It is intended that, after adoption of this standard, Appendix 1 of ISPM No. 26 will be deleted, the annexes and appendices will be renumbered, and the references in the text of ISPM No. 26 will be adjusted.

INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES

Annex 1 to ISPM No. 26 (ESTABLISHMENT OF PEST FREE AREAS FOR FRUIT FLIES (TEPHRITIDAE))

[PARAGRAPH 1]

Fruit fly trapping

(200-)

[Work programme topic: Trapping procedures for fruit flies (Tephritidae)]
[Specification No. 35]

[2]

CONTENTS

[3] **FRUIT FLY TRAPPING**

[4] This annex provides detailed information for trapping surveys under different scenarios of pest population and control situations for different fruit fly species (Tephritidae) of economic importance. Different trapping systems and procedures should be used depending on the fruit fly status of the target area, which can be either an infested area, an area of low pest prevalence (ALPP), or a pest free area (PFA). The information in this annex can therefore be applied to other ISPMs relating to fruit flies. The annex describes the most widely used trapping systems and procedures; nevertheless, there are others available that may be applied to obtain equivalent results for fruit fly surveys.

[5] **1. Trapping Survey Objectives and Control Situations**

[6] Depending on the pest status, there are three objectives of trapping surveys:

- To verify the characteristics of the pest population, **monitoring surveys** should be implemented.
- To determine if the pest is present in an area, **detection surveys** should be implemented.
- To determine the boundaries of an area considered to be infested or free from the pest, **delimiting surveys** should be implemented.

[7] There are five types of control situations where trapping surveys should be applied:

- **No control.** The pest population is present but not subject to any suppression measures. Nevertheless, such a population should be monitored before the initiation of suppression measures.
- **Suppression.** The pest population is present and subject to control measures, and surveys are required to monitor the efficacy of these measures.
- **Eradication of established population.** The pest population is present and subject to control measures, and surveys are required to monitor the progress towards eradication of the pest population.
- **Exclusion.** The pest population is absent, the pest free area (PFA) is under exclusion measures, and surveys are required to detect the entry of the pest.
- **Eradication of incursion.** After detection of an incursion (any type of detection prior to determining if it is an outbreak) of the target pest, delimiting surveys are required. Once surveys have determined the nature and extent of the incursion and if it is actionable (an outbreak), eradication surveys may be required.

[8] **2. Trapping Scenarios**

[9] Based on the status of the target pest, there are two possible starting points for trapping surveys:

- **pest present** – starting from an established population with no control and gradually progressing to a control situation, which in some cases progresses toward an ALPP and eventually may reach a PFA
- **pest absent** – starting from a PFA where an incursion occurs, and where detection surveys have to be complemented with delimiting surveys.

[10] Table 1 depicts which type of trapping survey is required for each specific control situation.

[11] **Table 1.** Matrix of the different trapping surveys required for different control situations

Trapping surveys	**Control situations**				
	No control (FTD>Suppression)	**Suppression** (FTD>Eradication)	**Eradication of established population** (FTD~0)	**Exclusion** (FTD=0)	**Eradication of incursion** (FTD~0)
Monitoring	**A**	**B**	**C**		
Detection				**D**	
Delimiting					**E**

FTD = flies per trap per day.

[12] According to Table 1, there are five possible scenarios, illustrating the interaction of the three types of trapping surveys and the five control situations:

- Scenario A: uncontrolled population subject to monitoring surveys
- Scenario B: population under suppression subject to monitoring surveys
- Scenario C: population under eradication subject to monitoring surveys
- Scenario D: no population, detection surveys for exclusion in a PFA
- Scenario E: incursion detected through ongoing detection surveys, therefore additional implementation of delimiting surveys.

[13] **3. Trapping Systems for Fruit Fly Surveys**

[14] Trapping systems used for fruit fly surveys consist of the following components:
- attractants (pheromones, para-pheromones or food attractants)
- killing agents (dry; wet; or dry or wet)
- devices for trapping
- procedures for use of the above items.

[15] The major fruit fly species of economic importance and the attractants commonly used to attract them are presented in Table 2.

[16] **Table 2.** Major fruit fly species of economic importance and their attractants

Scientific Name	**Attractant**
Anastrepha fraterculus (Wiedemann)	Protein attractants (PA)
Anastrepha ludens (Loew)	PA, 2C[1] attractant
Anastrepha obliqua (Macquart)	PA, 2C[1] attractant
Anastrepha striata (Schiner)	PA
Anastrepha suspensa (Loew)	PA, 2C[1] attractant
Bactrocera carambolae (Drew & Hancock)	Methyl eugenol (ME),
Bactrocera caryeae (Kapoor)	ME
Bactrocera correcta (Bezzi)	ME
Bactrocera dorsalis (Hendel)[4]	ME
*Bactrocera invadens (*Drew, Tsuruta, & White)	ME, 3C[2]
Bactrocera kandiensis (Drew & Hancock)	ME
Bactrocera occipitalis (Bezzi)	ME
Bactrocera papayae (Drew & Hancock)	ME
Bactrocera philippinensis (Drew & Hancock)	ME
Bactrocera umbrosa (Fabricius)	ME
Bactrocera zonata (Saunders)	ME, 3C[2], ammonium acetate (AA)
Bactrocera cucurbitae (Croquillet)	Cuelure (CUE), 3C[2], AA
Bactrocera cucumis (French)	CUE, PB
Bactrocera tryoni (Froggatt)	CUE
Bactrocera tau (Walker)	CUE
Bactrocera latifrons (Hendel)	PA
Bactrocera citri (Chen)	PA
Bactrocera tsuneonis (Miyake)	PA
Bactrocera minax (Enderlein)	PA
Bactrocera oleae (Gmelin)	PA, ammonium bicarbonate, Spiroketal
Ceratitis capitata (Wiedemann)	Trimedlure (TML), Capilure, PA, 3C[2], 2C[3]
Ceratitis cosyra (Walker)	PA, 3C[2], 2C[3]
Ceratitis rosa (Karsh)	TML, PA, 3C[2], 2C[3]
Dacus ciliatus (Loew)	PA, 3C[2], AA
Myopardalis pardalina (Bigot)	PA

Rhagoletis cerasi (Linnaeus)	Butyl hexanoate (BuH), ammonium salts (AS)
Rhagoletis pomonella (Walsh)	BuH, AS
Toxotrypana curvicauda (Gerstaecker)	2-methyl-vinyl-pyrazine (MVP)

[1] Two-component (2C) synthetic food attractant of ammonium acetate and putrescine, mainly for female captures.
[2] Three-component (3C) synthetic food attractant, mainly for female captures (ammonium acetate, putrescine, trimethylamine).
[3] Two-component (2C) synthetic food attractant of ammonium acetate and trimethylamine, mainly for female captures.
[4] Taxonomic status of some listed members of the *Bactrocera dorsalis* complex is uncertain.

[17] ## 3.1 Attractants and lures

[18] ### 3.1.1 Male specific

[19] The most widely used traps contain para-pheromone attractants that are male specific. The para-pheromone trimedlure (TML) captures *Ceratitis* species (including *C. capitata* and *C. rosa*). The para-pheromone methyl eugenol (ME) captures a large number of *Bactrocera* species (including *B. dorsalis*, *B. zonata*, *B. carambolae*, *B. philippinensis* and *B. musae)*. The para-pheromone cuelure (CUE) captures a large number of other *Bactrocera* species, including *B. cucurbitae* and *B. tryoni*. Para-pheromones are generally highly volatile, and can be used with a variety of traps (Table 3a). Controlled-release formulations exist for TML, CUE and ME, providing a longer-lasting attractant for field use.

