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Plant Health
Inspection
Service

Cooperating State
Departments of
Agriculture

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ACTION PLAN

MALAYSIAN FRUIT FLY
Bactrocera latifrons (Hendel)

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.

VI. Addenda.....VI-A1
Addendum A--Definitions.....VI-A1
Addendum B--Safety.....VI-B1
Addendum C--Hosts.....VI-C1
Addendum D--Technical Survey Information.VI-D1
Addendum E--Life History.....VI-E1
Addendum F--Identification of Specimens..VI-F1
Addendum G--Forms.....VI-G1
Addendum H--Contributors.....VI-H1
Addendum I--References.....VI-I1

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AUTHORIZATION

This Action Plan provides guidelines and actions for the eradication of a Malaysian fruit fly (MALFF), Bactrocera latifrons, 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.

The procedures described in this Action Plan were developed through discussion, consultation, or agreement with the cooperating State officials.

Lonnie J. King
Administrator
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3/31/93
Date

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4/9/93
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 the 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 Malaysian fruit fly (MALFF), Bactrocera latifrons (Hendel), 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 MALFF eradication program. Specific emergency program action is to be based on information available at that time.
- B. Background Information
- The MALFF is a native of South and Southeast Asia, including Southern China, Taiwan, Malaysia, Thailand, Laos, India and Pakistan. It has been recorded in about 25 hosts, mostly Solanaceae and Cucurbitaceae (see Addendum C). Of these, it is primarily a serious pest in the Solanaceae and is more incidental in the Cucurbitaceae.
- Fruit injury occurs through ovipositional punctures, with generally one egg laid per puncture. The female can lay up to 587 eggs (see Addendum E). The resultant larva feeds within the host, just under the skin, causing damage from feeding and deposition of larval frass. Secondary damage results from various microorganisms which enter the pulp through the puncture in the skin. Generally, the MALFF maintains low-level populations with a patchy distribution.
- Under laboratory conditions, development from egg to adult takes 21 days at an optimum temperature of 80 °F (26.6 °C) and 60% relative humidity. The adult may become sexually mature 6 to 17 days after eclosion. Under optimum conditions, about 31 days are required for each generation. Females will live, on average, over 2 months and those that remain are likely to live another month. About 5% remain after 4 months. The longest-lived female lived to about 20 weeks (136 days). All life stages are prolonged by cooler temperatures and other restrictive environmental factors (type of food, lack of food, etc.).
- 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, from private, State, university, or industry sources, or are generated by strategically placed thermometers. If available, electronic temperature recording equipment should be used to provide information for life cycle models.

The critical parameters for MALFF have not been determined. In the absence of specific data on MALFF, updated known thresholds from Melon fly will be employed. Melon Fly parameters were chosen since both species utilize cucurbitaceous and solanaceous hosts.

The applicable Melon fly thresholds are 48.6 °F (9.22 °C) in air for the egg and larval stages, 47.7 °F (8.72 °C) in soil for the pupal stage and 50.7 °F (10.39 °C) in air for the maturing 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, one life cycle for the Melon fly is complete when 867.2 DD are accumulated.

Periods of cooler weather may result in substantial extensions of the life cycle for larval and pupal stages and these formulas must be used with caution.

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.

Formula:

<u>Minimum</u> <u>Daily</u>	<u>Maximum</u> <u>Daily</u>	<u>Total</u>	<u>Average</u> <u>Daily</u>	<u>Developmental</u> <u>Threshold</u> <u>Temperature</u>	<u>Day</u> <u>Degrees</u>
Temp. °F + Temp. °F = $\frac{\text{Temp. °F}}{2}$ = Temp. °F - Temp. °F = Temp. °F					

Example: (Air Model 48.6 °F Threshold) Melon Fly Egg and Larva

An example of DD calculations for a day with a maximum temperature of 74 °F and a minimum temperature of 54 °F. An accumulation of 179.1 DD is required for development from egg to pupa.

