopleural callus) in front of each wing and another yellow swelling (humeral callus) on each side behind head. Wings clear with several brownish streaks; one narrow, complete streak along anterior margin of wing (coastal band) to apex, one streak covering wing near base

(anal streak). Head with one pear shaped blackish facial spot under each antenna in front of each eye, eyes red, green, or even purple. Scutellum with two long hairs; there are two other long hairs in front of these, but on the thorax. Abdomen red brown with dark brown bands on the sides. Legs are brownish yellow.

Variant or food form: Adults coming from larvae which have fed on nutritionally inadequate hosts (i.e., walnut, grape) may be quite small and dark.

Eggs: Slender, white, elliptical, without sculpturing; 1- to 2-mm long, slightly curved; in groups of 6 to 7 in any exposed host, especially in previous punctures or injuries.

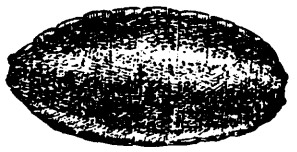
Queensland Fruit Fly



Bactrocera tryoni (Frogatt)

Adult (natural size)

Larva (magnified 5 times)



Pupa (magnified 7 times)

3. Biology

A mated female flies off in search of ripening fruit. For most commercial hosts, such fruit is most acceptable in the week before falling and when free of other fruit fly larvae (detected by chemical changes in the fruit). She lays up to 12 eggs (usually 4 to 5) by puncturing the skin in the leeward, shady side of each fruit where soft or rough areas of skin occur. A female can lay up to 1,000 eggs in a lifetime. The female will oviposit readily into previously unacceptable fruit after 4 days without access to suitable hosts. This is due to the physiological control of oocyte maturation. In QFF, in contrast to other, more specialized Dacus spp. which do not accumulate oocytes when deprived of fruit, there appears to be no inhibition of oocyte development once the primary follicle has matured. The accompanying increase in eggload influences its propensity to accept unusual fruits. This may help explain the rapid acceptance of most cultivated fruits introduced in the 1880's in Queensland, Australia.

Eggs hatch in 2 to 3 days, and after several days the larvae begin eating their way to the center of the fruit, often causing it to decay. While there may be few external signs, the fruit usually drops to the ground if severely infested. As fruit can be attacked repeatedly, many larvae can be found within one fruit. The larval period varies from 7 days in summer to more than 6 weeks in autumn, depending on temperature and fruit host.

Third instar larvae emerge from the fruit in 5 to 7 days and drop to the ground if fruit has not already fallen. They burrow 0.8 to 1.2 in (20 to 30 mm) into the soil (not absolutely necessary for survival) to pupate. The pupal period may be as short as 1 week, but is usually about 22 days in summer to 60 days by late fall before cold weather kills the remainder. While there is obviously some adjustment to cooler weather, there is no pupal diapause in this species.

Upon emergence, post-teneral adults undergo a migratory phase lasting 2 to 3 weeks, with 75 percent leaving the immediate vicinity in the first week. This dispersal is generally uniform and largely independent of the availability of hosts in the area or of prevailing wind direction. There may be some orientation toward broadleaf trees or bushes harboring leaf surface bacteria, especially if rains or heavy dew have been prevalent in an area. Since such nutrients provide a rich food source (proteins, vitamins, and minerals) for the adults and the means by which viable eggs are produced, locations with such trees or bushes may serve as important adult feeding areas even in the absence of suitable larval host plants. The average dispersal distance is 4 mi (6.4 kilometer (km)) but is known to extend up to 6 to 10 mi after 2 weeks and

10 to 16 mi after 3 to 7 weeks. The longest distance traveled in any numbers based on indirect evidence is 37.8 mi (60 km) for QFF. This dispersal mechanism is considered likely an adaptation to the original habitat of patches of rain forest along a narrow coastal belt in Queensland, Australia, in which both available hosts and the fly populations are sparse and scattered.

In warm weather, immature flies normally take 8 to 10 days to become sexually mature and to respond to pheromones or lure traps. In cooler weather, it may take up to several months for both sexes to become sexually mature. Generally, the female mates only once. If they resorb their ovaries due to cold weather or deplete their sperm supply several weeks after their first mating, they may mate again. Males are capable of mating repeatedly over several weeks.