[20] ### 3.1.2 Female biased

[21] Female-biased attractants are based on food or host odours (natural, synthetic, liquid or dry) (Table 3b). Historically, liquid protein attractants have been used to catch a wide range of different fruit fly species. Liquid protein attractants capture both females and males. These liquid attractants are generally not as sensitive as the para-pheromone traps. In addition, the use of liquid attractants results in capturing high percentages of non-target insects. Several food-based synthetic attractants have been developed using ammonia and its derivatives.

[22] For example, for capturing *C. capitata* a synthetic attractant consisting of three attractants (ammonium acetate, putrescine and trimethylamine) is used. For capture of *Anastrepha* species the trimethylamine attractant may be removed. A synthetic attractant will last approximately 6–10 weeks depending on climate conditions, captures few non-target insects and captures significantly less male flies, making this attractant suited for use in programmes releasing sterile flies. New synthetic food attractant technologies are available for use, including the long-lasting three-component and two-component mixtures contained in the same patch, as well as the three components incorporated in a single cone-shaped plug (Table 4).

[23] **Table 3a.** Attractants and traps for male fruit fly surveys

Fruit fly species	Attractant and trap (see below for abbreviations)																						
	TML/CE									ME							CUE						
	CC	CH	ET	JT	LT	ST	SE	TP	YP	CH	ET	JT	LT	ST	TP	YP	CH	ET	JT	LT	ST	TP	YP
Anastrepha fraterculus																							
Anastrepha ludens																							
Anastrepha obliqua																							
Anastrepha striata																							
Anastrepha suspensa																							
Bactrocera carambolae										x	x	x	x	x	x	x							
Bactrocera caryeae										x	x	x	x	x	x	x							
Bactrocera citri																							
Bactrocera correcta										x	x	x	x	x	x	x							
Bactrocera cucumis																	x	x	x	x	x	x	x
Bactrocera cucurbitae																	x	x	x	x	x	x	x
Bactrocera dorsalis										x	x	x	x	x	x	x							
Bactrocera invadens										x	x	x	x	x	x	x							
Bactrocera kandiensis										x	x	x	x	x	x	x							
Bactrocera latifrons																							
Bactrocera minax																							
Bactrocera occipitalis										x	x	x	x	x	x	x							
Bactrocera oleae																							
Bactrocera philippinensis										x	x	x	x	x	x	x							
Bactrocera tau																	x	x	x	x	x	x	x
Bactrocera tryoni																	x	x	x	x	x	x	x
Bactrocera tsuneonis																							
Bactrocera umbrosa										x	x	x	x	x	x	x							
Bactrocera zonata										x	x	x	x	x	x	x							
Ceratitis capitata	x	x	x	x	x	x	x	x	x														
Ceratitis cosyra																							
Ceratitis rosa	x	x	x	x	x	x	x	x	x														
Dacus ciliatus																							
Myopardalis pardalina																							
Rhagoletis cerasi																							
Rhagoletis pomonella																							
Toxotrypana curvicauda																							

Attractant abbreviations

TML Trimedlure
CE Capilure
ME Methyl eugenol
CUE Cuelure

Trap abbreviations

CC Cook and Cunningham (C&C) trap
CH ChamP trap
ET Easy trap
JT Jackson trap

Trap abbreviations

LT Lynfield trap
ST Steiner trap
SE Sensus trap
TP Tephri trap
YP Yellow panel trap

[24] **Table 3b.** Attractants and traps for female-biased fruit fly surveys

Fruit fly species	3C						2C[1]				2C[2]	PA			SK+AC		AS (AA, AC)			BuH		MVP
	ET	SE	MLT	OBDT	LT	TP	ET	MLT	LT	TP	MLT	ET	McP	MLT	CH	YP	RB	RS	YP	RS	YP	GS
Anastrepha fraterculus													x	x								
Anastrepha ludens											x		x	x								
Anastrepha obliqua											x		x	x								
Anastrepha striata													x	x								
Anastrepha suspensa											x		x	x								
Bactrocera carambolae													x	x								
Bactrocera caryeae													x	x								
Bactrocera citri													x	x								
Bactrocera correcta													x	x								
Bactrocera cucumis													x	x								
Bactrocera cucurbitae			x										x	x								
Bactrocera dorsalis													x	x								
Bactrocera invadens			x										x	x								
Bactrocera kandiensis													x	x								
Bactrocera latifrons													x	x								
Bactrocera minax													x	x								
Bactrocera occipitalis													x	x								
Bactrocera oleae												x	x	x	x	x			x			
Bactrocera philippinensis													x	x								
Bactrocera tau													x	x								
Bactrocera tryoni													x	x								
Bactrocera tsuneonis													x	x								
Bactrocera umbrosa													x	x								
Bactrocera zonata			x										x	x								
Ceratitis capitata	x	x	x	x	x	x	x	x	x	x		x	x	x								
Ceratitis cosyra			x					x					x	x								
Ceratitis rosa		x	x					x					x	x								
Dacus ciliatus			x										x	x								
Myopardalis pardalina													x	x								
Rhagoletis cerasi																	x	x	x	x	x	
Rhagoletis pomonella																	x		x			
Toxotrypana curvicauda																						x

Attractant abbreviations

SK	Spiroketal
3C	(AA+Pt+TMA)
2C[1]	(AA+TMA)
2C[2]	(AA+Pt)
AC	ammonium (bi)carbonate
AA	ammonium acetate

Attractant abbreviations

Pt	putrescine
TMA	trimethylamine
PA	protein attractant
BuH	butyl hexanoate
MVP	papaya fruit fly pheromone (2-methyl vinylpyrazine)

Trap abbreviations

CH	ChamP trap
ET	Easy trap
GS	Green sphere
LT	Lynfield trap
McP	McPhail trap
MLT	Multilure trap

Trap abbreviations

OBDT	Open bottom dry trap
RB	Rebell trap
RS	Red sphere
SE	Sensus
TP	Tephri trap
YP	Yellow panel trap

.

[25] **Table 4.** List of attractants

Common name	Acronym	Formulation	Field longevity[1] (weeks)	Survey programme			
				Monitoring/Detection		Delimiting	
				Inspection[2] (days)	Service[3] (rebait) (weeks)	Inspection[2] (days)	Service[3] (rebait) (weeks)
Para-pheromones							
Trimedlure	TML	Polymeric plug	4–10	7–14	6–10	2–3	4
		Laminate	3–6	7–14	4–6	2–3	3
		Liquid	1–4	7–14	2–4	2–3	1
Methyl eugenol	ME	Polymeric plug	4–10	7–14	8–10	2–3	4
		Liquid	4–8	7–14	6–8	2–3	4
Cuelure	CUE	Polymeric plug	4–10	7–14	8–10	2–3	4
		Liquid	4–8	7–14	6–8	2–3	4
Capilure (TML plus extenders)	CE	Liquid	12–36	7–14	12–26	2–3	12
Pheromones							
Papaya fruit fly (2-methyl-vinylpyrazine)	MVP	Patches	4–6	7–14	5–6	2–3	4
Olive Fly (spiroketal)	SK	Polymer	4–6	7–14	5–6	2–3	4
Food-based attractants							
Torula yeast/borax	PA	Pellet	1–2	7–14	2	2–3	1
Protein derivatives	PA	Liquid	1–2	7–14	2	2–3	1
Ammonium acetate	AA	Patches	4–6	7–14	5–6	2–3	4
		Liquid	1	7–14	1	2–3	1
		Polymer	2–4	7–14	3–4	2–3	2
Ammonium (bi)carbonate	AC	Patches	4–6	7–14	5–6	2–3	4
		Liquid	1	7–14	1	2–3	1
		Polymer	1–4	7–14	3–4	2–3	1
Ammonium salts	A	Salt	1	7–14	1	2–3	1
Putrescine	Pt	Patches	6–10	7–14	8–10	2–3	6
Trimethylamine	TMA	Patches	6–10	7–14	8–10	2–3	6
Butyl hexanoate	BuH	Vial	2	7–14	2	2–3	1
Ammonium acetate Putrescine Trimethylamine	3C	Cone/patches	6–10	7–14	8–10	2–3	6
Ammonium acetate Putrescine Trimethylamine	3C	Long-lasting patches	18–26	7–14	24–26	2–3	18
Ammonium acetate Trimethylamine	2C	Patches	6–10	7–14	8–10	2–3	6
Ammonium acetate Putrescine	2C	Patches	6–10	7–14	8–10	2–3	6

[1] Based on half-life.

