



TRAPPING GUIDELINES FOR AREA-WIDE FRUIT FLY PROGRAMMES



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International Atomic Energy Agency

TRAPPING GUIDELINES
FOR AREA-WIDE
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Preamble

Tephritid fruit flies cause devastating direct losses to many fresh fruits and vegetables. In addition, few insects have a greater impact on international marketing and world trade in agricultural produce than tephritid fruit flies. With expanding international trade, fruit flies as major quarantine pests of fruits and vegetables have taken on added importance, triggering the implementation of area-wide national or regional (trans-boundary) control programmes.

As part of globalization, trade in fresh fruits and vegetables is gradually being liberalized on a world-wide basis. The issues of this trade are considered in many fora, among them the WTO, Codex Commission of the Joint FAO/WHO Food Standards Programme, the International Plant Protection Convention (IPPC) of FAO, and other organizations with SPS (Sanitary and Phytosanitary Standards) issues in the forefront of concerns. To export their products, all countries must comply with increasingly stringent SPS measures. Among the major trading blocks, such as the EU, NAFTA, and MERCOSUR, many SPS issues are addressed that are vital to the prosperity of Member States. Mechanisms must be found to facilitate production to meet these requirements and in turn provide trading opportunities to all countries. Newly adopted International Standards for Phytosanitary Measures under the IPPC of FAO serves to expand such opportunities through the establishment of pest free areas and areas of low prevalence for fruit exports under a systems approach.

Accurate methods for fruit fly population surveys are a prerequisite for effective decision-making in area-wide control programmes aimed at pest suppression, as well as those attempting to establish fruit fly free or low prevalence areas. The FAO/IAEA Division of Nuclear Techniques, as part of its mandate to support the implementation of integrated area-wide fruit fly control programmes involving the use of the Sterile Insect Technique, has carried out over the last decade two coordinated research networks with the objective of developing and validating in the field

fruit fly attractants and traps. As a result, improved fruit fly trapping systems have been developed that are being adopted by operational fruit fly control programmes.

At the 3rd Western Hemisphere Fruit Fly Workshop on Fruit Flies of Economic Importance, held July 1999 in Guatemala City, representatives of National Plant Protection Organizations (NPPO's) of 21 participating FAO and IAEA Member States expressed difficulties as a result of a lack of uniformity in the application of the various trapping methodologies to survey fruit flies of economic importance. They recognized the acute need for some harmonization of trapping procedures in view of the increasing fruit fly related trans-boundary interactions resulting from the rapidly growing travel, transport, tourism and trade. Thus they requested FAO and IAEA to develop some guidelines in support of their fruit fly survey activities for the various pest fruit flies.

These Trapping Guidelines for Fruit Flies of Economic Importance, developed in response to this request, provide strategic guidance and direction on where and how to implement surveys in support of fruit fly control and quarantine activities. This document is the summation of recommendations put forth by a multi-national group of fruit fly workers that has the goal of providing objective information on fruit fly survey tools to NPPO's and industry in FAO and IAEA Member States. These Trapping Guidelines are to be considered as a "working" document to be regularly updated as survey techniques continue to improve and experience in fruit fly control programmes evolves.

Application of these recommendations, however, will not guarantee access to trade in fruit and vegetable commodities by an exporting country with an importing country. The use of information in this working document does not preclude the need for early contact of the exporting country's NPPO with the respective NPPO of the importing country to negotiate the specific trap-

ping protocols that will be needed to fulfil the quarantine requirements of the importing country.

The scope of this document is limited to trapping of fruit flies of economic and quarantine importance and does not include activities related to mass trapping or other fruit fly control activities. It only covers trapping technology currently in use or that has been extensively validated and assumes that fruit fly control programmes implementing the trapping activities are area-wide. Recommendations given for the different scenarios require customization to address the specific climatic and host conditions of the specific fruit fly control areas.

Valuable inputs to this guideline were provided by the following organizations:

Programa Nacional de Control y Erradicación de Mosca de los Frutos (PROCEN), SENASA Argentina; Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA), Central America; Proyecto Moscas de la Fruta, Servicio Agrícola y Ganadero (SAG), Chile; Campana Nacional Contra Mosca de la Fruta (CNCMF), SAGARPA Mexico; Centre of International Agriculture Research for Development

(CIRAD-FLHOR), Reunion, France; Carambola Fruit Fly Programme, Suriname; USDA/APHIS/PPQ/HPPL, Waimanalo, Hawaii, USA.

Disclaimer

Detection of economically important fruit flies is critical to the sustainability of agriculture. Development of trapping systems is an evolving process that results in improved agriculture. Trapping systems require a holistic approach that encompasses endemic and invasive species, human needs, as well as economic pressures. The purpose of this working document is to provide a mechanism for an evolutionary process culminating in providing NPPO's, RPPO's, action agencies, industry, and scientists a framework to fully utilize current and future trapping technologies. The dedication of the participants is based on a commitment to provide a coherent use of technologies available for trapping fruit flies. Every effort was made to ensure that this document is accurate, however, the activities associated with the trapping of fruit flies makes this a complex and dynamic process. This document is not an endorsement of products and assumes no liability for actions reported herein. Suggestions and comments to this working document are appreciated.

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I. Background

Different traps and lures have been developed and used over decades to survey fruit fly populations.

The first attractant for male fruit flies was methyl eugenol (ME) (for *Bactrocera zonata*, Howlett, 1912) followed by kerosene for Mediterranean fruit fly, *Ceratitidis capitata*, (medfly), Severin and Severin, 1913. In 1956, Angelica seed oil was used to trap medfly (Steiner et al, 1957). Beroza et al. (1961) discovered trimedlure (TML) to be effective for the same purpose. Beroza and Green, 1963, demonstrated cuelure to be an effective attractant for *Bactrocera cucurbitae*.

Food baits based on protein solutions, fermenting sugar solutions, fruit juices, and vinegar have been used since 1918 for the capture of females of several species.

The McPhail trap was the first device to be used with protein baits (McPhail, 1929). Steiner traps were developed in 1957 (Steiner et al., 1957) and Jackson traps in 1971 for TML (Harris et al., 1971). These traps are currently used in various countries for fruit fly surveys in support of control activities and eradication campaigns. The com-

ination of a McPhail trap with a protein attractant, Jackson trap with TML, and the Steiner trap with ME or cuelure (CUE), has remained unchanged for several decades.

Global trends in increasing food quality, revenue sources, and fruit and vegetable trade, has resulted in an increased worldwide movement of fruit fly species and requires refinement of survey systems.

After years of validating trapping technology through coordinated research programmes (CRP's) and extensive technical assistance to member countries, the Joint Division FAO/IAEA proposes the use of proven technologies in improving trap sensitivity in area-wide fruit fly control programmes (IAEA 1996 and IAEA 1998).

These proven technologies include the use of synthetic food lures such as female attractants that can be used for several species of *Anastrepha*, *Bactrocera* and *Ceratitidis*.

Other citations of information on these developments are included in the reference section of these trapping guidelines.

II. Trapping Survey Objectives

The operational concept of survey as used in these guidelines, is based on the following definition as defined by the Food and Agriculture Organization (FAO) in 1990:

An official procedure conducted over a defined period of time to determine the characteristics of a pest population, or to determine which species occur in an area.

The three objectives of trapping survey are:

- A. Detection survey:** To determine if species are present in an area.
- B. Delimiting survey:** To determine the boundaries of an area considered to be infested or free from a pest.
- C. Monitoring survey:** Ongoing survey to verify the characteristics of a pest population including seasonal population fluctuation, relative abundance host sequence and others.

III. Trapping Applications

Trapping surveys are applied in:

Infested area: to determine species presence and to monitor established fruit fly populations (it is assumed that no fruit fly control measures are used in the area).

Suppression: Suppression is a process that is applied to reach a fruit fly low prevalence area. Trapping is applied to measure the efficacy of control measures such as bait sprays, Sterile Insect Technique (SIT), biological control and Male Annihilation Technique (MAT), used in an infested area to reduce the fruit fly population and thereby limit damage and spread.

Eradication: Eradication is a process applied to reach a fruit fly free area. Trapping is applied to measure the efficacy of control measures such as bait sprays, SIT, biological control, and MAT, used to eliminate a pest from an area.

Exclusion: Exclusion is a process applied to minimize the risk of introduction or re-introduction of a pest in a free area. Trapping is applied to determine the presence of species that are under exclusion measures and confirms or rejects the free area status.

IV. Trapping Scenarios

The matrix below depicts which trapping application is used for each specific survey objective:

Table I. Matrix of the different trapping scenarios.

Trapping Survey	Trapping Applications			
	Infested Area FTD>1	Suppression FTD: 1 - 0.1	Eradication FTD: 0.1 - 0	Exclusion FTD: 0 - 0
Monitoring	x	x	x	
Delimiting		x	x	
Detection				x

FTD-Fly/Trap/Day (values used only as a reference)

The flow chart below illustrates the interaction of the trapping scenarios. It shows how trapping protocols change depending on the de-

sired outcome of the control process (i.e. suppression, eradication and exclusion) being used (Figure 1).