Once flies have reached maturity, they tend to seek out host fruits and mate. This results in a second, mature migrating phase which is directly related to the availability of host fruit. It also results, initially, in reaggregation of the sexes and facilitates mating. Overall, the mean distances traveled are about the same; however, if suitable fruiting hosts are available in an area, perhaps only 50 percent of these mature flies will emigrate away to other areas; and there may even be a net immigration rate higher than the emigration rate of either post-teneral or mature females, resulting in the mature immigrant females laying most of the eggs in the area.

There may be a third dispersive movement in response to adversity. Mature flies will avoid or stay away from localities that become unsuitable due to lack of fruit, water, food, or shelter and aggregate in localities where these are available. Thus, flies will rapidly leave a grove or orchard when they run out of fruit in which to oviposit or if it becomes dry and a water shortage develops. They will then aggregate around fruit trees elsewhere. In the late fall or early winter when flies do not mature and therefore do not seek out fruit, they will depart in response to dropping temperatures and leaf fall to search for and aggregate in overwintering (protective) sites.

If temperatures are within normal limits, moisture is of primary importance in determining the abundance of QFF. Fly density can be quite high and has been estimated at 16,000 mature adults per mi^2 in dry sclerophyll woodland influenced by migration of flies from nearby urban areas. Such densities have been measured with Cue-lure traps which have been demonstrated to have a capture efficiency of 8 percent of mature males of this kind of heavy population per week, when deployed at a rate of 16 traps per mi^2. Heavier populations can be expected where food, moisture, and host fruit are in ample supply.

Upper temperature limits for QFF indicate that a single daily maximum of 104 °F (40 °C) would be harmless to all stages but that daily maximums of 96.8 °F to 100.4 °F (36 °C to 38 °F) for a week would cause high mortality, while 100.4 °F to 104 °F (38 °C to 40 °C) would result in extinction.

If winter intervenes during the year, it is passed in the adult stage. This is predominantly of immature, unmated flies (90 percent). The QFF is capable, through acclimation, of adaptation to a wide range of environments from tropical to cool temperate and a range of temperature extremes from 26.6 °F to 109.4 °F.

The ability to acclimatize rapidly is due to two critical but short stages in the life cycle (developmental acclimation). Exposure to cold in the stage just prior to the "hopping larva" phase or the pharate adult phase (just before emergence) within the puparium produces, within a few days, an adult with the capacity for full acclimation to cold. Mature or post-teneral flies acclimatize only very slowly, taking about 100 days to reach the lowest temperature threshold. However, as average temperatures in the course of a season change only gradually, this is no handicap in the field and acclimatization for winter conditions can start 2 to 3 months before winter arrives.

Changes in the temperature threshold for cold-torpor and for survival at subfreezing temperatures improve chances of survival in climates where the yearly minimum is in the range 24.8 °F to 27.5 °F. Acclimation takes place in the fall but is not necessary for frost survival if the yearly minimum stays above 24.8 °F. Extinction occurs if the yearly minimum falls below 23.9 °F.

Another factor is that while adult D. tryoni acclimatize to dropping temperatures at the rate of 1.8 °F (1 °C) per minute, the torpor temperature (temperature at which flies are alive but are inactive) of any fly depends on the temperature they were reared in. The lowest possible torpor temperature is approximately 34.7 °F (1.95 °C) achieved by acclimation to 59 °F (15 °C) or lower. Acclimation will result in a fly with a lower torpor temperature down to this limit (maximum cold resistance). The reverse, an increase in temperature, will result in reacclimation at a slower rate to the higher temperature. This means that acclimation as a process, while effective in preserving the species, is not effective in preventing daily periods of torpor for much of the winter in cold areas. Resumption of activity in the spring to early summer is dependent on and delayed by reacclimation.

In the fall, flies will not attain maturity until the following spring or early summer. Females with mature ovaries will resorb their follicles, in effect regressing to an immature state. The most advanced follicle is resorbed first unless mature eggs are present, in which case the penultimate follicle is first. The

viable, mature eggs are laid, and then both the ultimate follicle and any sperm present are resorbed. If temperatures remain or go back above 2 DD per day above threshold 56.3 °F (13.5 °C), the ovaries may continue to mature even in winter, but both development and resorption will reoccur if the DD drop between 2 and 0 above the threshold again. Both development and resorption cease or do not occur if temperatures drop below the developmental threshold.

A behavioral adaptation to increasing cold also enhances survival. As the torpor threshold is approached, flies seek refuge in sheltered locations where they remain until temperatures rise again. They are capable of staying in such sheltered places until spring or until sufficiently warmed above the torpor threshold to become active again. During the day flies usually rest on the underside of leaves of broad-leafed evergreens (where flies can easily be seen against a green background). The microclimate in sheltered locations provides a refuge during nights of subfreezing temperatures and prolonged cold weather.