[2] Inspection refers to checking traps for target fruit fly catches.

[3] Service refers to rebaiting the trap based on half-life of the attractant.

[26] In addition, because food-foraging female and male flies respond to synthetic food attractants at the sexually immature adult stage, these attractant types are capable of detecting female flies earlier and at lower population levels than liquid protein attractants.

[27] **3.2 Killing agents**

[28] Attracted flies are retained in a variety of traps. In some dry traps, killing agents are a sticky material or a toxicant such as dichlorvos, malathion, spinosad and pyrethroids (such as deltamethrin). Some organophosphates may act as a repellent at higher doses.

[29] In other traps, liquid is the killing agent. When liquid protein attractants are used, 1.5 to 2 g of borax is added to preserve the captured fruit flies. There are protein attractants that are formulated with borax, and thus no additional borax is required. When water is used, 10% propylene glycol is added to preserve captured flies.

[30] **3.3 Trapping devices**

[31] Based on the killing agent, there are three types of traps commonly used:

- **Dry traps**. The fly is caught on a sticky material board or killed by a chemical agent. Some of the most widely used dry traps are Cook and Cunningham (C & C), ChamP, Jackson/Delta, Lynfield, Open bottom dry trap (OBDT) or Phase IV, Red sphere, Steiner and Yellow panel/Rebell.
- **Wet traps**. The fly is drowned in the attractant solution or in water with surfactant. One of the most widely used wet traps is the McPhail trap. The Harris trap is also a wet trap with a more limited use.
- **Dry or wet traps**. These traps can be used either dry or wet. Some of the most widely used are Easy trap, Multilure trap and Tephri trap.

[32] Commonly used traps are described below.

[33] **<u>Cook and Cunningham (C&C) Trap</u>**

[34] **General description**

[35] The C&C trap consists of three removable creamy white panels, spaced approximately 2.5 cm apart. The two outer panels are made of rectangular paperboard measuring 22.8 cm × 14.0 cm. One or both panels are coated with sticky material (Figure 1). The adhesive panel has one or more holes which allow air to circulate through. The trap is used with a polymeric panel containing an olfactory attractant (usually trimedlure), which is placed between the two outer panels. The polymeric panels come in two sizes – standard and half panel. The standard panel (15.2 cm × 15.2 cm) contains 20 g of TML, while the half size (7.6 cm × 15.2 cm) contains 10 g. The entire unit is held together with clips, and suspended in the tree canopy with a wire hanger.

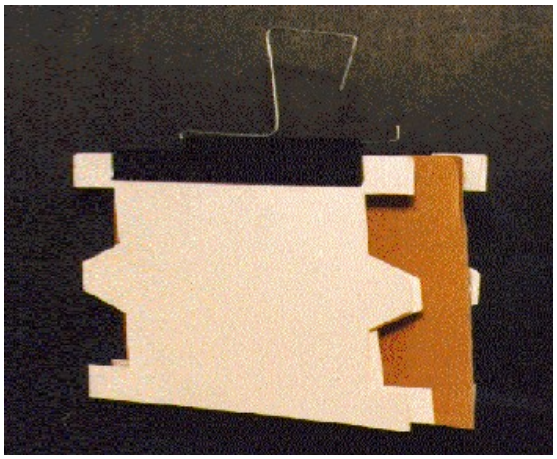


Figure 1. Cook and Cunningham (C&C) trap.

[36] **Use**

[37] As a result of the need for economic highly sensitive delimiting trapping of *C. capitata*, polymeric panels were developed for the controlled release of greater amounts of TML. The C&C trap with its multi-panel construction has significant adhesive surface area for fly capture.

[38] To be used for the following species: *Ceratitis capitata* (Table 2).

[39] For attractants used and rebaiting, see Tables 3 and 4.

[40] For use under different scenarios and recommended densities, see Table 5.

[41] **ChamP Trap**

[42] **General description**

[43] The ChamP trap is a hollow, Yellow panel-type trap with two perforated sticky side panels. When the two panels are folded, the trap is rectangular in shape (18 cm × 15 cm), and a central chamber is created to place the attractant (Figure 2). A wire hanger placed at the top of the trap is used to place it on branches.

Figure 2. ChamP trap.

[44] **Use**

[45] The ChamP trap can accommodate patches, polymeric panels, and plugs. It is equivalent to a Yellow panel trap in sensitivity.

[46] To be used for the following species: *Bactrocera oleae* and *Ceratitis capitata* (Table 2).

[47] For attractants used and rebaiting, see Tables 3 and 4.

[48] For use under different scenarios and recommended densities, see Table 5.

[49] **Easy Trap**

[50] **General description**

[51] The Easy trap is a two-part rectangular plastic container with an inbuilt hanger. It is 14.5 cm high, 9.5 cm wide, 5 cm deep and can hold 400 ml of liquid (Figure 3). The front part is transparent and the rear part is yellow. The transparent front of the trap contrasts with the yellow rear enhancing the trap's ability to catch fruit flies. It combines visual effects with para-pheromone and food-based attractants.


Figure 3. Easy trap.

[52] **Use**

[53] The trap is multipurpose. It can be used dry baited with para-pheromones (e.g. TML, CUE, ME) or synthetic food attractants (e.g. 3C and 2C attractants) and a retention system such as dichlorvos. It can also be used wet baited with liquid protein attractants holding up to 400 ml of mixture. When synthetic food attractants are used, one of the dispensers (the one containing putrescine) is attached inside to the yellow part of the trap and the other dispensers are left free.

[54] The Easy trap is one of the most economic traps commercially available. It is easy to carry, handle and service, providing the opportunity to service a greater number of traps per man-hour than some other traps.

[55] To be used for the following species: all fruit fly species **(**Table 2).

[56] For attractants used and rebaiting, see Tables 3 and 4.

[57] For use under different scenarios and recommended densities, see Table 5.

[58] **Jackson Trap (JT) or Delta Trap**

[59] **General description**

[60] The Jackson trap is hollow, delta shaped and made of a white waxed cardboard. It is 8 cm high, 12.5 cm long and 9 cm wide (Figure 4). Additional parts include a white or yellow rectangular insert of waxed cardboard which is covered with a thin layer of adhesive known as "sticky material" used to trap flies once they land inside the trap body; a polymeric plug or cotton wick in a plastic basket or wire holder; and a wire hanger placed at the top of the trap body.

[61] **Use**

[62] This trap is mainly used with para-pheromone attractants to capture male fruit flies. The attractants used with JT/Delta traps are TML, ME and CUE. When ME and CUE are used a toxicant must be added.

Figure 4. Jackson trap or Delta trap.

[63] For many years this trap has been used in exclusion and control programmes for multiple purposes, including population ecology studies (seasonal abundance, distribution, host sequence, etc.); detection and delimiting trapping; and surveying sterile fly populations in areas subjected to sterile fly mass releases. JT/Delta may not be suitable for some environmental conditions (e.g. rain or dust).

[64] The JT/Delta traps are some of the most economic traps commercially available. They are easy to carry, handle and service, providing the opportunity of servicing a greater number of traps per man-hour than some other traps.

[65] To be used for the following genus: *Bactrocera* spp., *Ceratitis* spp. and *Dacus* spp. (Table 2).

[66] For attractants used and rebaiting, see Tables 3 and 4.

[67] For use under different scenarios and recommended densities, see Table 5.