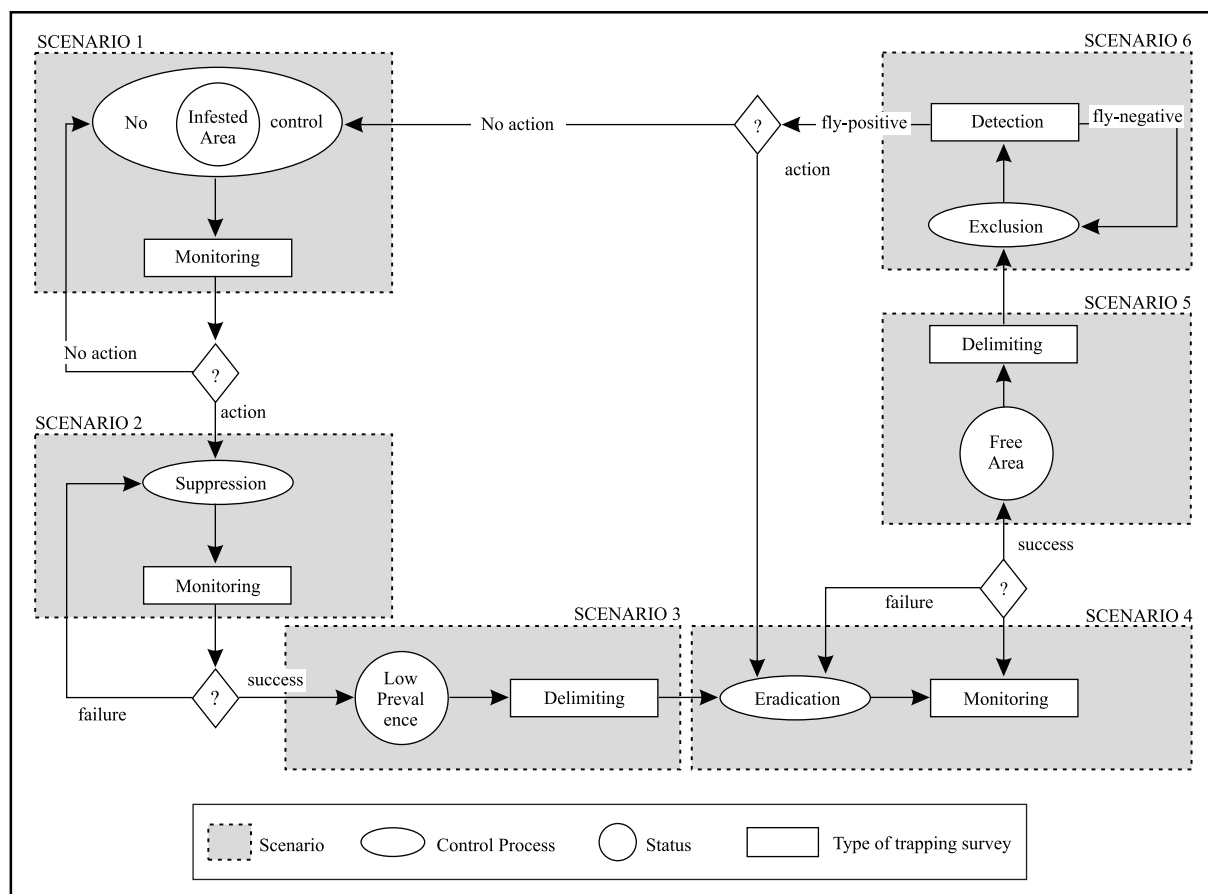


FIG. 1. Diagram of interacting scenarios, assuming an infested area as the starting event.

V. Species of Economic and Quarantine Importance Addressed in This Trapping Guideline

Scientific name	English Common name
<ul style="list-style-type: none"> • <i>Ceratitis capitata</i> • <i>Ceratitis rosa</i> • <i>Anastrepha ludens</i> • <i>Anastrepha suspensa</i> • <i>Anastrepha</i> spp. 	<ul style="list-style-type: none"> • Medfly, Mediterranean fruit fly • Natal fruit fly • Mexican fruit fly • Caribbean fruit fly
<ul style="list-style-type: none"> • <u><i>Bactrocera</i> spp. responding to ME*</u> • <i>B. dorsalis</i> • <i>B. zonata</i> • <i>B. carambolae</i> 	<ul style="list-style-type: none"> • Oriental fruit fly • Peach fruit fly • Carambola fruit fly
See Appendix 7	
<ul style="list-style-type: none"> • <u><i>Bactrocera</i> spp. responding to CUE**.</u> • <i>B. cucurbitae</i> • <i>B. tryoni</i> 	<ul style="list-style-type: none"> • Melon fly • Queensland fruit fly
See Appendix 7	
<ul style="list-style-type: none"> • <i>Bactrocera oleae</i> • <i>Rhagoletis pomonella</i> • <i>Rhagoletis cerasi</i> • <i>Rhagoletis</i> spp. • <i>Toxotrypana curvicauda</i> 	<ul style="list-style-type: none"> • Olive fruit fly • Apple maggot • European cherry fruit fly • Papaya fruit fly

*Methyl eugenol

**Cuelure

VI. Traps and Lures for Fruit Fly Surveys

Traps used for fruit flies are dependent on the nature of the attractant (Appendix 2 and 4). The most widely used traps contain para-pheromone or pheromone lures that are male specific. The para-pheromone trimedlure (TML) captures medfly and Natal fruit fly. The para-pheromone methyl eugenol (ME) captures a large number of *Bactrocera* species (Appendix 7) including: Oriental fruit fly (*B. dorsalis*), peach fruit fly (*B. zonata*), carambola fruit fly (*B. carambolae*), Philippine fruit fly (*B. philippinensis*), and banana fruit fly (*B. musae*). The para-pheromone cuelure (CUE) also captures a large number of *Bactrocera* including: melon fly (*B. cucurbitae*) and Queensland fruit fly (*B. tryoni*). The pheromone Spiroketal (SK) captures *B. oleae*. Para-pheromones are generally highly volatile, and can be used with panels, delta-traps and bucket-type traps (Appendix 1 and 4). TML, ME and CUE have controlled release formulations providing a longer lasting attractant for field use. Attracted flies are retained in panel and delta traps using a sticky material. Para-pheromones may also be mixed with a sticky material and applied to the surface of the panels. Killing agents used in panels, delta-traps and in bucket traps when used dry are usually a form of a volatile toxicant such as DDVP (2,2-Dichlorovinyl dimethyl phosphate) naled, and malathion, although some of these are repellent at higher doses. When bucket-type traps are used with liquid proteins, the liquid bait solution functions as the retention system. In this case the liquid protein baits have to be mixed with 1.5 to 2 g of borax to slow down the decomposition of the captured insects. For use of synthetic lures water is used with a surfactant to retain attracted flies. The percentage of females captured with a para-pheromone trap is extremely low.

Lures for capturing female fruit flies are based on food or host odours. Historically, liq-

uid protein baits have been used to catch a wide range of different fruit fly species (Appendix 4). Liquid protein baits capture both females and males, with a higher percent of females captured. These liquid baits are generally not as sensitive as the para-pheromone traps in low populations. The usage of liquid baits results in capturing large numbers of non-target insects. Several food-based synthetic attractants have been developed using ammonia and its derivatives. Ammonium carbonate (AC) and/or ammonium acetate (AA) lures are used for several *Rhagoletis* species (Appendix 4). A two component combination of AA and putrescine (PT) has been demonstrated to be attractive for Mexican fruit fly (*A. ludens*) and Caribbean fruit fly (*A. suspensa*). The addition of a third component, trimethylamine (TMA) results in a highly attractive female lure for medfly which is being used in early detection trapping networks. This synthetic food lure is more specific than the liquid protein baits, and is capable of detecting female medflies at a lower level compared to the male specific attractant, TML.

The two and three component synthetic lures described above are generally used in Multilure traps, although they can be used with a variety of other traps. Ammonium acetate and ammonium carbonate, when used for capture of *Rhagoletis* species, are used with red sphere traps or yellow panel traps coated with a sticky material. A synthetic attractant based on host fruit volatiles is currently used for detection of apple maggot fly. The chemical, butyl-hexanoate (BuH), is used with a red sphere trap coated with a sticky material, typically placed at a short distance from the trap. The pheromone, 2-methylvinyl-pyrazine, (MVP), of the papaya fruit fly (not commercially available), when used with sticky green spheres, is highly effective for detection and control.

VII. Recommended Trapping Survey Densities

Trap density is critical for fruit fly surveys. The densities need to be adjusted based on many factors including: trap efficiency, lure/attractant efficiency, location regarding altitude, type and presence of host, climate, topography, programme phase and type of fruit fly species.

For each species, trap densities are suggested for the various trapping scenarios as well

as fruit production areas and other target areas (Appendix 5). These recommendations are based on the available trapping technologies, taking into account that trapping is a dynamic process that changes according to survey objectives and control applications. For instance, the density of a specific trap may increase as much as 10 fold from a monitoring to a delimiting phase (Appendix 5).

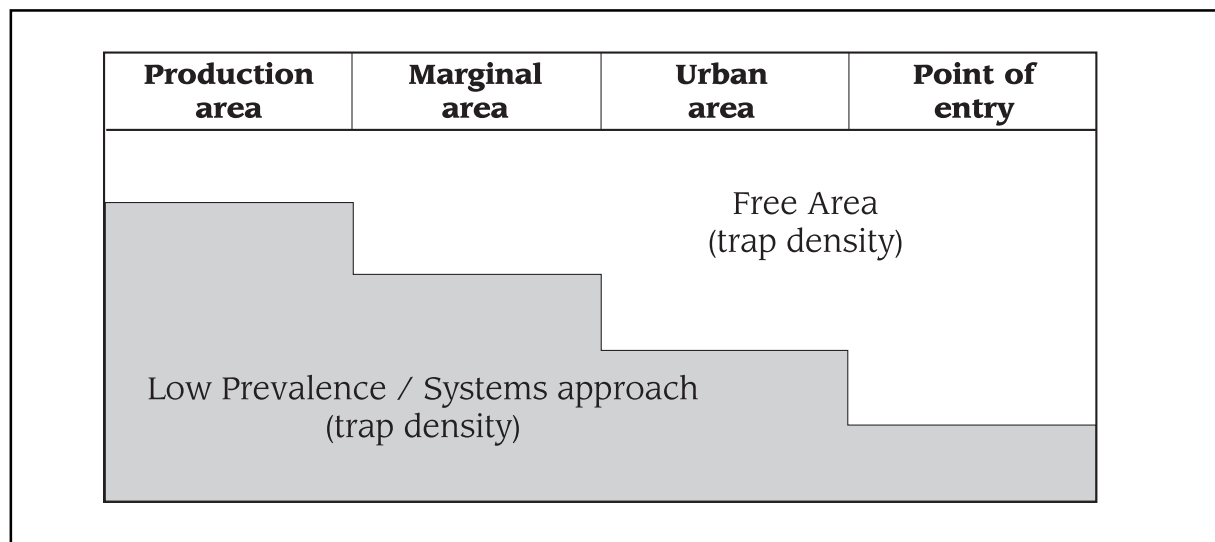


FIG. 2. *Trapping densities according to the type of areas.*

Densities may also vary as a gradient from the production to marginal areas, to urban areas and points of entry. For example, trapping densities in an area of low prevalence status, where the presence of the target species is known, should be higher in the production field and decrease toward points of entry. In a free area, the reverse occurs: a higher density is required at points of entry and lower density in commercial orchards (Figure 2). This gradient is associated to the level of pest risk, which is established based on the objective of the programme. There are atypical situations where in an infested area subjected to a control programme the pest population is found year round mainly in urban areas where they escape chemical control and survive the winter. In cases like this higher trap densities

should be used in urban areas than in the production areas. Atypical situations such as the one described above are not reflected in Figure 2 and Appendix 5.

It is important to note that the densities suggested in Appendix 5, serve only as a guide and that different trap densities may be required by importing countries during the preparation of protocols for exports of horticultural products.

Densities are also dependant on associated survey activities, such as fruit sampling to detect immature stages. In those cases where trapping survey programmes are complemented with fruit sampling activities, trap densities may be lower than the recommended densities.