<u>Minimum</u> <u>Daily</u>	<u>Maximum</u> <u>Daily</u>	<u>Total</u>	<u>Average</u> <u>Daily</u>	<u>Developmental</u> <u>Threshold</u> <u>Temperature</u>	<u>Day</u> <u>Degrees</u>					
54 °F	+	74 °F	=	$\frac{128 \text{ °F}}{2}$	=	64 °F	-	48.6 °F	=	15.4 DD

Example: (Soil Model 47.7 °F Threshold) Melon Fly Pupa

An example of DD calculations for a day with temperatures as above for pupal development. An accumulation of 285.4 DD is required for pupal development to the adult stage. The pupal stage begins at 179.1 DD and ends when 464.5 DD are accumulated. Note that the developmental threshold temperature is different (lower) for this life stage. While this results in a faster accumulation of DD at the same temperature levels for a given day, it is more than balanced by the DD required for pupal development.

<u>Minimum</u> <u>Daily</u>	<u>Maximum</u> <u>Daily</u>	<u>Total</u>	<u>Average</u> <u>Daily</u>	<u>Developmental</u> <u>Threshold</u> <u>Temperature</u>	<u>Day</u> <u>Degrees</u>					
54 °F	+	74 °F	=	$\frac{128 \text{ °F}}{2}$	=	64 °F	-	47.7 °F	=	16.3 DD

Example: (Air Model 50.7 °F Threshold) Melon Fly Maturation

An example of DD calculations for a maturing adult female. The adult stage begins at 464.5 DD and ends when 867.2 DD are accumulated. Note the developmental threshold temperature has changed again and is higher for this life stage. The DD accumulation will be slower as a result, given that temperature levels remain the same.

<u>Minimum</u> <u>Daily</u>	<u>Maximum</u> <u>Daily</u>	<u>Total</u>	<u>Average</u> <u>Daily</u>	<u>Developmental</u> <u>Threshold</u> <u>Temperature</u>	<u>Day</u> <u>Degrees</u>					
54 °F	+	74 °F	=	$\frac{128 \text{ °F}}{2}$	=	64 °F	-	50.7 °F	=	13.3 DD

preferred hosts are not fruiting or not available.

- 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 5 per mi² to monitor the wild MALFF population when full coverage protein bait sprays are used. The traps are used to monitor the effectiveness of the treatment program.
- 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 in infested fruit, it is taken in a sealed container for identification by an authorized entomologist.
- D. Host Collection and Holding
Fruit within 200 yards (yd) of a larval detection should be collected and held for at least one MALFF life cycle at optimum developmental temperatures of 80 °F (27 °C) and 60 percent relative humidity. Security of the facility where the fruit is held must be equal to that established for a quarantine insect rearing facility in APHIS publication, series 81, number 61.
- E. Detection Survey
The area beyond the delimiting survey is trapped at a minimum rate of five McPhail and/or Jackson traps per mi², depending on the availability of LTL. These traps are to be serviced weekly and rebaited monthly unless conditions indicate the need for greater or lesser servicing/rebaiting intervals. The traps are to be serviced for the equivalent of three generations after the last fly find. Traps are relocated at each servicing interval depending on availability of preferred host.
- F. Orientation of Survey Personnel
New Personnel will be trained on the job by experienced personnel.
- G. Survey Records
Records noting the areas surveyed, sites trapped, dates, locations, and hosts in which detections were made will be maintained.

III. REGULATORY PROCEDURES

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 (PTM).

B. Regulated Articles

A variety of articles may present direct or indirect risk of spreading MALFF. The movement of these articles will be regulated to prevent the infestation from spreading. Regulated articles include:

1. Those fresh fruits and vegetables listed in Addendum C which exist in the regulated area.
2. Cannery Waste.
3. Soil within the drip area of plants which produce the fruits, melons, vegetables and berries listed in Addendum C.
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 MALFF and the person in possession thereof has been so notified.

C. Quarantine Actions

Regulatory action will be required if:

1. Two or more adults are found within a 3 mile radius within one estimated MALFF 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, the following steps should be taken:

a. Emergency Action Notifications (PPQ Form 523) and/or comparable State notifications are issued by field personnel to the property owners or managers of all establishments within 1/2 mile of the epicenter that handles, moves, or processes articles capable of spreading the MALFF. 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, Parts A and B of the APHIS Emergency Programs Manual (for plant pests).