[68] **Lynfield Trap (LT)**

[69] **General description**

[70] The conventional Lynfield trap consists of a disposable, clear plastic, cylindrical container measuring 11.5 cm high with a 10 cm diameter base and 9 cm diameter screw-top lid. There are four entry holes evenly spaced around the wall of the trap (Figure 5). Another version of the Lynfield trap is the Morocco trap (Figure 6).

Figure 5. Lynfield trap.

[71] **Use**

[72] The trap uses an attractant and insecticide system to attract and kill target fruit flies. The screw-top lid is usually colour-coded to the type of attractant being used (red, CAP/TML; white, ME; yellow, CUE). To hold the attractant a 2.5 cm screw-tip cup hook (opening squeezed closed) screwed through the lid from above is used. The trap uses the male-specific para-pheromone attractants CUE, Capilure (CE), TML and ME.

[73] CUE and ME attractants, which are ingested by the male fruit fly, are mixed with malathion. However, because CE and TML are not ingested by either *C. capitata* or *C. rosa*, a dichlorvos-impregnated matrix is placed inside the trap to kill flies that enter.

Figure 6. Morocco trap.

[74] To be used for the following species: *Bactrocera* spp. (including *B. tryoni*) and *Ceratitis* spp. (Table 2).

[75] For attractants used and rebaiting, see Tables 3 and 4.

[76] For use under different scenarios and recommended densities, see Table 5.

[77] **McPhail (McP) Trap type**

[78] **General description**

[79] The conventional McPhail (McP) trap is a transparent glass or plastic, pear-shaped invaginated container. The trap is 17.2 cm high and 16.5 cm wide at the base and holds up to 500 ml of solution (Figure 7). The trap parts include a rubber cork or plastic lid that seals the upper part of the trap and a wire hook to hang traps on tree branches. A plastic version of the McPhail trap is 18 cm high and 16 cm wide at the base and holds up to 500 ml of solution (Figure 8). The top part is transparent and the base is yellow.

Figure 7. McPhail trap.

[80] **Use**

[81] For this trap to function properly it is essential that the body stays clean. Some designs have two parts in which the upper part and base of the trap can be separated allowing for easy service (rebaiting) and inspection of fruit fly catches.

[82] This trap uses a liquid food attractant, based on hydrolysed protein or torula yeast/borax tablets. Torula tablets are more effective than hydrolysed proteins over time because 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.

[83] To bait with yeast tablets, mix three to five torula tablets in 500 ml of water. Stir to dissolve tablets. To bait with protein hydrolysate, mix protein hydrolysate and borax (if not already added to the protein) in water to reach 5–9% hydrolysed protein concentration and 3% of borax.

[84] The nature of its attractant means this trap is more effective at catching females. Food attractants are generic by nature, and so McP traps tend to also catch a wide range of other non-target tephritid and non-tephritid flies in addition to the target species.

Figure 8. Plastic McPhail trap.

[85] McP-type traps are used in fruit fly management programmes in combination with other traps. In areas subjected to suppression and eradication 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 in a sterile insect technique (SIT) programme. In programmes releasing only sterile males or in a male annihilation technique (MAT) programme, McP traps are used as a population detection tool by targeting feral females, whereas Jackson traps, used with male-specific attractants, catch the released sterile males, and their use should be limited to programmes with an SIT component. Furthermore, in fly-free areas, McP traps are an important part of the exotic fruit-fly trapping network because of their capacity to catch fruit fly species of quarantine importance for which no specific attractants exist.

[86] McP traps with liquid protein attractant are labour intensive. Servicing and rebaiting take time, and the number of traps that can be serviced in a normal working day is half that of some other traps described in this guideline.

[87] To be used for the following species: all fruit flies species (Table 2).

[88] For attractants used and rebaiting, see Tables 3 and 4.

[89] For use under different scenarios and recommended densities, see Table 5.

[90] **Multilure Trap**

Figure 9. Multilure trap.

[91] **General description**

[92] The Multilure trap (MLT) is a version of the McPhail trap described previously. The trap is 18 cm high and 15 cm wide at the base and can hold up to 750 ml of liquid (Figure 9). It consists of a two-piece plastic invaginated cylinder-shaped container. The top part is transparent and the base is yellow. The upper part and base of the trap separate, allowing the trap to be serviced and rebaited. The transparent upper part of the trap contrasts with the yellow base enhancing the trap's ability to catch fruit flies. A wire hanger, placed on top of the trap body, is used to hang the trap from tree branches.

[93] **Use**

[94] This trap follows the same principles as those of the McP. However, an MLT used with dry synthetic attractant is more efficient and selective than an MLT or McP used with liquid protein attractant. Another important difference is that an MLT with a dry synthetic attractant allows for a cleaner servicing and is much less labour intensive than a McP trap. When synthetic food attractants are used, dispensers are attached to the inside walls of the upper cylindrical part of the trap or hung from a clip at the top. For this trap to function properly it is essential that the upper part stays transparent.

[95] When the MLT is 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 decomposition of captured flies.

[96] When the MLT is used as a dry trap, a suitable (non-repellent at the concentration used) insecticide such as dichlorvos or a deltamethrin (DM) strip is placed inside the trap to kill the flies. DM is applied to a polyethylene strip placed on the upper plastic platform inside the trap. Alternatively, DM may be used in a circle of impregnated mosquito net and will retain its killing effect for at least six months under field conditions. The net must be fixed on the ceiling inside the trap using adhesive material.

[97] To be used for the following species: all fruit flies species (Table 2).

[98] For attractants used and rebaiting, see Tables 3 and 4.

[99] For use under different scenarios and recommended densities, see Table 5.

[100] **Open Bottom Dry Trap or (Phase IV) Trap**

Figure 10. Open bottom dry trap (Phase IV).

[101] **General description**

[102] This trap is an open-bottom cylindrical dry trap that can be made from opaque green plastic or wax-coated green cardboard. The cylinder is 15.2 cm high and 9 cm in diameter at the top and 10 cm in diameter at the bottom (Figure 10). It has a transparent top, three holes (each of 2.5 cm diameter) equally spaced around the wall of the cylinder midway between the ends, and an open bottom, and is used with a sticky insert. A wire hanger, placed on top of the trap body, is used to hang the trap from tree branches.

[103] **Use**

[104] A food-based synthetic chemical attractant can be used to capture female and male *C. capitata*. Synthetic attractants for female fruit flies are attached to the inside walls of the cylinder. Servicing is easy because the sticky insert permits easy removal and replacement, similarly to the inserts used in the JT. This trap is less expensive than the plastic or glass McP-type traps.

[105] To be used for the following species: *Ceratitis capitata* (Table 2).

[106] For attractants used and rebaiting, see Tables 3 and 4.

[107] For use under different scenarios and recommended densities, see Table 5.

[108] **Red Sphere Trap**

[109] **General description**

[110] The trap is a red sphere 8 cm in diameter (Figure 11). The trap mimics the size and shape of a ripe apple. The trap is covered with a sticky material and baited with the synthetic fruit odour butyl hexanoate, which has a fragrance like a ripe fruit. Attached to the top of the sphere is a wire hanger used to hang it from tree branches.

Figure 11. Red sphere trap.

[111] **Use**

[112] The red sphere trap can be used unbaited, but it is much more efficient in catching flies when baited. Flies that are sexually mature and ready to lay eggs are attracted to this trap.

[113] Many types of insects will be caught by these traps. If the traps are used as a way to time insecticide sprays, it will be necessary to positively identify the target fly from the non-target insects likely to be present on the traps.

[114] To be used for the following species: *Rhagoletis pomonella* (Table 2).

[115] For attractants used and rebaiting, see Tables 3 and 4.

[116] For use under different scenarios and recommended densities, see Table 5.