VIII. Trapping And Quarantine Security

Standards for pest free and low prevalence areas (in preparation) issued by FAO and Regional Plant Protection Organizations (FAO-ISPM No. 10; NAPPO 1994), should be used as a basis to negotiate export/import protocols. However, specific trapping and quarantine pro-

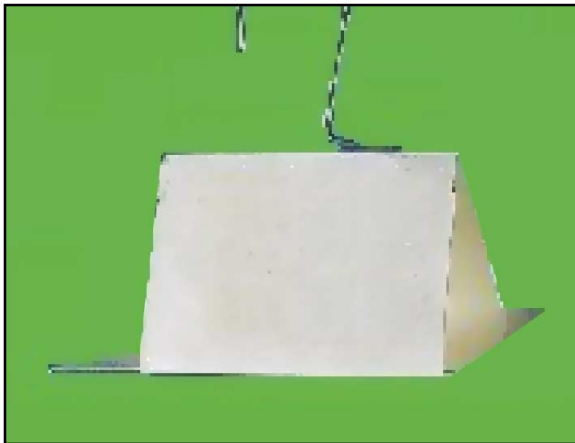
ocols and work plans (where detection, delimitation and monitoring surveys are defined) should be agreed to among the commercial partners before the establishment and maintenance of pest free and low prevalence areas that apply to a systems approach.

APPENDIX 1. TRAP DESCRIPTION

Jackson Trap (JT)

General description

The body of a standard JT is a delta shaped object made of waxed cardboard material. The additional parts include: 1) a white or yellow rectangular insert of waxed cardboard. The insert is covered with a thin layer of sticky material known as “stickem” (Tanglefoot) used to trap flies once they land inside the trap body, 2) a polymeric plug and a plastic basket that holds the lure plug and 3) a wire hanger placed at the top of the trap body.



Use

This trap is mainly used with parapheromone lures to capture male fruit flies. The most common lures used with the JT are: trimedlure (TML), methyl eugenol (ME) and cuelure (CUE). These lures are specific for the fruit fly species mentioned in Appendix 4 concerning traps and lures for fruit fly survey and listed in Appendix 7. The lure is added by suspending, from the center

of the trap, a cotton wick soaked in 2 to 3 ml of a mixture of the parapheromone and an insecticide, usually malathion, naled or dichlorvos (DDVP), when the trap is used with ME or CUE but without insecticide when the trap is used with TML. The insecticide is used to prevent attracted flies from escaping. Another form is the lure contained into a controlled-release polymeric plug in which case the plug is placed inside a plastic basket suspended from the trap ceiling. In this case if the trap is used with ME or CUE, a cotton wick soaked with malathion is placed inside the plastic basket together with the lure. It is also common to use a DDVP strip (1 to 1.5 cm in length) placed inside the basket or on the floor of the trap.

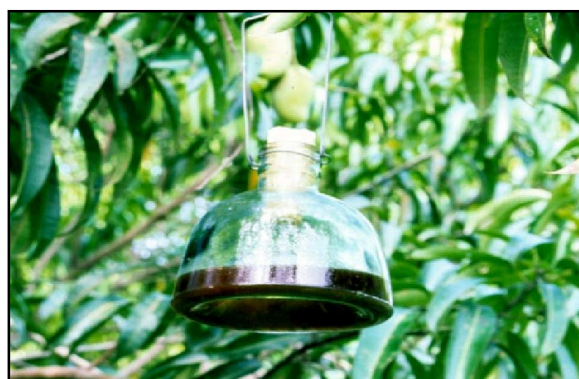
For many years this trap has been used in detection, exclusion and control programmes for multiple purposes including: population ecology studies (seasonal abundance, distribution, host sequence, etc.), detection and delimiting trapping, and to survey sterile fly populations in areas subjected to a sterile fly mass release programme. With the development of more sensitive traps (e.g. Yellow Panel) and lures (e.g. female dry-synthetic-lure), the JT trap use has become more specific. For service and re-baiting of the parapheromones used in the JT, see Appendix 6. For use of JT under different scenarios and recommended densities see Appendix 5.

The JT is one of the most economical traps commercially available. It is easy to carry, handle and service, providing the opportunity of servicing a greater number of traps per man-hour than other commercial traps.

McPhail (McP) - liquid protein bait

General description

The conventional McPhail trap (McP) is a transparent glass pear shape invaginated container. The trap parts include a rubber cork that seals the upper part of the trap and a wire hanger to place traps on tree branches.



Use

This trap uses a liquid food bait, based on hydrolyzed protein (Nu-lure, Staley's, Miller, etc.) or Torula yeast/borax tablets. Torula yeast/borax tablets are more effective than hydrolyzed proteins over time, as the pH is stable at 9.2. The level of pH in the mixture plays an important role in attracting fruit flies. Fewer fruit flies are attracted to the mixture as the pH becomes more acidic. Hydrolyzed protein is not effective over time as the pH drops from its initial state of 8.5.

The trap holds ca. 250 ml of the liquid food lure. Bait preparation is as follows: a) Torula yeast tablets: Mix three to five yeast/borax tablets in 2-

2 ½ cups water. Stir to dissolve tablets and b) Protein hydrolysate: Mix 5 to 10% Protein hydrolysate (example - Nu-lure), 3% borax, and 87 to 92% water by weight. Due to the nature of its lure, this trap is considered to be a female trap. The normal male:female catch rate is around two females per every male.

Food lures are generic by nature and, besides the target fruit fly species, traps tend to catch a wide range of other tephritid and non-tephritid flies.

McP traps are used in area-wide control programmes in combination with other traps. In areas subjected to suppression and post-suppression actions, these traps are used mainly to track female populations. Female catches are crucial in assessing the amount of sterility induced to a wild population. Also in programmes releasing only sterile males, MCP traps are used as a population detection tool by targeting feral females, while Jackson traps, baited with male specific lures, catch the released sterile males. In fly-free areas, MCP traps are an important part of the exotic fruit-fly trapping network considering their capacity to catch important fruit fly species of quarantine significance for which no specific lures exist.

For service and re-baiting of the hydrolysate protein used in MCP trap, see Appendix 6.

McP traps with liquid protein bait are labor intensive. Servicing and re-baiting take time and the number of traps that can be serviced in a eight-hour working day is half the amount compared to the other traps described in this guideline.

Multilure Trap - dry synthetic lure/liquid protein

General description

This trap is the newer version of the McPhail trap described previously. This new trap consists of a two piece plastic cylinder shaped invaginated container. The upper part and base of the trap separate allowing the trap to be serviced and baited. The transparent upper part of the trap contrasts with the yellow base enhancing the traps ability to catch fruit flies. For this trap to function properly it is essential that the upper part of the trap stays clear. This trap can be used with the liquid protein bait (as described for the conventional glass McPhail trap) or with the dry synthetic lure. The dry lure consists of three components that come in separate small flat dispensers. The lure dispensers are attached to the inside walls of the upper clear portion of the trap or hang on the ceiling using a clip. Since the conventional glass McP trap are in one piece the three dispensers are not easily attached to the glass walls.

Use

This trap follows the same basic principles as the McP. However, the Multilure used with the dry synthetic lure is more powerful and selective than the Multilure and McP used with liquid protein bait. Another important difference is that the Multilure, specially when used with the dry synthetic lure, allows for a cleaner servicing and is much less labor intensive. These differences make this trap substantially cheaper than the conventional McP used with liquid protein. For capturing Mediterranean fruit flies a synthetic female fruit fly attractant consisting of three lures, ammonium acetate, putrescine and trimethyl amine, is used. For capture of *Anastrepha* species the trimethyl amine lure should be removed. The synthetic lure will last approximately 6 to 10 weeks,

captures few non-target insects, and captures significantly fewer male flies making it best suited for use in SIT programmes. When used as a wet trap, a surfactant should be added to the water. In hot climates, 10% propylene glycol can be used to decrease water evaporation and provide decreased decomposition of captured flies. Another effective retention system is a mixture of water, borax and Triton (0.1% solution) adding 1 to 2 drops of the solution to the water. When used as a dry trap, a small piece (1 to 1.5 cm in length) of DDVP strip is placed inside the trap.



For service and re-baiting of the hydroly-sate protein and synthetic food lures used in the Multilure trap, see Appendix 6. For use of Multilure under different scenarios and recommended densities see Appendix 5. It is important to note that, apart from the conventional McP, Multilure and Tephri traps, there are other traps that have the same basic principle such as the International Pheromone McPhail trap, the Dome (McPhail) trap, etc., that could be used for the same purpose.

Open Bottom Dry Trap (OBT) - dry synthetic lure

General description

This trap is an open-bottom cylindrical dry trap that can be made from opaque green plastic or wax-coated green cardboard. It has a transparent plastic top, three equally-spaced holes around the circumference of the cylinder midway between the ends, an open bottom, and is used with a sticky insert. It is used with the synthetic female fruit fly attractant previously described in areas where more expensive plastic or glass McPhail type traps cannot be used.

Use

The food based synthetic chemical attractant is used to capture mainly female medflies but has the ability to capture also males. The synthetic female fruit fly lures previously described are attached to the inside walls of the cylinder. Servicing is easy because the sticky insert can be ma-

nipulated the same as the inserts used in Jackson traps.

For service and re-baiting of the synthetic food lures used in the OBT trap, see Appendix 6. For use of OBT under different scenarios and recommended densities see Appendix 5.



Yellow Panel (YP)

General description

This is a yellow, rectangular cardboard trap, which is covered on both sides with a thin layer of stickem (Tanglefoot). This trap uses the male specific parapheromone lures - TML, ME and CUE. The lures can be used in liquid form by impregnating a cotton wick with 2 to 3 ml of the lure. As in the case of the JT, when ME or CUE are used an insecticide has to be included to prevent flies from escaping. Another form is the lure contained into a controlled-release polymeric plug. In both cases the lure is attached to the face of the trap. The lures can also be used mixed into the cardboard's coating. A wire hanger, placed on top of the trap body, is used to hang the trap from the tree branches.

Use

Its two dimensional design and greater contact surface make this trap more efficient, in terms of fly catches, than the JT and McPhail type traps. It is also easy to handle in the field thus not labor intensive. However, it is important to consider that the trap requires special procedures for transportation, submission and fly screening methods because it is so sticky that specimens can be de-

stroyed in handling. Although this trap can be used in most control/suppression programme applications, its use is recommended for the post suppression and fly-free phases where highly sensitive traps are required. This trap should not be used in areas subjected to mass release of sterile flies due to the large number of released flies that would be caught. It is important to note that due to its yellow color and open design it has a tendency of catching other insects including beneficial.



For service and re-baiting of the parapheromones used in the YP trap, see Appendix 6. For use of YP under different scenarios and recommended densities see Appendix 5.