Mortality, which is equal between the sexes, occurs as a result of natural wastage at the rate of 8 percent (the same as other times) and by exposure to subfreezing temperatures. The latter effect increases in proportion to the severity and duration of the low temperatures experienced. Generally, short periods of 28.4 °F to 24.8 °F (-2 °C to -4 °C) do little harm, especially when potentially lethal temperature declines occur relatively slowly in the field. If, however, such temperatures drop suddenly or temperatures below (greater than) 24.8 °F (-4 °C) are very frequent, then the chances of survival are very low. A prolonged cold spell of 14 °F (-1 °C) is enough to eradicate the QFF from a given area. Temperatures of 32 °F (0 °C) or above are not sufficient to result in mortality above natural wastage.

In the spring or early summer, overwintering adults will become sexually mature (if emergence took place in late fall) or become mature again (older flies).

Maturation, under a minimum constant temperature regime of 2 DD per day above threshold, is at a rate of 3.5 percent per day and takes 28 days. Obviously, with increasing temperatures this period is greatly shortened to the optimum (minimum) of 8+ days. If temperatures are irregular but progressively higher in the spring, adults may become sexually mature but mating may be delayed. Adults will otherwise remain in an immature state. The older females (and males) will re-mate along with the younger flies when warm temperatures return. Mating follows a circadian pattern and takes place at dusk during an approximate 1/2-hour period with an optimal low light intensity of 9 lux, provided temperatures are above a threshold of 60.8 °F (16 °C).

Males generally aggregate from as far as 328 ft (100 meters (m)) away into a flying swarm and settle on the windward side of a host (or nonhost) tree. Aggregation is probably helped both by male pheromone and, for late arrivals, by stridulation. They may orient to a particular tree as a swarm marker, but this has not been proven.

Each male settles on a leaf. It defends a territory about 3/4 in (2 cm) in radius from other males. Each stridulates, standing on the leaf with head vertically upward and rubbing the wings across a pair of hairy combs on the third abdominal tergite. This can last for 5 minutes before another spot is chosen. Females, probably attracted by both male pheromone and stridulation, fly singly into the lek area, pick out a male, land, and go to him. Mating takes place quickly and on average lasts about 35 minutes. With a fall in light intensity to 1 lux, the swarm disperses approximately 1/2 hour after it formed. Aggregation and swarming are not obligate for successful mating as stridulating individuals and mated pairs have been found alone.

Mating is affected by acclimation. Cold-acclimated flies, such as those which have overwintered, mate at a low frequency for a greater number of days than warm acclimated flies which mate at high frequency for 1 to 2 days. The total number of matings is about similar for both groups. However, in competition for females, warm acclimated males always outcompete cold-acclimated males in mild temperature regimes and are equal in competitive abilities in harsh (near torpor threshold) regimes.

What is essentially a tropical species is, therefore, able to adapt to cooler regions due to its ability to acclimate to low temperatures, long life expectancy, and high capacity for increase when conditions are favorable. In some areas, the adult stage is the only one capable of survival throughout the winter. Over the last 100 years, the QFF has gradually extended its range in Australia as adaptation and availabilty of hosts have both apparently developed apace. The possible breakdown of isolating mechanisms between QFF (which mates at dusk) and Dacus humeralis Hardy, the lesser QFF (which mates at noon), as a result of cultivation and subsequent hybridization may have resulted in an introgression of genes. Such an introduction of additional genetic material could have helped serve as the raw material for the rapid adaptive evolution observed.

The mechanism for this adaptation and freeze tolerance is not understood at present for QFF. However, changes in enzyme levels or isozyme patterns may be involved. Alternatively, nucleating proteins could have been introduced into the blood, production of cynoprotectants (glycogen to polyols and sugars) through enzyme kinetic properties, and increase in intracellular bound water could all, alone or in some combination, be factors.

The complete life cycle usually takes 5 to 9 weeks. It can be as short as 2 to 3 weeks in summer and up to 2 months by autumn. As many as five overlapping generations may develop annually as adult females live for extended periods, which can be as much as a year or more under cool temperature regimes. The life span of males may also be correspondingly prolonged, but there is no certainty on this point.

Addendum F--Identification of Specimen(s)

As many specimens as possible of the pest are to be collected for screening/ identification by the local designated identifier.

Suspect adult specimens collected from Jackson traps should be handled carefully. To insure that specimens caught in sticky material can be accurately identified, the following procedures are recommended.