[117] **Sensus Trap**

[118] **General description**

[119] The Sensus trap consists of a vertical plastic bucket 12.5 cm in high and 11.5 cm in diameter (Figure 12). It has a transparent body and a blue overhanging lid which has a hole just underneath it. A wire hanger placed on top of the trap body is used to hang the trap from tree branches.

Figure 12. Sensus trap.

[120] **Use**

[121] The trap is dry and uses male-specific para-pheromones or, for female-biased captures, dry synthetic food attractants. A dichlorvos block is placed in the comb on the lid to kill the flies.

[122] To be used for the following species: *Ceratitis capitata* and *C. rosa* (Table 2).

[123] For attractants used and rebaiting, see Tables 3 and 4.

[124] For use under different scenarios and recommended densities, see Table 5.

[125] **Steiner Trap**

[126] **General description**

[127] The Steiner trap is a horizontal, clear plastic cylinder with openings at each end. The conventional Steiner trap is 14.5 cm long and 11 cm in diameter (Figure 13). Other versions of the Steiner traps are 12 cm long and 10 cm in diameter (Figure 14) and 14 cm long and 8.5 cm in diameter (Figure 15). A wire hanger, placed on top of the trap body, is used to hang the trap from tree branches.

Figure 13. Conventional Steiner trap.

[128] **Use**

[129] This trap uses the male-specific para-pheromone attractants TML, ME and CUE. The attractant is suspended from the centre of the inside of the trap. The attractant may be a cotton wick soaked in 2–3 ml of a mixture of para-pheromone or a dispenser with the attractant and an insecticide (usually malathion, dibrom or deltamethrin) as a killing agent.

Figure 15. Steiner trap.

Figure 14. Steiner trap.

[130] To be used for the following species: *Ceratitis capitata*, *Bactrocera* spp. and *Dacus* spp. (Table 2).
[131] For attractants used and rebaiting, see Tables 3 and 4.
[132] For use under different scenarios and recommended densities, see Table 5.

[133] **Tephri Trap**

[134] **General description**

[135] The Tephri trap is similar to a McP trap. It is a vertical cylinder 15 cm high and 12 cm in diameter at the base and can hold up to 450 ml of liquid (Figure 16). It has a yellow base and a clear top, which can be separated to facilitate servicing. There are entrance holes around the top of the periphery of the yellow base, and an invaginated opening in the bottom. Inside the top is a platform to hold attractants. A wire hanger, placed on top of the trap body, is used to hang the trap from tree branches.

Figure 16. Tephri trap.

[136] **Use**

[137] The trap is baited with hydrolysed protein at 9% concentration; however, it can also be used with other liquid protein attractants as described for the conventional glass McP trap or with the female dry synthetic food attractant and with TML in a plug or liquid as described for the JT/Delta and Yellow panel traps. If the trap is used with liquid protein attractants or with dry synthetic attractants 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 (e.g. malathion) soaked into a cotton wick or other killing agent is needed to avoid escape of captured insects. Other suitable insecticides are dichlorvos or deltamethrin (DM) strips placed inside the trap to kill the flies. DM is applied in a polyethylene strip, placed on the plastic platform inside the top of the trap. Alternatively, DM may be used in a circle of impregnated mosquito net and will retain its killing effect for at least six months under field conditions. The net must be fixed on the ceiling of the inside of the trap using adhesive material.

[138] To be used for the following species: *Bactrocera oleae*, *Ceratitis capitata*, *Rhagoletis cerasi* (Table 2).
[139] For attractants used and rebaiting, see Tables 3 and 4.
[140] For use under different scenarios and recommended densities, see Table 5.

[141] **Yellow Panel Trap/Rebell Trap**

[142] **General description**

[143] The Yellow panel (YP) trap consists of a yellow rectangular cardboard plate (23 cm × 14 cm) coated with plastic (Figure 17). The rectangle is covered on both sides with a thin layer of sticky material. The Rebell trap is a three-dimensional YP-type trap with two crossed yellow rectangular plates (15 cm × 20 cm) made of plastic (polypropylene) making them extremely durable (Figure 18). The trap is also coated with a thin layer of sticky material on both sides of both plates. A wire hanger, placed on top of the trap body, is used to hang it from tree branches.

Figure 17. Yellow panel trap.

[144] **Use**

[145] These traps can be used as visual traps alone and baited with TML, spiroketal or ammonium salts (ammonium acetate). The attractants may be contained in controlled-release dispensers such as a polymeric plug. The attractants are attached to the face of the trap. The attractants can also be mixed into the cardboard's coating. The two-dimensional design and greater contact surface make these traps more efficient, in terms of fly catches, than the JT and McPhail-type traps. It is important to consider that these traps require special procedures for transportation, submission and fly screening methods because they are so sticky that specimens can be destroyed in handling. Although these traps can be used in most types of control programme applications, their use is recommended for the post-eradication phase and for fly-free areas, where highly sensitive traps are required. These traps should not be used in areas subjected to mass release of sterile flies because of the large number of released flies that would be caught. It is important to note that their yellow colour and open design allow them to catch other non-target insects including natural enemies and pollinators.

Figure 18. Rebell trap.

[146] To be used for the following species: (YP or Rebell) *Ceratitis* spp. and *Rhagoletis* spp.; (YP only) *Bactrocera oleae* (Table 2).

[147] For attractants used and rebaiting, see Tables 3 and 4.

[148] For use under different scenarios and recommended densities, see Table 5.

[149] **3.4 Trapping procedures**

[150] **3.4.1 Layout of trapping network**

[151] In suppression and eradication programmes, an extensive trapping network should be deployed over the entire area subject to survey and control actions.

[152] 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 areas where hosts exist, traps are usually deployed in a grid system which may have a uniform distribution.

[153] In areas with scattered commercial orchards, rural areas with fruit hosts and in marginal areas where commercial and wild hosts exist, trap network arrays are normally distributed along roads that provide access to host material.

[154] Trapping networks are also placed as part of exclusion programmes for early detection of introduced fruit flies of quarantine importance. In this case traps are placed in high-risk areas such as points of entry, fruit markets and urban areas, as appropriate.

[155] **3.4.2 Trap deployment (placement)**

[156] Trap deployment involves the actual placement of the traps in the field. One of the most important factors of trap deployment is selecting a proper trap site. It is of vital importance to have a list of the primary, secondary and occasional fruit fly hosts, 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 effective planning of a programme of trap relocation.

[157] When possible, pheromone traps should be placed in mating areas. Fruit flies normally mate in the crown of host plants or close by, selecting semi-shaded spots and usually on the upwind side of the crown. Other suitable trap sites are resting and feeding areas in plants that provide shelter and protect flies from strong winds and predators.

[158] Protein traps should be deployed in shaded areas in host plants. In this case traps should be deployed in primary host plants during their fruit maturation period. In the absence of primary host plants, secondary host plants should be used. In areas with no host plants identified as potential fruit fly pathways, traps should be deployed in plants that can provide shelter, protection and food to adult fruit flies.

[159] Traps should be deployed in the middle to the top part of the host plant canopy, depending on the height of the host plant, 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, leaves and other obstructions such as spider webs to allow proper air flow and easy access for the fruit flies.

[160] Placement of traps in the same tree baited with different attractants should be avoided because it may cause interference among attractants and a reduction of trap efficiency. For example, placing a *C. capitata* male-specific TML trap and a protein attractant trap in the same tree will cause a reduction of female catches in the protein traps because TML acts as a female repellent.

[161] Traps have to be relocated following the maturation phenology of the primary fruit hosts. By relocating 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.

[162] 3.4.3 Trap mapping

[163] Once traps are placed in carefully selected sites at the correct density and distributed in an adequate array, the location of the traps must be recorded. It is recommended that the location of traps should be geo-referenced with use of the global positioning system (GPS) equipment. A map or sketch of the trap location and the area around the traps should be prepared.