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

d. A narrative description of the regulated area with supporting documents will be developed by USDA, APHIS Field personnel and the State cooperator and provided to the Domestic and Emergency Operations Staff (DEO), Operational Support (OS), PPQ. The regulated area will normally be within an approximate 3-mile radius around each fly find.

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.

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

D. Regulated
Establishments
Trapping

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 include airports, landfill sites, fruit stands, farmer's markets, produce markets, flea markets, nurseries, and any other establishments

that handle regulated articles. Traps may be placed and serviced by survey personnel at regulated establishments which are considered a significant risk during a large MALFF infestation.

E. Use of Authorized Chemicals

The PTM and this Action Plan identify chemicals authorized for MALFF control, methods and rates of application, and any special application instructions. Concurrence by the DEO staff 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 compliance with current pesticide labels, 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. Regulated articles may be certified for movement after treatment.

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 the top 2 inches (in) of soil over 1,000 square feet (ft²) to kill larvae, pupae, and emerging adults. The water hydrogen-ion concentration (pH) should be adjusted to a pH of 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 to 16 day interval.

2. Fumigation: The application of an approved fumigant (methyl bromide) as a treatment 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 protease bait spray to commercial host properties within the regulated area, as a condition for certification and movement.

G. Principal Activities

The following identifies principal activities necessary for conducting a regulatory program to prevent the spread of the MALFF. The extent of regulatory activity required is dependent on the degree of infestation.

For example, to safeguard fruit stands throughout the entire regulated area when these stands are only engaged in local retail activity may not be necessary during a localized 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.

Principal regulatory activities include:

1. Contacting and advising regulated industry of regulations and required treatment procedures.
2. Issuing compliance agreements, certificates and permits.
3. Supervising, monitoring, and certifying treatments of regulated articles.
4. Conducting compliance inspections at regulated establishments such as:
 - a. Nurseries
 - b. Fruit stands
 - c. Landscape gardeners and lawn maintenance companies
 - d. Local growers and packers
 - e. Farmers, produce, and flea markets
 - f. Commercial haulers of regulated articles
 - g. Public transportation
 - h. Post office contacts and
 - j. Canneries and other processing establishments.
5. Monitoring the movement of waste material to 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.
8. Notifying homeowners near detection sites of regulations.

H. Removing
Areas from
Quarantine

Areas placed under regulation may be removed from quarantine requirements after the MALFF has been declared eradicated. Program management will identify areas to be removed when the equivalent of three MALFF

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.

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 Development, PPQ and research agencies, will identify and outline effective treatments to be used and must be notified of all treatment plans. If treatments selected or proposed are not in compliance with current pesticide labels, an emergency exemption will need to be obtained under Section 18, or 24C, SLN, of FIFRA, as amended. For further instructions, see Emergency Programs Manual, Section V.B.

Eradiation of a MALFF infestation in the continental United States is essential. The following provides approved procedures available for use in most situations. These procedures include mechanical and chemical controls. Local conditions will determine the most acceptable procedure or combination of procedures to achieve eradication.

A. 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.

Various environmental components are monitored to ensure the safe application of all pesticides (see Part F. Monitoring of this Section).

B. Approved Eradication Treatments

1. Ground Applied Proteinaceous Bait Spray

Application of protein bait spray should be initiated as soon as an eradication project is began. All host plants or trees of MALFF within 400 yards (yd) of the detection site will be sprayed at the prescribed intervals. Ground spraying may be discontinued after an estimated two generations of negative trapping or after the initiation of aerial bait spray treatments.

Formulation

Malathion 50 WP or ULV-----1 pound (lb) ai/acre
Protein (Miller's)-----2.5 gallons (gal)

Plus sufficient water (if applicable) 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 to the leaves on shady areas of hosts.

When applied as a full-coverage foliar spray, mist blowers or similar units can be used. Treatments are to be applied 1 week apart.

2. Aerial Proteinaceous Bait Spray

Full-coverage bait spray should be applied on a 7 to 10 day schedule. Protein bait spray for aerial application is applied at the rate of 2.4 oz of technical grade malathion plus 9.6 oz of protein bait per acre. The area of full-coverage bait spray will extend a minimum of 1 1/2 mi beyond any known fly detection.