C & C (Cook and Cunningham)

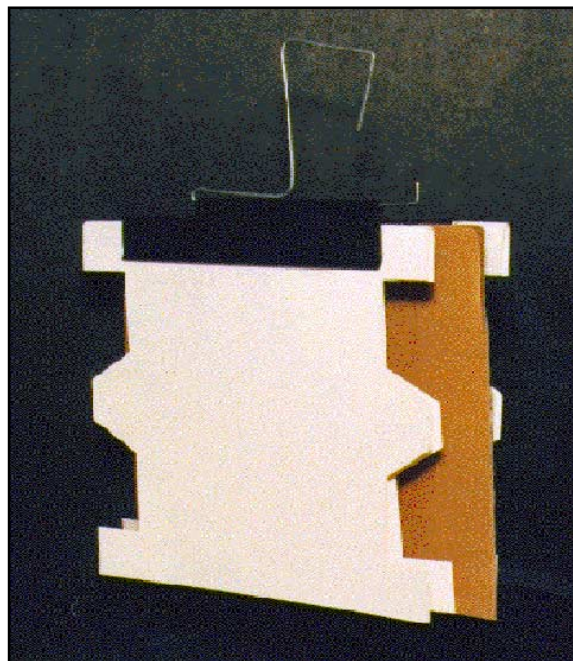
General description

This trap consists of three removable panels spaced approximately 2.5 cm apart. The two outer panels are made of 22.8-by-13.9-cm paper board with both coated with stickem on the exposed (outer) side of each panel. The adhesive panel has one or more holes which air may circulate through. The trap is used with a centre polymeric panel containing the olfactory attractant (usually trimedlure). The polymeric panels come in two sizes – standard and half panel. The standard panel (15.2 x 15.2 cm) contains 20 grams of TML, while the half size (7.6 x 15.2 cm) contains 10 grams. With its multi-panel construction, there is significantly more adhesive surface area for fly capture. The entire unit is held together with clips, and suspended in the tree canopy with a wire hanger.

Use

The need for economic mass-trapping of the medfly, polymeric panels were developed for the controlled-release of amounts of trimedlure. The C&C trap was developed to house these panels. This trap is also used for monitoring and detect-

ing very low medfly population incursions and, depending on environmental conditions, the lure may last for several months.



For service and re-baiting of the para-pheromones used in the C&C trap, see Appendix 6. For use of C&C under different scenarios and recommended densities see Appendix 5.

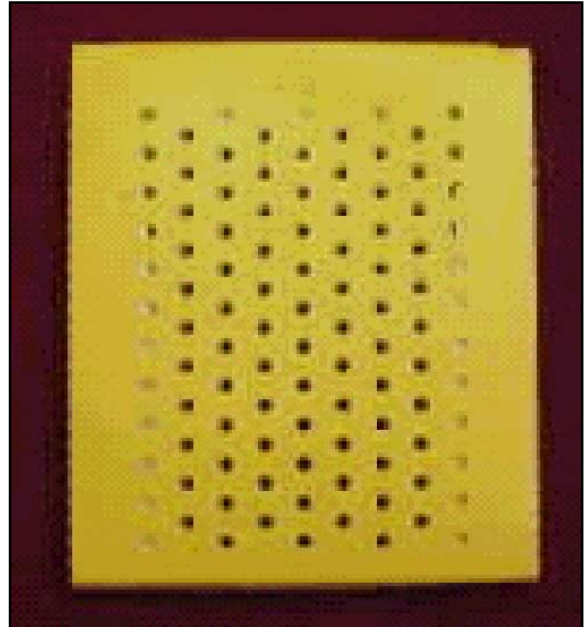
ChamP Trap

General description

The ChamP trap is a two dimensional yellow sticky panel that has been designed to be used with a polymeric panel or with a polymeric plug. The face of the rectangular panel is perforated to allow high release of the attractant. The outer surface is coated with stickem and the traps use synthetic attractants.

Use

The ChamP trap uses a smaller version of the polymeric panel used in the C&C trap. Panels (10.2 x 10.2 cm) contain 4 grams of TML and are formulated to release a lower dose for a 4-6 week period or a very high dose for a 2-week period. It is essentially equivalent to the yellow panel trap in sensitivity. This trap is recommended for delimiting infestations in medfly eradication programmes. ChamP traps, baited with ammonium carbonate lures, have been used in California to monitor olive flies.



For service and re-baiting of the parapheromones used in the ChamP trap, see Appendix 6. For use of ChamP trap under different scenarios and recommended densities see Appendix 5.

Tephri Trap

General description

The Tephri trap is a McPhail type trap extensively used in Europe (i.e. Mediterranean coast) for monitoring of medfly populations. It has a yellow base and a clear top, which can be separated to facilitate servicing. This trap has entrance holes around the top of the periphery of the yellow base, and an invaginated opening in the bottom. Inside the clear top is a platform on which to house attractants. It is designed for Tephritid fruit flies (medfly, olive fly, cherry fly, etc.) but can be adopted to any other insect that can be attracted by active substances of any type, such as food attractants, pheromones, and so on.

Use

This trap is commonly used in Europe baited with hydrolyzed protein at 9% concentration (e.g. Nu-lure, Buminal), however, it can also be used with other liquid protein baits as described for the conventional glass McP trap or with the female dry synthetic food lure and with trimedlure or cera lure in a plug or liquid as described for the JT and YP traps. If the trap is used with liquid protein baits or with dry synthetic lures combined with a liquid retention system and without the side holes,

the insecticide will not be necessary. However, when used as a dry trap and with side holes, an insecticide solution (malathion, naled) soaked into a cotton wick or a small piece (1 to 1.5 cm) of DDVP strip will be needed to avoid escape of captured insects.



For service and re-baiting of the synthetic food lures used in the Tephri trap, see Appendix 6. For use of Tephri trap under different scenarios and recommended densities see Appendix 5.

Steiner Trap (ST)

General description

This is a horizontal, clear cylinder with a large opening at each end. This trap uses the male specific paraffin lures TML, ME and CUE. A wire hanger, placed on top of the trap body, is used to hang the trap from the tree branches. As in the case of other dry traps (except for the sticky traps that use TML), an insecticide has to be used to prevent flies escaping and predation of captured flies.

Use

The lure is added by suspending, from the center of the trap, a cotton wick soaked in 2 to 3 ml of a mixture of the paraffin and an insecticide, usually malathion or naled. Another form is the lure contained into a controlled-release polymeric plug in which case the plug is placed inside a plastic basket suspended from the trap

ceiling. In this case it is common to use a cotton wick soaked with malathion, naled or a DDVP strip (1 to 1.5 cm in length) placed inside the basket or on the floor of the trap.



For service and re-baiting of the paraffin lures used in the Steiner trap, see Appendix 4. For use of the Steiner trap under different scenarios and recommended densities see Appendix 5.

APPENDIX 2. LIST OF LURES AND ATTRACTANTS

Common name	Acronym	Chemical	Formulation (weeks)	Field Longevity*
Para-pheromones				
Trimedlure	TML	<i>tert</i> -butyl 4 (and 5)-chloro-2-methylcyclohexane-1-carboxylate	Polymeric plug/panel	6
			Laminate	6
			Liquid	2-4
Methyl Eugenol	ME	Benzene, 1,2-dimethoxy-4-(2-propenyl)	Polymeric plug/panel	6
			Liquid	2-4
Cuelure	CUE	4-(<i>p</i> -hydroxyphenyl)-2-butanone acetate	Polymeric plug/panel	6
			Liquid	2-4
Pheromones				
Papaya fruit fly	PFFP	3-methyl-1-pyrazine	Membrane-based	4
Olive fly (spiroketal)	OFP	(1,7)-dioxaspiro-[5,5]undecane (olean)	Polymer	4
Food-based attractants				
a) Protein baits:				
Torula yeast/borax	TY	Torula yeast/borax	Pellet	1-2
Protein derivatives	HP	hydrolized protein	Liquid	1-2
b) Synthetic food lures:				
Ammonium acetate	AA	ammonia + acetic acid	Membrane-based	4-6
			Liquid	1
			Polymer	4
ammonium (bi)carbonate	AC	Ammonia	Membrane-based	6
			Liquid	1
			Polymer	4
ammonium salts	A	Ammonia	Salt	
putrescine	Pt	1,4 diaminobutane	Membrane-based	4-6
trimethylamine	TMA		Membrane-based	4- 6
butyl hexanoate	BuH		Vial	2

*Based on half-life, which is very much determined by weather conditions.

APPENDIX 3. TRAPPING PROCEDURES

Layout of trapping network

In area-wide suppression/eradication programmes, an extensive trapping network has to be deployed over the entire area subjected to control actions. The trapping network layout, will depend on the intrinsic characteristics of the area. In areas where continuous compact blocks of commercial orchards are present and in urban and suburban high populated areas, where hosts exist in backyards, traps are arranged in a grid system with a uniform trap distribution. In areas with scattered commercial orchards, rural low populated villages

with backyard fruit hosts and in marginal areas where commercial and wild host exist, trap network arrays are normally linear with a distribution pattern that follows roads that provide access to host material. Trapping networks are also placed as part of exclusion programmes for early detection of introduced fruit flies of quarantine importance. In this case no defined trapping layout is used. Traps are placed in high risk areas such as points of entry and places where fruit is gathered for latter distribution.

Trap placement



It is of vital importance to have a list of the primary, secondary, and occasional fruit fly hosts (for fruit fly hosts refer to Allwood and Drew 1996; Liquido et al, 1991; White and Elson-Harris, 1992 and others), their phenology, distribution, and abundance. With this basic information, it is possible to properly place and distribute the traps in

the field and it also allows for an effective planning of a trap rotation programme. Traps have to be rotated following the maturation phenology of the main fruit hosts. By rotating the traps it is possible to follow the fruit fly population throughout the year and increase the number of sites being checked for fruit flies.

One of the most important factors of trap placement is selecting a proper trap site. When possible, pheromone traps should be placed in mating areas. Fruit flies normally mate in the crown of a fruit host tree or close to the host trees selecting semi shaded spots and usually on the upwind side of the crown. Other suitable trap sites are resting and feeding areas in trees that provide shelter and protect flies from strong winds and predators. Protein traps should be placed close to fruit host trees, in a shady area. In this case traps should be placed in primary hosts during their fruit maturation period. In absence of

primary hosts, secondary hosts should be used. In areas with no hosts, identified as potential fruit fly pathways, traps should be placed in trees that can provide shelter, protection and food to adult fruit flies. Traps should be placed 2-4 meters from the ground (will depend on the height of the host tree) in the middle to the top part of the host tree canopy and oriented towards the upwind side. Traps should not be exposed to direct sunlight, strong winds or dust. It is of vital importance to have the trap entrance clear from twigs and leaves to allow proper air flow and an easy access for the fruit flies.

Trap mapping

Once traps are placed in carefully selected sites at the right density and distributed in an adequate array, the location of the traps has to be recorded. A map or sketch of the trap location and the area around the traps should be prepared. The references of the trap location should include visible land marks and in the case of traps placed in hosts located in suburban and urban areas references should include the full address of the property where the trap was placed. The trap reference should be clear enough to allow trapping inspectors, control brigades and supervisors to find the trap with ease.