[164] The application of the GPS and geographic information systems (GIS) in the management of trapping network has proved 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.

[165] If GPS is not available, the references of the trap location should include visible landmarks, and in the case of traps placed in host plants 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 trappers, control brigades and supervisors to find the trap easily.

[166] A database or trapping book of all traps with their corresponding coordinates is kept, together with the records of trap services, rebaiting, trap catches etc. GIS provides high-resolution maps showing the exact location of each trap and other valuable information such as exact location of fly finds (incursions or outbreaks), historical profiles of the geographical distribution patterns of the pest, and relative size of the populations in given areas. This information is extremely useful in planning control activities, ensuring that bait sprays and sterile fly releases are accurately placed and cost-effective in their application.

[167] 3.4.4 Trap servicing and inspection

[168] Trap servicing intervals are specific to each trap system. Capturing flies will depend, in part, on how well the trap is serviced. Trap servicing includes rebaiting and maintaining the trap in a clean and proper operating condition.

[169] Attractants have to be used in the proper volumes and concentrations and replaced at the recommended intervals. The release rate of attractants varies considerably with environmental conditions. The release rate

is generally high in hot and dry areas, and low in cool and humid areas. Thus, in cool climates traps may have to be rebaited less often than in hot conditions.

[170] Inspection intervals (i.e. checking for fruit fly catches) should be adjusted according to the prevailing environmental conditions and control situations. The interval can range from one day up to 30 days. However, the most common inspection interval is seven days in areas where fruit fly populations are present and 14 days in fruit fly free areas. In the case of delimiting surveys inspection intervals may be more frequent (Table 4).

[171] When changing attractants it is important to avoid spillage or contamination of the external surface of the trap body or the ground. Attractant spillage or trap contamination would reduce the chances of flies entering the trap. For traps that use a sticky insert to capture flies, it is important to avoid contaminating areas in the trap that are not meant for catching flies with the sticky material. This also applies for leaves and twigs that are in the trap surroundings.

[172] The number of traps serviced per day per person will vary depending on type of survey, environmental and topographic conditions and trapper experience.

[173] **3.4.5 Trapping records**

[174] The following information must be included in order to keep proper trapping records: trap location, plant where the trap is placed, trap and attractant type, servicing and inspection dates, and target fly capture. Any other information considered necessary can be added to the trapping records. The trapping records should be retained for at least 24 months and made available to the NPPO of the importing country on request.

[175] **3.4.6 Flies per trap per day**

[176] Flies per trap per day (FTD) is a population index that indicates the average number of flies of the target species captured per trap per day during a specified period in which the trap was exposed in the field.

[177] The function of this population index is to have a comparative measure of the size of the adult pest population in a given space and time.

[178] It is used as baseline information to compare the size of the population before, during and after the application of a fruit fly control programme. The FTD should be used in all report of trapping surveys.

[179] The FTD is comparable within a programme; however, for meaningful comparisons between programmes, it should be based on the same fruit fly species, trapping system and trap density.

[180] In areas where sterile flies are being released it is used to measure the relative abundance of the sterile and wild flies.

[181] FTD is obtained by dividing the total number of captured flies by the product obtained from multiplying the total number of inspected traps by the average number of days the traps were exposed. The formula is as follows:

$$FTD = \frac{F}{T \times D}$$

where,
F = total number of flies
T = number of inspected traps
D = average number of days traps were exposed in the field.

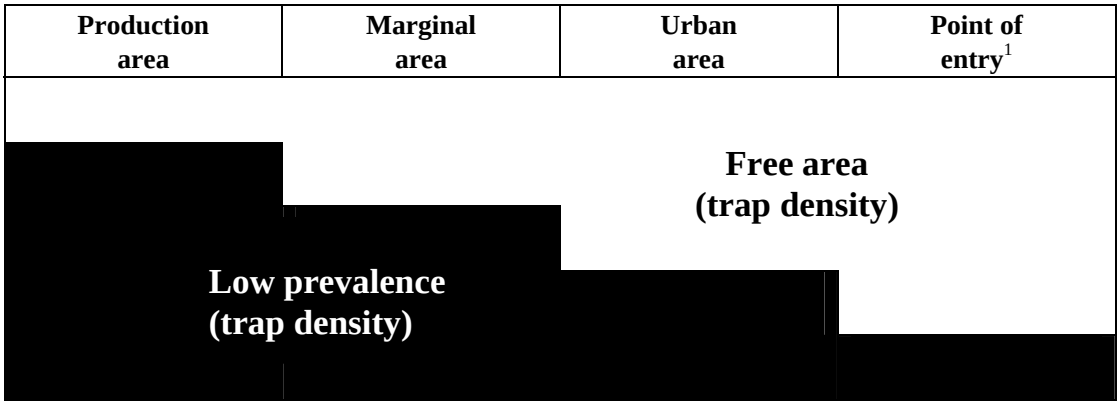
[182] **4. Trap Densities**

[183] Trap density is critical for fruit fly surveys. The trap densities need to be adjusted based on many factors including type of survey, trap efficiency, location regarding type and presence of host, climate, topography and programme phase. In terms of type and presence of hosts, as well as the risk involved, the following types of location are of concern:

- production areas

- marginal areas
- urban areas
- points of entry (and other high-risk areas such as fruit markets).

[184] Trap densities have to vary as a gradient from production areas to marginal areas, urban areas and points of entry. For example, in a pest free area, a higher density of traps is required at points of entry and a lower density in commercial orchards (Figure 19). Or, in an area where suppression is applied, such as in a low prevalence area or an area under a systems approach where the target species is present, the reverse occurs, and trapping densities for that pest should be higher in the production field and decrease toward points of entry (Figure 19).



[1] Also applies to other high-risk areas.

[185] **Figure 19.** Relative trapping densities required according to the status and type of areas

[186] Tables 5a–5f show recommended trap densities for various fruit fly species. Trap densities are also dependent on associated survey activities, such as the type and intensity of fruit sampling to detect immature stages of fruit flies. In those cases where trapping survey programmes are complemented with equivalent fruit sampling activities, trap densities can be lower than the recommended densities shown in Table 5.

[187] The density recommendations presented in Table 5 have been made taking into account:
- various survey objectives and control situations (Table 1)
- fruit flies of economic importance (Table 2)
- production and other areas (Figure 19).

[188] **Table 5a.** Trap densities for *Anastrepha* spp.

Scenario	Trap type[1]	Attractant	Trap density/km^2 (2)			
			Production area	Marginal	Urban	Points of entry[3]
A. Monitoring survey, no control	MLT/McP	2C/PA	0.25–1	0.25–0.5	0.25–0.5	0.25–0.5
B. Monitoring survey for suppression	MLT/McP	2C/PA	2–4	1–2	0.25–0.5	0.25–0.5
C. Monitoring survey for eradication	MLT/McP	2C/PA	3–5	3–5	3–5	3–5
D. Detection survey for exclusion	MLT/McP	2C/PA	1–2	2–3	3–5	5–12
E. Delimitation survey after incursion in addition to detection survey	MLT/McP	2C/PA	20–50[4]	20–50	20–50	20–50

[1] Different traps can be combined to reach the total number.
(2) Refers to the total number of traps.
[3] Also other high-risk sites.
[4] This range includes high-density trapping in the immediate area of the detection (core area) and decreasing towards the surrounding trapping zones.