After an estimated two MALFF generations of negative trapping, spray operations may be discontinued.

Treatment or retreatment should not be considered if weather reports indicate a 50 percent or greater chance of precipitation within 48 hours. Rainfall immediately following a treatment reduces the effective period of the treatment.

The objectives of this treatment are to eradicate the pest with minimal environmental contamination. Any treatment or retreatment recommendations must consider these objectives.

3. Soil Treatment

Approved soil treatments should be applied under host plants on properties with confirmed larval infestations, and may be applied under host plants within 200 yd radius of infested properties. The prescribed treatments should be applied at intervals stated in the section 18 or section 24(c), 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 ft² to kill larvae and emerging adults. Use enough water to soak the top 2 in of soil. To avoid premature degradation of the ai, adjust pH of water to 6.5 prior

to adding insecticide.

Diazinon--Work Diazinon 14G 2 inches into soil at the rate of 35 lb per acre (a) or 1.45 oz per 12 ft diameter drip circle (113 ft²). The area may be pretreated with water that has been buffered (6.0 - 6.5) to enhance distribution of the material into the soil.

4. Cultural Control

a. Fruit Stripping

All ripe host fruit within 200 yd of an infested property when a larval find has occurred, and which has either dropped or is still on the vine or bush, will be stripped. Stripped fruit is to be double bagged in thick plastic bags, securely tied, and disposed of by deep burial in an approved landfill.

b. Plowing

Plots or fields of annual or perennial hosts, such as tomatoes, which are within 200 yd of a confirmed larval find, should be plowed to minimize survival of any life stages present in the soil.

- 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.
- 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 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 will be assessed through the use of appropriate monitoring program criteria. The evaluation must effectively address Agency, cooperator, and public concerns.

The program plan will include at least the following elements:

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

2. Evaluate dye cards to monitor aerial bait applications, especially;

- a. Droplet size
- b. Droplet distribution
- c. Bait deposition
- d. Identification of drift components
- e. Verification of spray block boundaries
- f. Identification of skips

3. Sampling to evaluate the effect of a MALFF program on the environment will be conducted in accordance with the Environmental Monitoring Plan for either the Florida Fruit Fly Eradication Program or the Mediterranean Fruit Fly Eradication Program. These monitoring plans are developed by the Technical and Scientific Services (TSS) staff of Biotechnology, Biologics, and Environmental Protection (BBEP). They include pre and post application sampling and observations to determine the impact on soil, water, vegetation, and non-target species. Carcass searches are a part of this monitoring.

In compliance with the National Environmental Policy Act (NEPA), an Environmental Assessment (EA) has been prepared for the MALFF Action Plan by the Environmental Analysis and Documentation (EAD) staff of BBEP. In the event of an infestation, appropriate site-specific NEPA documentation will be prepared by EAD in cooperation with PPQ.

V. CONTACTS

When a MALFF eradication program is implemented, its success will depend on the cooperation, assistance, and understanding of many involved groups. The following groups should be continually 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.

VI. ADDENDA

Addendum A--definitions

Aerial Proteinaceous Bait Treatment:	Applying an insecticide and a protein hydrolysate bait by aircraft over a treatment area.
Array:	The trapping pattern in the delimiting survey area located around a detection.
Array Sequence:	The intensity of traps within an array, beginning with the core area and continuing outward through each buffer area, ending with the outer buffer area.
<u>Bactrocera latifrons</u> : (Hendel)	The scientific name for Malaysian fruit fly (MALFF).
Bait:	An attractant and food source mixed with an insecticide for treating MALFF infestations.
Buffer Area:	The area extending a prescribed distance beyond the boundary of the core, the 1-, and 2-mi buffers.
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 is grown for wholesale or retail markets.
Confirmed Detection:	A positive laboratory identification of a submitted life form (specimen) as MALFF.
Core Area: (Survey)	The four square mile area surrounding any confirmed MALFF detection.
Core Area: (Regulatory)	The one square mile area defined in the CFR for the purpose of determining where treatments may be conducted.
Day Degrees:	An accumulation of heat units above a developmental threshold.

Addendum B--Safety

Personal 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 Section V.D. in the Emergency Programs Manual.