The application of the geographic positioning systems (GPS) and geographic information systems (GIS) in management of trapping

network has proven to be a very powerful tool. The GPS allows each trap to be geo-referenced through geographical coordinates, which are then used as input information in the GIS. A data base of all traps with their corresponding coordinates is kept together with the records of trap services, re-baiting, trap catches, etc. The GIS provides high resolution maps showing the exact location of each trap and other valuable information such as exact location of fly finds (detections or outbreaks), historical profiles of the geographical distribution patterns of the pest, relative size of the populations in given areas, etc. This information is extremely useful in planning of control activities making bait sprays and sterile fly releases more cost-effective in their application.

Trap service

Trap servicing and re-baiting intervals are specific to each trap system. However, the following guidelines are effective for most of the current commercially available traps. Capturing flies will depend, in part, on how well the trap is serviced. Servicing a trap has to be a clean and quick procedure. Lures (pheromones or food lures) have to be used in the exact amounts and replaced at the recommended intervals. Commercially avail-

able pheromone lures are contained in dispensers or plugs in amounts that are standard for each different type of lure. However, the release rate will vary with different environmental conditions. The release rate is high in hot and dry areas, and low in cool and humid areas. Service interval should be adjusted according to the prevailing environmental conditions. Liquid food lures have to be diluted in water before use. In cool and dry cli-

mates traps have to be re-baited twice per week, whereas, under hot and humid/dry conditions re-bait interval is once per week. When liquid lures are used (e.g. liquid trimedlure or hydrolyzed proteins) it is important to avoid spillage or contamination of the external surface of the trap body as well as ground contamination. This would reduce the chances for flies entering the trap. For traps that use a sticky insert to capture flies, it is important to avoid contaminating, with the sticky material, areas in the trap that are not meant for catch-

ing flies. This also applies for leaves and twigs that are in the trap surroundings.

In general the estimated number of traps serviced per day per person for most of the traps is 30. The exception is the McP type traps baited with liquid protein that requires more time. The number of McP type traps typically serviced per person per day is 25. The actual number will vary depending on host density, environmental and topographic conditions and trapper experience.

Flies per trap per day (FTD)

The flies per trap per day is a population index that estimates the average number of flies captured in one trap in one day that the trap is exposed in the field. The function of this population index is to have a relative measure of the size of the adult pest population in a given space and time. It is used as base-line information to compare the size of the population before, during and after the application of a fruit fly control programme. In areas where sterile flies are being released it is used to measure the relative abundance of the sterile flies and thus assess the ratios of sterile to fertile flies in the field.

Its value is the result of dividing the total number of captured flies by the product obtained

from multiplying the total number of serviced traps by the average number of days the traps were exposed. The formula is as follows:

$$\text{F.T.D.} = \frac{\text{F}}{\text{TxD}}$$

where,

F = Total number of flies

T= Number of serviced traps

D= Average number of days traps were exposed in the field

APPENDIX 5. TRAP DENSITIES

Table I. Matrix of the different trapping scenarios.

Survey objectives	Trapping Application			
	Infested Area FTD>1	Suppression FTD: 1 - 0.1	Eradication FTD: 0.1 - 0	Exclusion 0 - 0
Monitoring	x	x	x	
Delimiting		x	x	
Detection				x

FTD-Fly/Trap/Day (values used only as a reference)

Ceratitis capitata

Scenario	Trap type	Attractant	Trap Density/km ²			Points of Entry
			Production area	Marginal	Urban	
1-Monitoring of infested area	JT ¹ /MULTILURE ² /OBDT ² /TEPHRI ²	TML/3C/PB	0.5 to 1.0*	0.25 to 0.5*	0.25 to 0.5*	0.25 to 0.5*
1-Monitoring for suppression	JT ¹ /MULTILURE ² /OBDT ² /TEPHRI ²	TML/3C/PB	2 to 4*	1-2*	0.25 to 0.5*	0.25 to 0.5*
1-Monitoring for eradication	JT ¹ /MULTILURE ² /OBDT ² /TEPHRI ²	TML/3C/PB	3 to 5**	3 to 5**	3 to 5**	3 to 5**
2-Delimitation for suppression	JT ¹ /MULTILURE ² /OBDT ² /TEPHRI ²	TML/3C/PB		10 to 20**		
2-Delimitation for eradication	JT ¹ /MULTILURE ² /OBDT ² /TEPHRI ²	TML/3C/PB		20 to 50**		
3-Detection for exclusion/ containment	JT ¹ /MULTILURE ² /CC ²	TML/3C/PB	1***	2***	2 to 4***	4-10***

¹With TML for male captures

²With 3C mainly for female captures

Ceratitis rosa

Scenario	Trap type	Attractant	Trap Density/km ²			Points of Entry
			Production area	Marginal	Urban	
1-Monitoring of infested area	JT ¹ /MULTILURE ² /TEPHRI ²	TML/3C	0.5 to 1.0*	0.25 to 0.5*	0.25 to 0.5*	0.25 to 0.5*
1-Monitoring for suppression	JT ¹ /MULTILURE ² /TEPHRI ²	TML/3C	2 to 4*	1-2*	0.25 to 0.5*	0.25 to 0.5*
1-Monitoring for eradication	JT ¹ /MULTILURE ² /TEPHRI ²	TML/3C	3 to 5**	3 to 5**	3 to 5**	3 to 5**
2-Delimitation for suppression				10 to 20**		
2-Delimitation for eradication				20 to 50**		
3-Detection for exclusion/ containment	JT ¹ /MULTILURE ²	TML/3C	1***	2***	2 to 4***	4-10***

*1:3 ratio (1 female trap for each 3 male trap)

**1:1 ratio (1 female trap for each male trap)

***3:1 ratio (3 female traps per each male trap)

TML - trimethlure

AA - ammonium acetate

PT - putrescine

TMA - trimethylamine

JT - Jackson trap

YP - yellow panel

PB - Protein baits (eg. Nulure, Torula, Buminal, etc)

MULTILURE - Plastic McPhail type trap

CC - Cook & Cunninghamham

Bactrocera ME

Scenario	Trap type	Attractant	Trap Density/km ²			Points of Entry
			Production area	Marginal	Urban	
1-Monitoring of infested area	JT/STEINER/TEPHRI	ME	0.5 to 1.0	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5
1-Monitoring for suppression	JT/STEINER/TEPHRI	ME	2 to 4	1-2	0.25 to 0.5	0.25 to 0.5
1-Monitoring for eradication	JT/STEINER/TEPHRI	ME	3 to 5	3 to 5	3 to 5	3 to 5
2-Delimitation for suppression	JT/STEINER/TEPHRI	ME		10 to 20		
2-Delimitation for eradication	JT/STEINER/TEPHRI/MULTILURE	ME/PB		20 to 50		
3-Detection for exclusion/ containment	YP/CH	ME	1	2	2 to 4	4-10
	MULTILURE	PB	1	2	2 to 4	4-10

Bactrocera CUE

Scenario	Trap type	Attractant	Trap Density/km ²			Points of Entry
			Production area	Marginal	Urban	
1-Monitoring of infested area	JT/TEPHRI	CUE	0.5 to 1.0	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5
1-Monitoring for suppression	JT/TEPHRI	CUE	2 to 4	1-2	0.25 to 0.5	0.25 to 0.5
1-Monitoring for eradication	JT/TEPHRI	CUE	3 to 5	3 to 5	3 to 5	3 to 5
2-Delimitation for suppression	JT/TEPHRI	CUE		10 to 20		
2-Delimitation for eradication	YP/MULTILURE	CUE/PB		20 to 50		
3-Detection for exclusion/ containment	YP/CH	CUE	1	2	2 to 4	4-10
	MULTILURE	PB	1	2	2 to 4	4-10

Bactrocera oleae

Scenario	Trap type	Attractant	Trap Density/km ²			
			Production area	Marginal	Urban	Points of Entry
1- Monitoring of infested area	MULTILURE/CARDBOARD/CH/YP	PB/AC + SK	0.5 to 1.0	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5
1-Monitoring for suppression	MULTILURE/CARDBOARD/CH/YP	PB/AC + SK	2 to 4	1-2	0.25 to 0.5	0.25 to 0.5
2-Delimitation for suppression	MULTILURE/CARDBOARD/CH/YP	PB/AC + SK		5 to 10		
3-Detection for exclusion/ containment	MULTILURE/CARDBOARD/CH/YP	PB/AC + SK	1	2	2 to 4	4-10
JT - Jackson trap	CH - ChampP trap	ME - methyl-eugenol		SK - spiroketal		
YP - yellow panel	PMT - Plastic McPhail type trap	CUE - cue lure		PB - protein baits		
	CARDBOARD - Cardboard trap used in California					

Anastrepha ludens/obliqua/suspensa

Scenario	Trap type	Attractant	Trap Density/km ²				Points of Entry
			Production area	Marginal	Urban	Urban	
1-Monitoring of infested area	MULTILURE	2C/PB	0.5-1	0.25-0.5	0.25-0.5	0.25-0.5	
1-Monitoring for suppression	MULTILURE	2C/PB	2 to 4	1 to 2	0.25-0.5	0.25-0.5	
1-Monitoring for eradication	MULTILURE	2C/PB	3 to 5	3 to 5	3 to 5	3 to 5	
2-Delimitation for suppression	MULTILURE	2C/PB		10 to 20			
2-Delimitation for eradication	MULTILURE	2C/PB		20 to 50			
3-Detection for exclusion/ containment	MULTILURE	2C/PB	2	3	6	6 to 10	

Anastrepha spp.

Scenario	Trap type	Attractant	Trap Density/km ²				Points of Entry
			Production area	Marginal	Urban	Urban	
1-Monitoring of infested area	MULTILURE	2C/PB	0.25-0.5	0.25-0.5	0.25-0.5	0.25-0.5	
1-Monitoring for suppression	MULTILURE	2C/PB	2 to 4	1	0.25-0.5	0.25-0.5	
2-Delimitation for suppression	MULTILURE	2C/PB		10 to 20			
3-Detection for exclusion/ containment	MULTILURE	2C/PB	2	3	6	6 to 10	

MULTILURE - Plastic McPhail trap
2C (AA+PT)

PB - Protein baits (e.g. Nulure, Torula Yeast, etc)

Rhagoletis pomonella

Scenario	Trap type	Attractant	Trap Density/km ²			Points of Entry
			Production area	Marginal	Urban	
1-Monitoring of infested area	Red Spheres/YP	BH	0.5 to 1.0	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5
1-Monitoring for suppression	Red Spheres/YP	BH	2 to 4	1-2	0.25 to 0.5	0.25 to 0.5
3-Detection for exclusion/ containment	Red Spheres/YP	BH	1	2	2 to 4	4-10

Rhagoletis cerasi

Scenario	Trap type	Attractant	Trap Density/km ²			Points of Entry
			Production area	Marginal	Urban	
1-Monitoring of infested area	REBEL/Red Spheres/YP	AS	0.5 to 1.0	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5
1-Monitoring for suppression	REBEL/Red Spheres/YP	AS	2 to 4	1-2	0.25 to 0.5	0.25 to 0.5
3-Detection for exclusion/ containment	REBEL/Red Spheres/YP	AS	1	2	2 to 4	4-10

Rhagoletis spp.