Trap type

McP	McPhail trap
MLT	Multilure trap

Attractant

2C	(AA+Pt)
PA	protein attractant

[189] **Table 5b.** Trap densities for *Bactrocera* spp. responding to methyl eugenol (ME), cuelure (CUE) and food attractants[1] (PA = protein attractants)

Scenario	Trap type[2]	Attractant	Trap density/km^2 (3)			
			Production area	Marginal	Urban	Points of entry[4]
A. Monitoring survey, no control	JT/ST/TP/LT/MLT/ McP/TP	ME/CUE/PA	0.5–1.0	0.25–0.5	0.25–0.5	0.25–0.5
B. Monitoring survey for suppression	JT/ST/TP/LT/MLT/ McP/TP	ME/CUE/PA	2–4	1–2	0.25–0.5	0.25–0.5
C. Monitoring survey for eradication	JT/ST/TP/MLT/LT/ McP/TP	ME/CUE/PA	3–5	3–5	3–5	3–5
D. Detection survey for exclusion	CH/ST/LT/MLT/McP /TP/ YP	ME/CUE/PA	1	1	1–5	3–12
E. Delimitation survey after incursion in addition to detection survey	JT/ST/TP/MLT/LT/ McP//YP	ME/CUE/PA	20–50[5]	20–50	20–50	20–50

1 *Bactrocera zonata, B. invadens, B. cucurbitae* (3- and 2-component lures and other ammonium-based synthetic food lures).

2 Different traps can be combined to reach the total number.

(3) Refers to the total number of traps.

4 Also other high-risk sites.

5 This range includes high-density trapping in the immediate area of the detection (core area) and decreasing towards the surrounding trapping zones.

Trap type

CH	ChamP trap
JT	Jackson trap
LT	Lynfield trap
McP	McPhail trap
MLT	Multilure trap
ST	Steiner trap
TP	Tephri trap
YP	Yellow panel trap

[190] **Table 5c.** Trap densities for *Bactrocera oleae*

Scenario	Trap type[1]	Attractant	Trap density/km^2 (2)			
			Production area	Marginal	Urban	Points of entry[3]
A. Monitoring survey, no control	MLT/CH/YP	AC+SK/PA	0.5–1.0	0.25–0.5	0.25–0.5	0.25–0.5
B. Monitoring survey for suppression	MLT/CH/YP	AC+SK/PA	2–4	1–2	0.25–0.5	0.25–0.5
C. Monitoring survey for eradication	MLT/CH/YP	AC+SK/PA	3–5	3–5	3–5	3–5
D. Detection survey for exclusion	MLT/CH/YP	AC+SK/PA	1	2	2–5	3–12
E. Delimitation survey after incursion in addition to detection survey	MLT/CH/YP	AC+SK/PA	20–50[4]	20–50	20–50	20–50

1 Different traps can be combined to reach the total number.

(2) Refers to the total number of traps.

3 Also other high-risk sites.

4 This range includes high-density trapping in the immediate area of the detection (core area) and decreasing towards the surrounding trapping zones.

Trap type

CH	ChamP trap
MLT	Multilure trap
YP	Yellow panel trap

Attractant

AC	ammonium bicarbonate
PA	protein attractants
SK	Spiroketal

[191] **Table 5d.** Trap densities for *Ceratitis* spp.

Scenario	Trap type[1]	Attractant	Trap density/km^2 (2)			
			Production area	Marginal	Urban	Points of entry[3]
A. Monitoring survey, no control[4]	JT/MLT/OBDT/ST /SE/ET/LT/TP	TML/CE/3C /2C/PA	0.5–1.0	0.25–0.5	0.25–0.5	0.25–0.5
B. Monitoring survey for suppression[4]	JT/MLT/OBDT/ST /SE/ET/LT/TP	TML/CE/3C /2C/PA	2–4	1–2	0.25–0.5	0.25–0.5
C. Monitoring survey for eradication[5]	JT/MLT/OBDT/ST /ET/LT/TP	TML/CE/3C /2C/PA	3–5	3–5	3–5	3–5
D. Detection survey for exclusion[5]	JT/MLT/ ST/ET/LT/CC	TML/CE/3C /PA	1	1-2	1-5	3–12
E. Delimitation survey after incursion in addition to detection survey[6]	JT/YP/MLT/OBD T/ST//ET/LT/TP	TML/CE/3C /PA	20–50	20–50	20–50	20–50

1 Different traps can be combined to reach the total number.
(2) Refers to the total number of traps.
3 Also other high-risk sites.
4 1:1 ratio (1 female trap per male trap).
5 3:1 ratio (3 female traps per male trap).
6 This range includes high-density trapping in the immediate area of the detection (core area) and decreasing towards the surrounding trapping zones (ratio 5:1, 5 female traps per male trap).

Trap type

CC	Cook and Cunningham (C&C) Trap (with TML for male capture)
ET	Easy trap (with 2C and 3C lures for female-biased captures)
LT	Lynfield trap (with TML for male capture)
JT	Jackson trap (with TML for male capture)
MLT	Multilure trap (with 2C and 3C lures for female-biased captures)
OBDT	Open Bottom Dry Trap (with 2C and 3C lures for female-biased captures)
ST	Steiner trap (with TML for male capture)
SE	Sensus trap (with CE for male captures and with 3C for female-biased captures)
TP	Tephri trap (with 2C and 3C lures for female-biased captures)
YP	Yellow panel trap

Attractant

2C	(AA+TMA)
3C	(AA+Pt+TMA)
AA	Ammonium acetate
CE	Capilure
PA	Protein attractant
Pt	Putrescine
TMA	Trimethylamine
TML	Trimedlure

[192] **Table 5e.** Trap densities for *Rhagoletis* spp.

Scenario	Trap type[1]	Attractant	Trap density/km^2 (2)			
			Production area	Marginal	Urban	Points of entry[3]
A. Monitoring survey, no control	RB/RS/YP/McP	BuH/AS	0.5–1.0	0.25–0.5	0.25–0.5	0.25–0.5
B. Monitoring survey for suppression	RB/RS/YP/McP	BuH/AS	2–4	1–2	0.25–0.5	0.25–0.5
C. Monitoring survey for eradication	RB/RS/YP/McP	BuH/AS	3–5	3–5	3–5	3–5
D. Detection survey for exclusion	RB/RS/YP/McP	BuH/AS	1	2–3	3–5	4–12
E. Delimitation survey after incursion in addition to detection survey	RB/RS/YP/McP	BuH/AS	20–50[4]	20–50	20–50	20–50

1 Different traps can be combined to reach the total number.
(2) Refers to the total number of traps.
3 Also other high-risk sites.
4 This range includes high-density trapping in the immediate area of the detection (core area) and decreasing towards the surrounding trapping zones.

Trap type

McP McPhail trap
RB Rebell trap
RS Red sphere trap
YP Yellow panel trap

Attractant

AS Ammonium salt
BuH Butyl hexanoate

[193] **Table 5f.** Trap densities for *Toxotrypana curvicauda*

Scenario	Trap type[1]	Attractant	Trap density/km^2 (2)			
			Production area	Marginal	Urban	Points of entry[3]
A. Monitoring survey, no control	GS	MVP	0.25–0.5	0.25–0.5	0.25–0.5	0.25–0.5
B. Monitoring survey for suppression	GS	MVP	2–4	1	0.25–0.5	0.25–0.5
C. Monitoring survey for eradication	GS	MVP	3–5	3–5	3–5	3–5
D. Detection survey for exclusion	GS	MVP	2	2–3	3–6	5–12
E. Delimitation survey after incursion in addition to detection survey	GS	MVP	20–50[4]	20–50	20–50	20–50

[1] Different traps can be combined to reach the total number.
(2) Refers to the total number of traps.
[3] Also other high-risk sites.
[4] This range includes high-density trapping in the immediate area of the detection (core area) and decreasing towards the surrounding trapping zones.