Jujube, common
Kikania-lei
Lemon
Litchi
Mango
Melon
Melon, oriental pickling
Orange
Potato Tree

Rambai

Ziziphus jujuba
Solanum aculeatissimum
Citrus limon
Litchi chinensis
Mangifera indica
Cucumis melo
Cucumis melo var. conomon
Citrus sinensis
Solanum erianthum
 (=verbascifolium)
Baccaurea motleyana

No Common Name Available

Solanum spp.
Solanum aurattense
Solanum incanum
Solanum indicum
Solanum nigrescens
Solanum trilobatum

Solanum auriculatum
Solanum nodiflorum
Solanum sarmentosum
Solanum surattense
Solanum pseudocapsicum

Addendum D--Technical Survey Information

Details on trapping and servicing are currently under development. Contact Dr. Nicanor J. Liquido, USDA, ARS Tropical Fruit and Vegetable Research Laboratory, P.O. Box 4489, Hilo, Hawaii 96720, Telephone (808) 959-9138.

A trapping manual is under development. When complete, details of trap servicing, quality control, trapper training, public relations, etc., that are common to any fruit fly survey will be available.

Addendum E--Life History

1. Systematic Position

Malaysian Fruit Fly, Bactrocera latifrons (Hendel) (Diptera, Tephritidae)

Class : Insecta
Order : Diptera
Family: Tephritidae

A South and Southeast Asian species, found in Southern China, Taiwan, Malaysia, India, Thailand, and Laos. It has since been found in Hawaii. The relationship of this species to other species in the Dacinae is not clear at present.

2. Identification Characters (Prepared by Nicanor J. Liquido)

(Illustrated in Figures A and B)

- Eggs (1): White; elongate elliptical, dorsal surface slightly convex; ventral edge straight or nearly straight; chorion of egg smooth; area behind the micropyle pointed to mammilate with nipple drawn out. Average egg length 1.38 millimeter (mm) (1.20-1.58); average egg width 0.32 mm (0.25-0.43).
- Third-Instar Larvae (2a): White; elongate; mouth hooks and cephalopharyngeal sclerites strongly sclerotized and blackish in color; mouth hooks strongly curved; anterior spiracles with 15-19 lobes, 0.05-0.10-mm in height, 0.08-0.14-mm wide at the base, 0.23-0.30-mm wide at the distal end; digits of prothoracic spiracle form a wave (viewed from the side) (2b); interspiracular processes of posterior spiracles heavily branched, smallest interspiracular process with 6-10 trunks; average anal elevation 0.17 mm (0.12-0.24) and 0.38-0.41 mm wide; average anal lobe extension 0.06 mm (0.03-0.11); posterior spiracle raised on cylindrical base 0.10 mm (0.06-0.13) above the integument (2c).
- Puparia (3a): Color varies from pale tan to dark brownish-yellow; barrel-shaped; anterior spiracles with 15-19 lobes; wave in larval anterior spiracle visible in pupa (3b); base of anterior spiracle swollen; height of base of spiracle approximately equal to height of lobes; area between spiracles concave.
- Adults (4a): Front of head broad, scarcely longer than wide as measured from median ocellus; mesonotum black, with two postsutural yellow vittae; wings with costal band expanded at apex into a brown mark extending across vein R_{4+5} in upper apical portion of cell R_5 ; legs predominately yellow with a brown preapical mark on each femur and slightly brown areas on