Scenario	Trap type	Attractant	Trap Density/km ²			Points of Entry
			Production area	Marginal	Urban	
1-Monitoring of infested area	Red Spheres/YP	AS	0.5 to 1.0	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5
1-Monitoring for suppression	Red Spheres/YP	AS	2 to 4	1-2	0.25 to 0.5	0.25 to 0.5
3-Detection for exclusion/ containment	Red Spheres/YP	AS	1	2	2 to 4	4-10

YP - yellow panel BuH - buthyl hexanoate PFFP - papaya fruit fly pheromone AS - ammonium salt

Toxotrypana curvicauda

Scenario	Trap type	Attractant	Trap Density/km ²				Points of Entry
			Production area	Marginal	Urban	Urban	
1-Monitoring of infested area	Red Spheres	PFFP	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5	0.25 to 0.5	
1-Monitoring for suppression	Red Spheres	PFFP	2 to 4	1	0.25 to 0.5	0.25 to 0.5	
1-Monitoring for eradication	Red Spheres	PFFP	3 to 5	3 to 5	3 to 5	3 to 5	
2-Delimitation for suppression	Red Spheres	PFFP		10 to 20			
2-Delimitation for eradication	Red Spheres	PFFP		20 to 50			
3-Detection for exclusion/ containment	Red Spheres	PFFP	2	3	6	6 to 10	

PFFP - papaya fruit fly pheromone

APPENDIX 6. RECOMMENDED RE-BAIT AND SERVICE INTERVALS FOR VARIOUS LURES AND ATTRACTANTS

Common name	Formulation	SURVEY PROGRAMME				
		Field longevity* (weeks)	Monitoring/Detection		Delimiting	
			Service Days	Rebait Weeks	Service Days**	Rebait Weeks
Para-pheromone						
Trimedlure	polymeric plug	3-6	14	3-6	1-7	3-4
	laminate	3-6	14	3-6	1-7	3-4
	liquid	2-4	7	2-4	1-7	1-2
Methyl Eugenol ME/Malathion/Naled	polymeric plug	6	14	6	1-7	4
	liquid	2-4	14	2-4	1-7	1-2
Cuelure CUE/Malathion/Naled	polymeric plug	6	14	6	1-7	4
	liquid	2-4	14	2-4	1-7	1-2
Pheromone						
Papaya fruit fly (pyrazine) membrane-based		4	7	4	1-7	3
Olive Fly (Spiroketal)	Polymer	6	7	6	1-7	5
Food-based attractants						
a) Protein baits						
Torula yeast	pellet	1-2	7	1-2	1-7	1
NuLure	liquid	1-2	7	1-2	1-7	1
b) Synthetic food lures:						
ammonium acetate	membrane-based	4-6	14	4-6	1-7	4
	liquid	1	7	1	1-7	1
	polymer	4	14	4	1-7	2
ammonium (bi)carbonate	membrane-based	6	14	6	1-7	4
	liquid	1	7	1	1-7	1
	polymer	4	14	4	1-7	1
ammonium salts	salt	1	7	1	1-7	1
putrescine	membrane-based	4-6	14	4-6	1-7	4
trimethylamine	membrane-based	4-6	14	4-6	1-7	4
butyl hexanoate	vial	2	7	2	1-7	1

*Based on half-life longevity.

**This interval applies until control actions are implemented.

APPENDIX 7. LIST OF *BACTROCERA* SPECIES RESPONDING TO METHYL EUGENOL AND CUELURE

SPECIES THAT RESPOND TO CUELURE

- Bactrocera (Afrodacus) hypomelaina* Drew
Bactrocera (Afrodacus) jarvisi (Tryon)
Bactrocera (Afrodacus) minuta (Drew)
Bactrocera (Afrodacus) ochracea Drew
Bactrocera (Asiadacus) apicalis (Meijere)
Bactrocera (Asiadacus) maculifacies (Hardy)
Bactrocera (Asiadacus) melanopsis (Hardy)
Bactrocera (Bactrocera) abdonigella (Drew)
Bactrocera (Bactrocera) abscondita (Drew & Hancock)
Bactrocera (Bactrocera) abundans Drew
Bactrocera (Bactrocera) aemula Drew
Bactrocera (Bactrocera) aeruginosa (Drew & Hancock)
Bactrocera (Bactrocera) affindorsalis (Hardy)
Bactrocera (Bactrocera) albistrigata (Meijere)
Bactrocera (Bactrocera) allwoodi (Drew)
Bactrocera (Bactrocera) alyxiae(May)
Bactrocera (Bactrocera) ampla (Drew)
Bactrocera (Bactrocera) andamanensis (Kapoor)
Bactrocera (Bactrocera) anfracta Drew
Bactrocera (Bactrocera) anomala (Drew)
Bactrocera (Bactrocera) anthracina (Drew)
Bactrocera (Bactrocera) antigone (Drew & Hancock)
Bactrocera (Bactrocera) aquilonis (May)
Bactrocera (Bactrocera) assita Drew
Bactrocera (Bactrocera) aterrima (Drew)
Bactrocera (Bactrocera) atriliniellata Drew
Bactrocera (Bactrocera) aurantiaca (Drew & Hancock)
Bactrocera (Bactrocera) beckeriae (Hardy)
Bactrocera (Bactrocera) bimaculata Drew & Hancock
Bactrocera (Bactrocera) breviaculeus (Hardy)
Bactrocera (Bactrocera) brevistriata (Drew)
Bactrocera (Bactrocera) bryoniae (Tryon)
Bactrocera (Bactrocera) caledoniensis Drew
Bactrocera (Bactrocera) carbonaria (Hendel)¹
Bactrocera (Bactrocera) cibodasae Drew & Hancock
Bactrocera (Bactrocera) cinnamea Drew
Bactrocera (Bactrocera) circumusae Drew
Bactrocera (Bactrocera) cognata (Hardy & Adachi)
Bactrocera (Bactrocera) congener Drew
Bactrocera (Bactrocera) curreyi Drew
Bactrocera (Bactrocera) curvipennis (Froggatt)
Bactrocera (Bactrocera) decumana (Drew)
Bactrocera (Bactrocera) distincta (Malloch)
Bactrocera (Bactrocera) dyscrita (Drew)
Bactrocera (Bactrocera) enochra (Drew)
Bactrocera (Bactrocera) epicharis (Hardy)
Bactrocera (Bactrocera) erubescens (Drew & Hancock)
Bactrocera (Bactrocera) facialis (Coquillett)
Bactrocera (Bactrocera) fagraea (Tryon)
Bactrocera (Bactrocera) frauenfeldi (Schiner)
Bactrocera (Bactrocera) fuliginus (Drew & Hancock)
Bactrocera (Bactrocera) fulvicauda (Perkins)
Bactrocera (Bactrocera) fulvifemur Drew & Hancock
Bactrocera (Bactrocera) furfurosa Drew
Bactrocera (Bactrocera) furvescens Drew
Bactrocera (Bactrocera) furvilineata Drew
Bactrocera (Bactrocera) fuscitibia Drew & Hancock
Bactrocera (Bactrocera) gombokensis Drew & Hancock
Bactrocera (Bactrocera) holtmanni (Hardy)
Bactrocera (Bactrocera) inconstans Drew
Bactrocera (Bactrocera) indecora (Drew)
Bactrocera (Bactrocera) kinabalu Drew & Hancock
Bactrocera (Bactrocera) kirki (Froggatt)
Bactrocera (Bactrocera) kraussi (Hardy)
Bactrocera (Bactrocera) lata (Perkins)
Bactrocera (Bactrocera) lateritaenia Drew & Hancock
Bactrocera (Bactrocera) laticosta Drew
Bactrocera (Bactrocera) latissima Drew
Bactrocera (Bactrocera) limbifera (Bezzi)
Bactrocera (Bactrocera) lineata (Perkins)
Bactrocera (Bactrocera) lombokensis Drew & Hancock
Bactrocera (Bactrocera) longicornis Macquart
Bactrocera (Bactrocera) luzonae (Hardy & Adachi)
Bactrocera (Bactrocera) makilingensis Drew & Hancock
Bactrocera (Bactrocera) malaysiensis Drew & Hancock
Bactrocera (Bactrocera) manskii (Perkins & May)
Bactrocera (Bactrocera) melanotus (Coquillett)
Bactrocera (Bactrocera) melastomatos Drew & Hancock
Bactrocera (Bactrocera) merapiensis Drew & Hancock
Bactrocera (Bactrocera) moluccensis (Perkins)
Bactrocera (Bactrocera) morobiensis Drew
Bactrocera (Bactrocera) morula Drew
Bactrocera (Bactrocera) mucronis (Drew)
Bactrocera (Bactrocera) mulyonoi (Hardy)
Bactrocera (Bactrocera) neocognata Drew & Hancock
Bactrocera (Bactrocera) neohumeralis (Hardy)
Bactrocera (Bactrocera) nigrescentis (Drew)
Bactrocera (Bactrocera) nigrotibialis (Perkins)
Bactrocera (Bactrocera) obfuscata Drew
Bactrocera (Bactrocera) oblineata Drew
Bactrocera (Bactrocera) obscura (Malloch)
Bactrocera (Bactrocera) parafrasfeldi Drew
Bactrocera (Bactrocera) paramusae Drew
Bactrocera (Bactrocera) passiflorae (Froggatt)
Bactrocera (Bactrocera) pedestris (Bezzi)
Bactrocera (Bactrocera) penecognata Drew & Hancock
Bactrocera (Bactrocera) peninsularis (Drew & Hancock)
Bactrocera (Bactrocera) perkinsi (Drew & Hancock)
Bactrocera (Bactrocera) phaea (Drew)
Bactrocera (Bactrocera) pisinna Drew
Bactrocera (Bactrocera) propinqua (Hardy & Adachi)
Bactrocera (Bactrocera) pseudocucurbitae White
Bactrocera (Bactrocera) pseudodistincta (Drew)
Bactrocera (Bactrocera) psidii (Froggatt)
Bactrocera (Bactrocera) pusilla (Hardy)
Bactrocera (Bactrocera) quadrata (May)