Trap type

GS Green sphere

Attractant

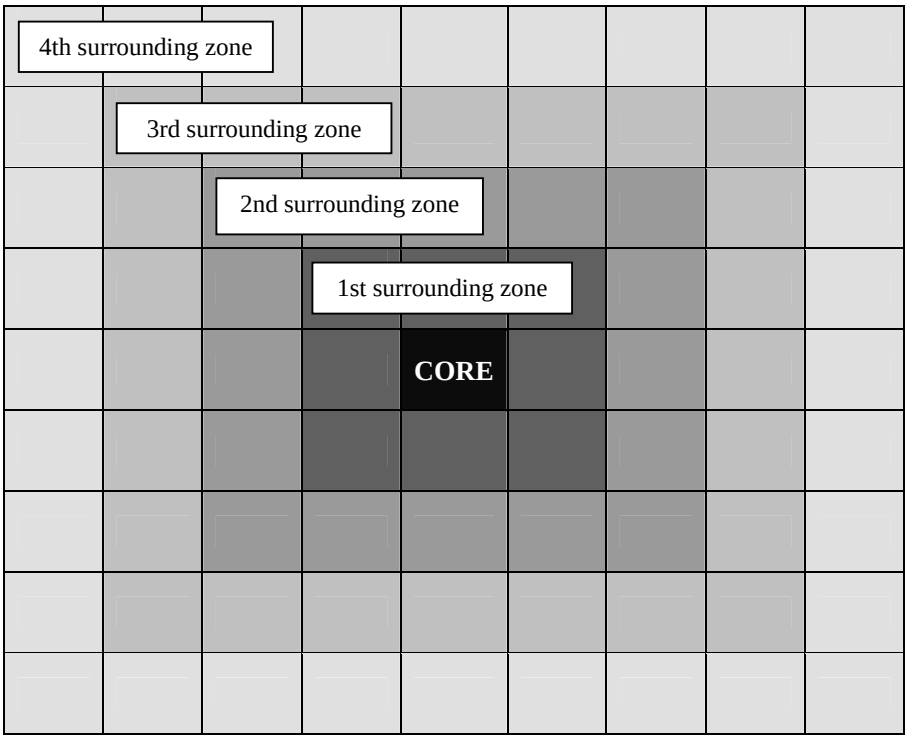
MVP Papaya fruit fly pheromone (2-methyl-vinyl-pyrazine)

[194] ## 5. Delimiting Surveys

[195] A delimiting survey is designed to determine the boundaries of an incursion into a fruit fly free area and to determine if it is an outbreak. The trap density may vary by situation, but there are some commonalities. The area immediately surrounding each find is termed a core area. The core area is defined by a set radius surrounding each find. The area defined by this radius is often squared off to produce a grid. The trapping density in the core area is higher than that used for detection surveys. Around the core area may be one or more surrounding zones where the trap density is higher than for detection surveys but usually lower than that of the core area, as appropriate. Trap densities in the surrounding zones may be proportionally tiered in a decreasing density the further away they are from the core area. Examples of delimiting surveys for single and multiple core areas are presented in Figures 20 and 21, respectively.

[196] A delimiting survey must be implemented as soon as possible after the initial detection of a targeted fly. The duration of a delimiting survey should be dependent on the developmental biology of the species. In general, delimiting survey trapping occurs for three life cycles past the last find for multivoltine species. However, one or two generations may be used for particular situations or fly species based on scientific information, as well as that provided by the surveillance system in place.

[197] **Figure 20.** Example of delimiting survey using single km^2 core and surrounding zones for various flies (number of traps per km^2)



Surrounding zones	**km^2**	***Anastrepha* McP**	***Bactrocera* spp. CUE + McP** (McP core only)	***B. dorsalis* ME + McP** (McP core only)	***Ceratitis capitata* TML + MLT** (MLT core only)
Core	1	32	20 + 10	10 + 10	40 + 10
1st	8	16	10	2	20
2nd	16	8	6	2	10
3rd	24	4	4	2	8
4th	32	2	2	2	4

[198] **Figure 21.** Sample delimiting survey showing a multiple km^2 core and surrounding zones (number in squares represent traps per km^2)

10	**10**	**10**	**10**	**10**	**10**	**10**	**10**
10	**10**	**10**	**10**	**10**	**10**	**10**	**10**
10	**10**	**20**	**20**	**20**	**20**	**10**	**10**
10	**10**	**20**	**40**	**40**	**20**	**10**	**10**
10	**10**	**20**	**40**	**40**	**20**	**10**	**10**
10	**10**	**20**	**20**	**20**	**20**	**10**	**10**
10	**10**	**10**	**10**	**10**	**10**	**10**	**10**
10	**10**	**10**	**10**	**10**	**10**	**10**	**10**

Surrounding zones	**km^2**	**Number of traps per km^2**	**Total traps**
Core	4	40	160
1st	12	20	240
2nd	48	10	480

[199] **6. Supervision Activities**

[200] Supervision of trapping activities includes assessing the quality of the materials used and reviewing the effectiveness of the use of these materials and trapping procedures.

[201] The materials used should perform effectively and reliably at an acceptable level for a prescribed period of time. The traps themselves should maintain their integrity for the entire duration that they are anticipated to remain in the field. The attractants should be certified or bioassayed for an acceptable level of performance based on their anticipated use.

[202] Formal independent evaluations should occur periodically to assess the effectiveness of the trapping survey. In order to allow for an independent evaluation, formal evaluations of the trapping programme should be conducted by someone who is not a part of the trapping programme. The timing of evaluations will vary by programme, but it is recommended to occur at least twice a year in programmes that run for six months or more. The evaluation addresses all aspects related to the ability of the trapping programme to detect targeted pests in a timely manner. Aspects of an evaluation include quality of trapping materials, record-keeping, layout of the trapping network, trap mapping, trap placement, trap condition, trap servicing, trap inspection frequency and capability for fruit fly identification.

[203] The trap deployment should be evaluated to ensure that the prescribed types and densities of traps are in place. Field confirmation is achieved through inspection of individual routes.

[204] Trap placement should be evaluated for proper host selection, trap relocation schedule, height, light/shade balance, fly access to trap, and proximity to other traps. Host selection, trap relocation and proximity to other traps can be evaluated from the records for each trap route. Host selection, placement and proximity can be further evaluated by field examination.

[205] Proper record-keeping is key to the proper functioning of a trapping programme. The records for each trap route should be inspected to ensure that they are complete and up to date. Field confirmation can then be used to validate the accuracy of the records.

[206] Traps should be evaluated for their overall condition, correct attractant, proper trap servicing and inspection intervals, correct identifying markings (such as trap identification and date placed), evidence of contamination and proper warning labels. This is performed in the field at each site where a trap is placed.

[207] Evaluation of identification capability can occur via target flies that have been marked in some manner in order to distinguish them from wild trapped flies. These marked flies are placed in traps in order to evaluate the trapper's diligence in servicing the traps, competence in recognizing the targeted species, and knowledge of the proper reporting procedures once a fly is found. Commonly used marking systems are fluorescent dyes and/or wing clipping. In some programmes that survey for eradication or exclusion, the flies may also be marked by using sterile irradiated flies in order to further reduce the chances of the marked fly being falsely identified as a wild fly and resulting in unnecessary actions by the programme. A slightly different method is necessary under a sterile fly release programme in order to evaluate the screeners on their ability to accurately distinguish target wild flies from the released sterile flies. The marked flies used are sterile and lack the fluorescent dye, but are marked physically by wing clipping or some other method. These flies are placed into the trap samples after they have been collected in the field but before they are inspected by the screeners.

[208] The independent evaluation should be summarized in a report detailing how many inspected traps on each route were found to be in compliance with the accepted standards in categories such as trap mapping, placement, condition, and servicing and inspection interval. Aspects that were found to be deficient should be identified, and specific recommendations should be made to correct these deficiencies.

[209] In cases where the trapping programme is a component of an export programme, records of independent evaluations should be retained for at least 24 months because trading partners may request this information or some evidence of an active independent evaluation programme. Alternatively, trading partners may request that they conduct their own independent evaluation programme.

[210] **7. Selected References**

[211] The following references to accessible scientific publications may provide further guidance on the methods and procedures contained in this document.

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