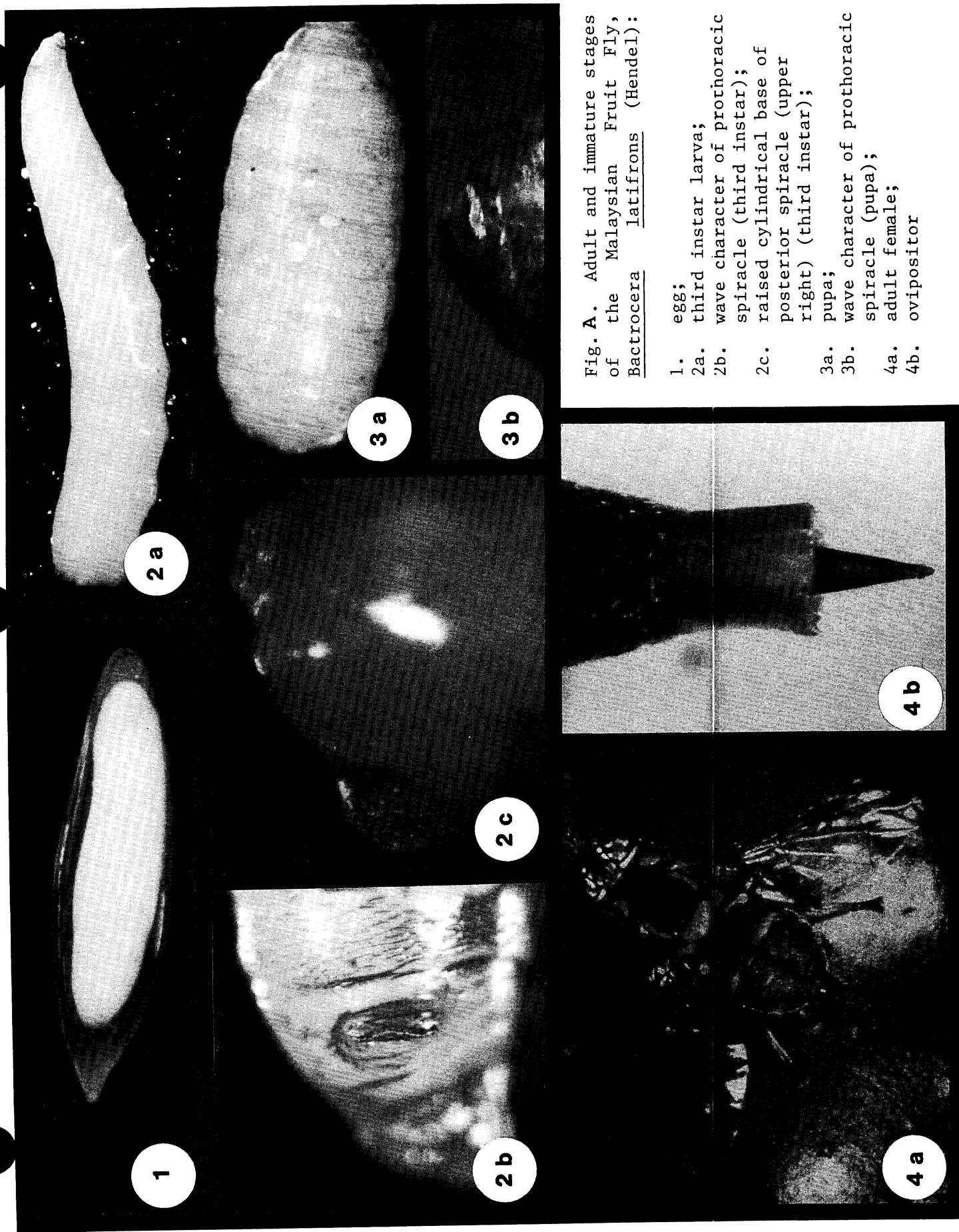
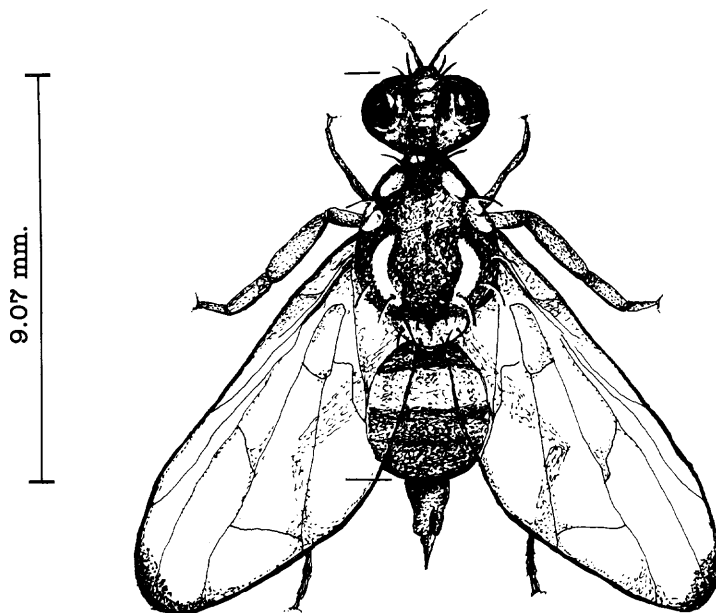