Bactrocera (Bactrocera) quasisilvicola Drew
Bactrocera (Bactrocera) recurrens (Hering)
Bactrocera (Bactrocera) redunca (Drew)
Bactrocera (Bactrocera) rhabdota Drew
Bactrocera (Bactrocera) robertsi Drew
Bactrocera (Bactrocera) robiginosa (May)
Bactrocera (Bactrocera) rubigina (Wang and Zhao)
Bactrocera (Bactrocera) rufescens (May)
Bactrocera (Bactrocera) rufofuscula (Drew & Hancock)
Bactrocera (Bactrocera) rufula (Hardy)
Bactrocera (Bactrocera) russeola (Drew & Hancock)
Bactrocera (Bactrocera) sembaliensis Drew & Hancock
Bactrocera (Bactrocera) silvicola (May)
Bactrocera (Bactrocera) simulata (Malloch)
Bactrocera (Bactrocera) sumbawaensis Drew & Hancock
Bactrocera (Bactrocera) thistletoni Drew
Bactrocera (Bactrocera) tinomiscii Drew
Bactrocera (Bactrocera) trifaria (Drew)
Bactrocera (Bactrocera) trifasciata (Hardy)
Bactrocera (Bactrocera) trilineola Drew
Bactrocera (Bactrocera) trivialis (Drew)
Bactrocera (Bactrocera) tryoni (Froggatt)
Bactrocera (Bactrocera) turneri Drew
Bactrocera (Bactrocera) unifasciata (Malloch)
Bactrocera (Bactrocera) unilineata Drew
Bactrocera (Bactrocera) usitata Drew & Hancock
Bactrocera (Bactrocera) ustulata Drew
Bactrocera (Bactrocera) varipes (Malloch)
Bactrocera (Bactrocera) vishnu Drew & Hancock
Bactrocera (Bactrocera) vulgaris (Drew)
Bactrocera (Gynnodacus) petila Drew
Bactrocera (Javadacus) scutellaria (Bezzi)
Bactrocera (Javadacus) trilineata (Hardy)
Bactrocera (Niuginidacus) singularis Drew
Bactrocera (Papuodacus) neopallescens Drew
Bactrocera (Paradacus) abdopallescens (Drew)
Bactrocera (Paradacus) angustifinis (Hardy)
Bactrocera (Paradacus) aurantiventer Drew
Bactrocera (Paradacus) citroides Drew
Bactrocera (Paradacus) longicaudata (Perkins)²
Bactrocera (Semicallantra) aquila Drew
Bactrocera (Sinodacus) angusticostata Drew
Bactrocera (Sinodacus) bivittata Drew
Bactrocera (Sinodacus) chonglui (Chao & Lin)
Bactrocera (Sinodacus) hochii (Zia)
Bactrocera (Sinodacus) infesta (Enderlein)
Bactrocera (Sinodacus) paulula Drew
Bactrocera (Sinodacus) perpusilla (Drew)
Bactrocera (Sinodacus) qiongana (Chao & Lin)
Bactrocera (Sinodacus) quaterna (Wang)
Bactrocera (Sinodacus) salamander (Drew & Hancock)
Bactrocera (Sinodacus) strigifinis (Walker)
Bactrocera (Sinodacus) surrufula Drew
Bactrocera (Sinodacus) transversa (Hardy)
Bactrocera (Sinodacus) triangularis (Drew)
Bactrocera (Sinodacus) univittata (Drew)
Bactrocera (Zeugodacus) abdoangusta (Drew)
Bactrocera (Zeugodacus) abnormis (Hardy)
Bactrocera (Zeugodacus) amoena (Drew)
Bactrocera (Zeugodacus) atrifacies (Perkins)
Bactrocera (Zeugodacus) bogorensis (Hardy)
Bactrocera (Zeugodacus) brachus (Drew)
Bactrocera (Zeugodacus) caudata (Fabricius)
Bactrocera (Zeugodacus) chorista (May)
Bactrocera (Zeugodacus) cilifera (Hendel)

Bactrocera (Zeugodacus) cucurbitae (Coquillett)
Bactrocera (Zeugodacus) curta (Drew)
Bactrocera (Zeugodacus) daula Drew
Bactrocera (Zeugodacus) diaphora (Hendel)
Bactrocera (Zeugodacus) dubiosa (Hardy)
Bactrocera (Zeugodacus) elegantula (Hardy)
Bactrocera (Zeugodacus) emittens (Walker)
Bactrocera (Zeugodacus) fallacis (Drew)
Bactrocera (Zeugodacus) gracilis (Drew)
Bactrocera (Zeugodacus) heinrichi (Hering)
Bactrocera (Zeugodacus) incisa (Walker)
Bactrocera (Zeugodacus) ishigakiensis (Shiraki)
Bactrocera (Zeugodacus) isolata (Hardy)
Bactrocera (Zeugodacus) macrovittata Drew
Bactrocera (Zeugodacus) persignata (Hardy)
Bactrocera (Zeugodacus) reflexa (Drew)
Bactrocera (Zeugodacus) scutellaris (Bezzi)
Bactrocera (Zeugodacus) scutellata (Hendel)
Bactrocera (Zeugodacus) siceni (Chao and Lin)
Bactrocera (Zeugodacus) synnephes (Hendel)³
Bactrocera (Zeugodacus) tau (Walker)
Bactrocera (Zeugodacus) trichota (May)
Bactrocera (Zeugodacus) vultus (Hardy)
Bactrocera (Zeugodacus) yoshimotoi (Hardy)⁴
Dacus (Callantra) ambonensis Drew & Hancock
Dacus (Callantra) axanus (Hering)
Dacus (Callantra) calirayae Drew & Hancock
Dacus (Callantra) capillaris (Drew)
Dacus (Callantra) discors (Drew)
Dacus (Callantra) formosanus (Tseng and Chu)
Dacus (Callantra) lagunae Drew & Hancock
Dacus (Callantra) leongi Drew & Hancock
Dacus (Callantra) longicornis (Wiedemann)
Dacus (Callantra) mayi (Drew)
Dacus (Callantra) nanggalae Drew & Hancock
Dacus (Callantra) ooi Drew & Hancock
Dacus (Callantra) ramanii Drew & Hancock
Dacus (Callantra) siamensis Drew & Hancock
Dacus (Callantra) solomonensis (Malloch)
Dacus (Callantra) sphaeroidalis (Bezzi)
Dacus (Callantra) tenebrosus Drew & Hancock
Dacus (Callantra) trimacula (Wang)
Dacus (Callantra) vijaysegarani Drew & Hancock
Dacus (Dacus) absonifacies (May)
Dacus (Dacus) alarifumidus Drew
Dacus (Dacus) badius Drew
Dacus (Dacus) bakingiliensis Hancock
Dacus (Dacus) bellulus Drew and Hancock
Dacus (Dacus) bivittatus (Bigot)
Dacus (Dacus) concolor Drew
Dacus (Dacus) demmerezi (Bezzi)
Dacus (Dacus) diastatus Munro
Dacus (Dacus) durbanensis Munro
Dacus (Dacus) eclipsus (Bezzi)
Dacus (Dacus) humeralis (Bezzi)
Dacus (Dacus) ikelenge Hancock
Dacus (Dacus) newmani (Perkins)
Dacus (Dacus) pecropsis Munro
Dacus (Dacus) pleuralis Collart⁵
Dacus (Dacus) punctatifrons Karsch
Dacus (Dacus) sakeji Hancock
Dacus (Dacus) santongae Drew & Hancock
Dacus (Dacus) secamoneae Drew
Dacus (Dacus) signatifrons (May)
Dacus (Dacus) telfaireae (Bezzi)

Dacus (Dacus) xanthopterus (Bezzi)
Dacus (Didacus) aequalis Coquillett
Dacus (Didacus) africanus Adams
Dacus (Didacus) chiwira Hancock
Dacus (Didacus) devure Hancock
Dacus (Didacus) dissimilis Drew
Dacus (Didacus) eminus Munro
Dacus (Didacus) famona Hancock
Dacus (Didacus) frontalis Becker
Dacus (Didacus) hardyi Drew
Dacus (Didacus) kariba Hancock

Dacus (Didacus) langi Curran
Dacus (Didacus) pallidilatus Munro
Dacus (Didacus) palmerensis Drew

¹ *B. atramentata* (Hering) is a synonym.

² *D. vinnulus* Hardy is a synonym.

³ *D. ubiquitous* Hardy is a synonym.

⁴ Needs confirmation.

⁵ *D. masaicus* Munro is a synonym

SPECIES ATTRACTED TO METHYL EUGENOL

Bactrocera (Apodacus) cheesmanae (Perkins)
Bactrocera (Apodacus) neocheesmanae Drew
Bactrocera (Apodacus) visenda (Hardy)
Bactrocera (Bactrocera) abdulonginqua (Drew)
Bactrocera (Bactrocera) aethriobasis (Hardy)
Bactrocera (Bactrocera) affinis (Hardy)
Bactrocera (Bactrocera) amplexiseta (May)
Bactrocera (Bactrocera) atrifemur Drew & Hancock
Bactrocera (Bactrocera) bancroftii (Tryon)
Bactrocera (Bactrocera) batemani Drew
Bactrocera (Bactrocera) biarcuata (Walker)
Bactrocera (Bactrocera) cacuminata (Hering)
Bactrocera (Bactrocera) carambolae Drew & Hancock
Bactrocera (Bactrocera) caryeae (K Kapoor)
Bactrocera (Bactrocera) collita Drew & Hancock
Bactrocera (Bactrocera) confluens (Drew)
Bactrocera (Bactrocera) correcta (Bezzi)
Bactrocera (Bactrocera) curvifera (Walker)
Bactrocera (Bactrocera) dapsiles Drew
Bactrocera (Bactrocera) decurtans (May)
Bactrocera (Bactrocera) diallagma Drew¹
Bactrocera (Bactrocera) diospyri Drew
Bactrocera (Bactrocera) dorsalis (Hendel)
Bactrocera (Bactrocera) ebenea (Drew)
Bactrocera (Bactrocera) endiandrae (Perkins and May)
Bactrocera (Bactrocera) floresiae Drew & Hancock
Bactrocera (Bactrocera) froggatti (Bezzi)
Bactrocera (Bactrocera) fuscilata Drew
Bactrocera (Bactrocera) honiarae Drew
Bactrocera (Bactrocera) humilis (Drew & Hancock)
Bactrocera (Bactrocera) impunctata (Meijere)
Bactrocera (Bactrocera) indonesiae Drew & Hancock
Bactrocera (Bactrocera) infulata Drew & Hancock
Bactrocera (Bactrocera) kandiensis Drew & Hancock
Bactrocera (Bactrocera) kelaena Drew
Bactrocera (Bactrocera) lampabilis (Drew)
Bactrocera (Bactrocera) laticaudus (Hardy)
Bactrocera (Bactrocera) latilineola Drew & Hancock
Bactrocera (Bactrocera) mayi (Hardy)
Bactrocera (Bactrocera) melanogaster Drew
Bactrocera (Bactrocera) mimulus Drew
Bactrocera (Bactrocera) minuscula Drew & Hancock
Bactrocera (Bactrocera) musae (Tryon)
Bactrocera (Bactrocera) neonigratus (Drew)