-Cut out a portion of the insert surrounding the specimen. This will leave you with the specimen imbedded in sticky material on a small piece of cardboard. Put an insect pin (number 2 size) through the cardboard and pin the cardboard (with specimen attached) in a mailmaster type pinning box. You are thus treating the specimen as a pinned specimen and do not need to use alcohol or other liquids. To ship the pinning box for identification place it inside a second shipping box and put padding between the two boxes.

- You may find it easier to lift the specimen out of the sticky material with a small spatula. Try not to touch the specimen, i.e., lift from underneath and bring a glob of the sticky material with it. Place the specimen on a small square of paper such as a piece of 3 x 5 index card. The sticky material should hold it on. Then put an insect pin through the piece of index card and place it in a mailmaster pinning box. Ship as described above.

Suspect larvae should be killed by placing in water, bringing to the boiling point, cooling, and then preserved in 70-75% ethyl alcohol. Suspect adult specimens collected from McPhail and Jackson traps and other insect stages should all be forwarded in vials of alcohol for confirmation to 1/ in the following chart. These specimens must be accompanied by PPQ Form 391 (Specimens for Determination) marked "Urgent" (see PPQ Manual M390.500). Telephone the identifier prior to shipping specimens to alert them of the shipment.

INFORMATION FLOW FOR THE IDENTIFICATION OF SPECIMENS

SPECIMENS COLLECTED

V

SCREENING/IDENTIFICATION BY STATE OR PPQ
Laboratory (Optional)

V

SPECIMEN SUBMITTED for Confirmation[1/]

V

CONFIRMATION NOTIFICATION[2/]
to Other USDA Agencies

V

RESULTS SENT TO APHIS AND IF EXOTIC
Information Relayed to [3/] [4/]

1/	Arizona, Louisiana, New Mexico, Texas	Mr. D. Riley PPQ, APHIS, USDA P.O. Box 306 Brownsville, Texas 78520
	Other States West of the Mississippi River	Ms. K. Corwin California Department of Food and Agriculture 1220 N Street Sacramento, California 95814
	States East of the Mississippi River	Dr. H. Weems Florida Department of Agriculture and Consumer Services P.O. Box 1269 Gainesville, Florida 32602

2/APHIS — Plant Protection and Quarantine

3/All States — State and Territory Agricultural Regulatory Officials

4/NAPPO — North American Plant Protection Organization

Addendum G--Forms

	Number	Title
CONTROL	PPQ 213	Airplane Inspection Record
	PPQ 431-R	Treatment Test Record
	PPQ 468	Caution - Pesticide Treatment in Progress
	PPQ 552-R	Pesticide Samples for Chemical Analysis
	PPQ 602	Environmental Monitoring
	PPQ 603	Residue Sample for Food or Feed Products
	PPQ 802	Daily Aircraft Record
REGULATORY	PPQ 214	Warning Quarantine Label
	PPQ 244	USDA - APHIS Warning Quarantine (Tag)
	PPQ 254	Disposition of Plants and Plant or Animal Products
	PPQ 287	Mail Interception Notice
	PPQ 468	Caution - Pesticide Treatment in Progress
	PPQ 518	Report of Violation
	PPQ 519	Compliance Agreement
	PPQ 522	Certified Under All Applicable Federal or State Cooperative Domestic Plant Quarantine (Tag)
	PPQ 523	Emergency Action Notification
	PPQ 524	Issuance Record for Permits or Certificates
	PPQ 527	Certified Under All Applicable Federal or State Cooperative Domestic Plant Quarantine (Package Certificate)
	PPQ 530	Limited Permit
	PPQ 535	Certificate of Treatment (Fruit-Foreign Site)
	PPQ 537	Limited Permit (Movement of Noncertified Articles)
	PPQ 540	Certificate of Federal/State Domestic Plant Quarantines
	PPQ 551	Regulated Establishment Record
	PPQ 554	Certified Under All Applicable Federal or State Cooperative Domestic Plant Quarantines (Label)
	PPQ 577	Phytosanitary Certificate
SURVEY	PPQ 343	Trapping Record
	PPQ 345	Caution - Do Not Handle or Move
	PPQ 391	Specimens for Determination
	PPQ 539	Trapping Survey Record

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Addendum I--References

Owing to its importance in Australia, the literature on QFF in that country is very extensive. QFF, in fact, is one of the best researched fruit flies, but it is little known outside Australia in spite of its potential as an extremely serious agricultural pest.

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