Fig. A. Adult and immature stages of the Malaysian Fruit Fly, Bactrocera latifrons (Hendel):

1. egg;
- 2a. third instar larva;
- 2b. wave character of prothoracic spiracle (third instar);
- 2c. raised cylindrical base of posterior spiracle (upper right) (third instar);
- 3a. pupa;
- 3b. wave character of prothoracic spiracle (pupa);
- 4a. adult female;
- 4b. ovipositor

Malaysian Fruit Fly



Bactrocera latifrons (Hendel)



Adult (natural size)



Egg



Larva



Pupa

Fig. B. Line Drawings. Adult and immature Stages of the Malaysian Fruit Fly, Bactrocera latifrons (Hendel).

apices of hind tibiae and apical tarsimeres; abdomen completely rufous.

Rectum of male with secretory sac and reservoir of pheromone gland relatively small, off posterior part of rectum on right side. Female rectum without sack, but with much thicker musculature than that of male for defecation purposes, owing to the considerable volume of eggs carried in the abdomen.

Female ovipositor with trilobed apex (4b).

3. Biology

The life cycle is 31 days under ideal conditions. Of this period, it takes 11 (10.8) days from egg (1.9 to 2.7 days) to larva (8.4 to 8.6 days) to pupa and 10 (10 to 10.4) days from pupa to adult. Adults actually began emerging on day 20 and emergence peaks on day 21. The preovipositional period lasts from 6-17 days.

The female tends to deposit eggs singly rather than in clutches as with other fruit flies. In one study, about 86% of the punctures contained one egg, 12% contained two eggs, 1% three eggs and 1% four eggs. Egg laying may begin on day 27 and rise sharply during the second and third weeks of reproduction. After about eight weeks, egg laying drops off gradually over a nine week period. The female may lay as many as 30 eggs in a single day. She deposits approximately 134 eggs in a one month period. Each female is capable of laying from 9 to 587 eggs, with an average of 232-280 eggs. The ovipositional period itself ranges from a minimum of 6 days to 117 days; the average is about 50 days. Egg viability averages about 80%.

Larvae feed on the soft tissue just below the skin of the fruit and may enter the seed cavity. There is usually a visible air or pin-hole at the site. The feeding area becomes contaminated with frass. This eventually creates a "windowing" effect, of brown rotten patches on the surface of the fruit. If the fruit is of the hanging type, it may drop to the ground, from which the fully grown larva will emerge to pupate in the soil.

Average longevity for females is 64.1 days. The longest lived female in any study had a life span of 136 days.

Males stridulate 2 to 3 hours prior to actual mating. Odor and smoke (pheromone) are quite evident. They frequently attempt to mate during this period, but are not successful. Actual mating takes place when female receptiveness is triggered by the low level light intensity about 15 minutes prior to sunset.

Based on intrinsic rates of birth, death and increase, the population will double every 8 days or so. If the age distribution is stable, the population will consist of 21% eggs, 48.5% larvae, 18.5% pupae and 12.1% adults.

Since a characteristic of this species is to lay small numbers of eggs over a long time period, it may be described as a *k*-selected species, that is, listed with those species with a long life span and a relatively low fecundity. These species allocate more energy to efficient use of environmental resources than to maximization of their reproductive rate. Such species are well adapted to tropical habitats. MALFF efficiently utilizes its hosts, primarily solanaceous vegetables, filling a niche not occupied by other fruit flies in its native range. Thus, if established, MALFF will generally be found in solanaceous vegetables, with scattered populations in cucurbitaceous vegetables.

Generally, these finds seem to agree with the observations made on MALFF in Pakistan. There, this species, while widespread, is comparatively more common in sub-coastal areas than in areas where summers are cooler, where it only occurs in small numbers at best. In Hawaii, it appears to be widespread, but not in any great numbers. It appears to frequent common nightshade, which is a common weed around fields and other cultivated areas in Hawaii. However, the main reservoir host in Hawaii is Sodom apple.