Bactrocera (Bactrocera) nigella (Drew)
Bactrocera (Bactrocera) nigrescens (Drew)
Bactrocera (Bactrocera) occipitalis (Bezzi)
Bactrocera (Bactrocera) ochromarginis (Drew)
Bactrocera (Bactrocera) ochromarginis (Drew)
Bactrocera (Bactrocera) opiliae (Drew & Hardy)
Bactrocera (Bactrocera) pallida (Perkins and May)
Bactrocera (Bactrocera) papayae Drew & Hancock
Bactrocera (Bactrocera) parabarringtoniae Drew & Hancock
Bactrocera (Bactrocera) pepisalae (Froggatt)
Bactrocera (Bactrocera) philippinensis Drew & Hancock
Bactrocera (Bactrocera) picea (Drew)
Bactrocera (Bactrocera) prolixa Drew
Bactrocera (Bactrocera) reclinata Drew
Bactrocera (Bactrocera) retrorsa Drew
Bactrocera (Bactrocera) ritsemai (Weyenbergh)
Bactrocera (Bactrocera) romigae (Drew & Hancock)
Bactrocera (Bactrocera) seguyi (Hering)
Bactrocera (Bactrocera) sulawesiae Drew & Hancock
Bactrocera (Bactrocera) tenuifascia (May)
Bactrocera (Bactrocera) tuberculata (Bezzi)
Bactrocera (Bactrocera) umbrosa (Fabricius)
Bactrocera (Bactrocera) unimacula Drew & Hancock
Bactrocera (Bactrocera) unistriata (Drew)
Bactrocera (Bactrocera) verbascifoliae Drew & Hancock
Bactrocera (Bactrocera) versicolor (Bezzi)
Bactrocera (Bactrocera) zonata (Saunders)
Bactrocera (Hemigymnodacus) diversa (Coquillett)
Bactrocera (Javadacus) melanothoracica Drew
Bactrocera (Javadacus) montana (Hardy)
Bactrocera (Javadacus) unirufa Drew
Bactrocera (Notodacus) xanthodes (Broun)
Bactrocera (Paratridacus) alampeta Drew
Bactrocera (Paratridacus) atrisetosa (Perkins)
Bactrocera (Semicallantra) memnonius Drew
Bactrocera (Trypetidacus) invisitata Drew
Bactrocera (Zeugodacus) pubescens (Bezzi)²
Dacus (Callantra) melanothoracica Drew
Dacus (Callantra) pusillus (May)

¹ Questionable (see Drew et al 1999).

² Two records show it is attracted to ME, but still needs confirming as this is the only *Zeugodacus* to respond to it

APPENDIX 8. LIST OF TRAPPING MATERIAL SUPPLIERS

(this is not a complete list and other suppliers may be available locally)

BRAZIL

Bio Controle

R. João Anes, 117
S. Paulo, SP 05060-020
Tel: 55-11-3834-1627
Fax: 55-11-3831-6630
E-mail: biocontrole@biocontrole.com.br
Web: biocontrole.com.br
Attn: Mario Menezes

COSTA RICA

ChemTica Internacional S.A.

Apdo. 159-2150
San Jose, Costa Rica
Tel: (506) 261-5396 and 261-2424
Fax: (506) 261-5397
E-mail: chemtica@racsa.co.cr

SPAIN

SORYGAR S.L.

Quinta del Sol 37
Las Rozas
28230 Madrid
Fax/Phone: ++34 91 6407000
E-mail: sorygar@nexo.es

SOUTH AFRICA

Quest Development

South Africa
E-mail: questdev@icon.co.za

UNITED KINGDOM

AgriSense-BCS Ltd.

Treforest Industrial Estate
Pontypridd, CF37 5SU
United Kingdom
Tel: +44 1443 841155
Fax: +44 1443 841152
E-Mail: nickb@agrisense.demon.co.uk
Attn. Nicholas J. Brown

USA

Better World Manufacturing Inc.

5690 E. Dayton
Fresno, CA 93727
Tel: (599) 2914276
E-Mail: bettertrap@msn.com
Attn. Ricardo Alvarado

BioNova

P.O.Box 27618
Fresno, CA 93729
Tel / Fax 209 4490651
Attn. William H. Denton

D. V. Industries

P.O.Box 666
Pender, NE 68047
Tel: (402) 3853001
Fax: (402) 3853570
Attn. Laurie

ECOGEN Inc.

610 Central Ave.
Billings, Montana 59102
Tel: (406) 2453016

Edsal Maschine Products, Inc.

126 56th. Street
Brooklyn, NY 11220
Tel: (718) 4399163
Fax: (718) 7484984
Attn. Steve Tsendos

GET Trap

1240 E. Madison St.
Brownsville, Texas, 78521
Tel: (956) 982-1900
Fax: (956) 982-1754
E-Mail: ehcd@aol.com
Web: gettrap.com

Great Lakes IPM

Vestaburg, Michigan
E-mail: glimp@nethawk.com

H. Loeb Corporation

419 Sawyer Street
P.O.Box 61013
New Bedford, MA 02746
Tel.: (508) 9963745
Fax: (508) 9963777
Attn. Julius Shan

Ja-V Industries, Inc.

1128 West Ninth Street
Upland, CA 91786
Tel: (909) 9465959
Fax: (909) 9824840
Attn. Glenn

Olsen Products, Inc.

P.O.Box 1043
Medina OH 44258
Tel: (216) 7233210
Fax: (216) 7239977
Attn. Mr. Olsen

Plato Industries Inc.

2020 Holmes Road
Houston, TX 77045
Tel: (713) 7970406
Fax: (713) 7954665
E-Mail: plato@nol.net
Attn. Jorge E. Gonzalez

Rollins Container

9661 Newton Avenue South
Bloomington, MN 55431
Tel: (612) 8887550
Fax: (612) 8881435
Attn. Cammie Strey

Seabright Laboratories

4026 Harlan Street
Emeryville, CA 94608
Tel: (510) 6553126
Fax: (510) 6547982
Attn. Jim Wimberly

Scentry Biologicals Inc.

610 Central Venue
Billings, MT 59102
Tel.: 00 1 406 248 5856
Fax: 00 1 406 245 2790

Suterra, LLC (Former CONSEP)

213 SW Columbia Street
Bend, OR 97702
E-Mail: hernande@suterra.com.
Tel: 001 541 388 3688; 388 3705
Attn. Luis Hernandez

Trece Inc.

P.O.Box 6278
1143 Madison Lane
Salinas, CA 93912
Tel: (408) 7580205
Fax: (408) 7582625
Attn. Suzanne Berry

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- Campaña Nacional Contra Moscas de la Fruta, DGSV/ CONASAG/SAGAR 1999. Apéndice Técnico para el Sistema de Información de Índices Técnicos y Operativos (ITO2) (Operaciones de Campo). México DF. febrero de 1999. 28 pp.
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APPENDIX 11. GLOSSARY OF ACRONYMS AND TERMS

ACRONYMS

AA Ammonium acetate	NAFTA North America Free Trade Organization
AC Ammonium (bi)carbonate	NAPPO North American Plant Protection Organization
BuH Butyl hexanoate	NPPO National Plant Protection Organization
CRP Coordinated Research Programme	PFPP Papaya Fruit Fly Pheromone
CUE Cuelure	PMT Plastic McPhail Trap
DDVP Dichlorvos	PT Putrescine
EU European Union	RPPO Regional Plant Protection Organization
FAO Food and Agriculture Organization	SIT Sterile Insect Technology
GIS Geographical Information System	SKT Spiroketal
GPS Geographic Positioning Systems	SPS Sanitary and Phytosanitary Standards
IAEA International Atomic Energy Agency	TML Trimedlure
IPPC International Plant Protection Convention	WHO World Health Organization
JT Jackson Trap	WTO World Trade Organization
MAT Male Annihilation Technique	YP Yellow Panel
ME Methyl eugenol	

GLOSSARY

Area

An officially defined country, part of a country, or all or parts of several countries (revised FAO, 1995; CEPM, 1999).

Area of low pest prevalence

An area, whether all of a country, part of a country, or all or parts of several countries, as identified by the competent authorities, in which a specific pest occurs at low levels and which is subject to effective surveillance, control or eradication measures (IPPC, 1997).

Attractant

A chemical or visual stimulus that results in movement of a pest towards the source.

Buffer zone

Is an area adjacent to an infested area in which phytosanitary measures are taken to prevent spread of the pest (FAO, 1999).

Commercial production area

A place of production where plants for commerce are grown (revised, FAO, 1991) [Note: this concept was eliminated from the glossary on the 1995 revision].

Containment

Application of phytosanitary measures in and around an infested area to prevent spread of a pest (FAO, 1995).

Control (of a pest)

Suppression, containment or eradication of a pest population (FAO, 1995).

Delimiting Survey

Survey conducted to establish the boundaries of an area considered to be infested by or free from a pest (revised, FAO, 1999).

Detection Survey

Survey conducted in an area to determine if pests are present (revised, FAO, 1999).

Eradication

Application of phytosanitary measures to eliminate a pest from an area (revised, FAO, 1995).

Exclusion

The application of regulatory and phytosanitary measures to prevent the introduction or re-introduction of a pest into a pest free area.

Flies per trap per day (FTD)

Average number of flies captured per trap per day.

Infested

Contaminated with a pest or so exposed to a pest that contamination can be reasonably be expected to exist. (NAPPO).

Infested Area

An area that has been determined to have an established pest population. (revised, FAO,1987) [Note: this concept was eliminated from the glossary on the 1995 revision].

Marginal area

An area that is adjacent to a commercial production area.

Monitoring Survey

Ongoing survey to verify the characteristics of a pest population (FAO, 1999).

Outbreak

An isolated pest population recently detected and expected to survive for the immediate future (FAO, 1994).

Pest free area

An area in which a specific pest does not occur as demonstrated by scientific evidence and in which,

where appropriate, this condition is being officially maintained (FAO, 1999).

Point of entry

Airport, seaport, or land border point officially designated for the importation of consignments, and/or entrance of passengers (FAO, 1995).

Suppression

The application of phytosanitary measures in an infested area to reduce pest populations. (FAO, 1995; revised CEPM, 1999).

Survey

An official procedure conducted over a defined period of time to determine the characteristics of a pest population or to determine which species occur in an area. (FAO, 1999; CEPM, 1996).

System approach

The systems approach is the integration of those preharvest and postharvest practices used in production, harvest, packing, and distribution of a commodity which cumulatively meet the requirements for quarantine security (Jang and Moffit, 1995).

Trap array

The spatial pattern of trap placement within an area. (NAPPO).

Trap density

The number of traps per unit of area (NAPPO).

Trap

A baited device used for catching.

Urban area

An area that comprises a town, village or city.