4. Parasites

The following parasites are known:

Opius persulcatus Silvestri

Opius oophilus Fullaway

Splangia sp.

Dirhinus giffardi Silvestri

Dirhinus luzonensis Rohwer

Opius sp.

Opius incisi Silvestri

Biosteres sp.

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.

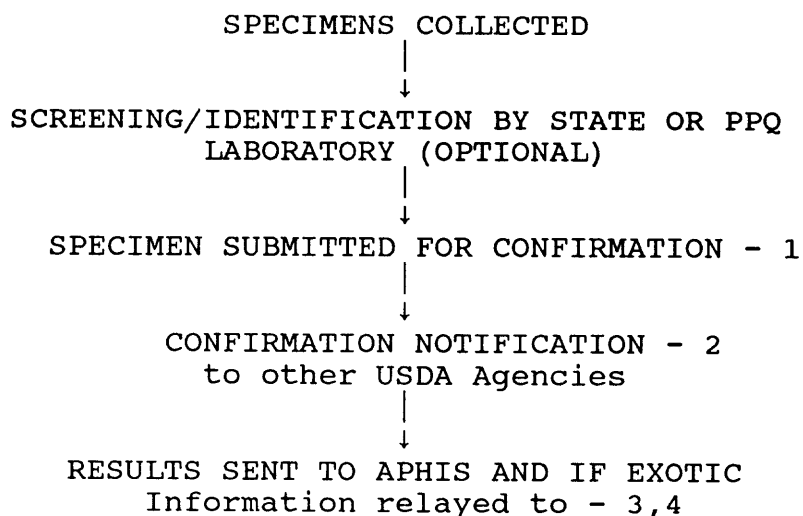
1. Ship entire trap. Pin the trap in a mailmaster type pinning box. Place it in a second shipping box and put padding between the two boxes.

or

2. 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 two 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.

Suspect larvae should be killed by placing in water, bringing to the boiling point, cooling, and then preserved in 70-75% ethyl alcohol. These, along with any suspect adult specimens collected from McPhail and other non-sticky traps, should all be forwarded with any other insect stages that have been collected, in vials of alcohol for confirmation to 1/ in the following chart. All specimens must be accompanied by PPQ Form 391 (Specimens for Determination) marked "Urgent" (see PPQ, Airport and Maritime Operations Manual). Telephone the identifier's office prior to shipping specimens to alert them of the shipment.

INFORMATION FLOW FOR THE IDENTIFICATION OF SPECIMENS



- | | | |
|---|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 |
| | Florida Only | Dr. G. Steck
Florida Department of Agriculture
and Consumer Services
P.O. Box 147100
Gainesville, Florida 32614-7100 |
| | Other States East of
the Mississippi River | Dr. A.L. Norrbom
Systematic Entomology Laboratory, PSI
U.S. Department of Agriculture
c/o U.S. National Museum of Natural
History, NHB-168
Washington, DC 20560 |
| 2 | APHIS | Plant Protection and Quarantine |
| 3 | All States | State Plant and Territory Agricultural
Regulatory Officials |
| 4 | NAPPO | North American Plant Protection Organization |

Addendum G--Forms

	<u>Number</u>	<u>Title</u>
CONTROL	PPQ 213-R	Airplane Inspection Record
	PPQ 431-R	Treatment Test Record
	PPQ 468	Caution - Pesticide Treatment in Progress
	PPQ 552-R	Pesticide Samples for Chemical Analysis
	APHIS 2060	Environmental Monitoring
	APHIS 2061	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
PPQ 345		Caution - Do Not Handle or Move (Warning label used on insect traps)
PPQ 391		Specimens for Determination

University: Steve Saul
Entomology Department
University of Hawaii
Honolulu, Hawaii 96822

Industry: Hank Brokaw
Brokaw Nursery, Inc.
P.O. Box 4818
Saticoy, California 93004

Addendum I--References

The literature on MALFF is very scant, owing to its relative unimportance and restricted host range, until its recent discovery in Hawaii brought it a measure of attention.

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