Armed Forces Pest Management Board
Technical Guide No. 27

Stored-Product Pest Monitoring Methods

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AFPMB Technical Guides

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Foreword

Stored-product pests cause considerable damage to military food and clothing worldwide. The Department of Defense (DoD) must ensure that effective integrated pest management (IPM) programs are established for stored-product pests that use all appropriate surveillance and control techniques currently available. This TG provides current information on insect monitoring systems, including pheromone lures and other trapping devices, that are appropriate for use in the stored-product pest programs within the DoD.

Section 1. Introduction

Purpose. The purpose of this TG is to provide current information that DoD personnel can use to establish a stored-product insect monitoring program. The main emphasis of this TG is on pheromone and food attractant traps. Other insect monitoring and detection methods are also briefly discussed.

Background

1) Stored-product insects may cause significant damage and loss to stored foods, fibers such as those used to produce uniforms, tents and blankets, and animal products such as leather. DoD personnel can minimize losses if infestations are quickly identified and the appropriate management measures implemented. Methods of identifying stored- product insect infestations at DoD installations include: product inspections (receipt, warranty, cyclic and issue), walk-through (visual) inspections, customer complaints, and accidental discovery by personnel. Product and visual inspections are both labor- intensive and time-consuming activities. Product inspection is subject to "luck of the draw" in finding an actual infestation when low-level infestations are involved.

2) Numerous methods for detecting stored-product insects, particularly food pests, have been proposed and investigated. The most useful technique currently available is monitoring storage facilities with traps baited with insect pheromones and/or food attractants. This technique is the key component of an integrated management program for stored-product pests. Other detection and monitoring methods that are useful in specific situations or are being researched include carbon dioxide emission, acoustics, light traps, pitfall traps, product incubation, glue boards, and immunoassay techniques.

3) The incorporation of monitoring methods into existing stored-product pest management programs can lead to early detection of low-level infestations and can aid in pinpointing hidden infestations. Monitoring has several distinct advantages. For example, information obtained from monitoring may be used to justify levels of pesticide use, or the need for intensified surveillance and other pest management methods. Monitoring results can also serve as an indicator of how well an IPM program’s components are functioning.

4) Detailed information on individual monitoring methods and insect monitoring systems can be found in journal articles, research reports, and manufacturers' literature. A selected bibliography of publications is listed in Section 4.

Section 2. Definitions

Food Attractant. An oil or food extract (non-nutritive products are preferred) or synthesized scent that will attract a select group of insects. In some cases the food attractant is impregnated into an artificial medium. Oil food attractants are also used as killing or

trapping agents.

Food Attractant Trap. A device using a food attractant to attract insects. It is used for monitoring a group of insects (e.g., stored-product insects, soil insects). Some traps are designed to retain attracted insects. They are often combined with pheromone lures in a single trap.

Incubation. The process or procedure of keeping material in a favorable (optimum) environment in order to stimulate development of organisms or life stages (eggs, larvae, spores, bacteria, etc.) that may be present.

Lure. A small rubber or plastic device impregnated with or retaining a pheromone or food attractant. Lures are designed to release materials gradually over a designated period of time, either passively or by controlled release.

Mating Disruption. Using a higher concentration of sex pheromone to saturate an area, thereby disrupting/reducing mating.

Pheromone. A chemical compound produced by an organism that initiates a behavioral activity in others of the same species. Pheromones are identified and synthesized to attract target insect species.

- Aggregation pheromone. A communication chemical predominantly produced by males that attracts both sexes. Effective compounds have been synthesized for stored-product insect species with long-lived adults (e.g., red/confused flour beetles, *Tribolium* spp.) and species that need to feed to reproduce.

- Sex attractant pheromone. A communication chemical usually produced by females in order to attract males. Effective compounds have been synthesized for stored-product insect species with short-lived adults (e.g., cigarette beetle, *Lasioderma serricorne*) and adults that do not need to feed to reproduce.

Pheromone Trap. A device using a pheromone lure that attracts and captures insects, used primarily for monitoring particular species. In some situations, these traps can aid in the suppression of insect populations. Pheromone traps may be combined with food attractants in a single trap to further augment collections.

Precision Targeting. A technique developed to rapidly monitor, assess and efficiently treat insect infestations. For stored-product pests, monitoring data from pheromone or food attractant traps are analyzed spatially to identify the source(s) of the infestation.

Section 3. Detection/Monitoring Methods

A. **Pheromone/Food Attractant Traps (PFAT).** Pheromones have been identified for

many stored-product insects. Some synthesized lures have been commercially developed and a variety of trap designs are available. Pheromone traps have been used for monitoring stored-product pests in a variety of stored food commodities. PFAT monitoring has the potential for early detection of low-level and isolated infestations of certain stored-product insects.

1) Benefits of PFAT Monitoring.

a. Provide round-the-clock monitoring.

b. Target a defined area of a facility.

c. Help pinpoint the location of an infestation.

d. Can reduce the amount of pesticide used for control by targeting the specific area to be treated and indicating when applications are necessary.

e. Can reduce the amount of product loss by early detection of insect activity.

f. Easily moved around in a warehouse. Not labor intensive.

g. Non-toxic.

h. Do not involve additional product inspections (unless an infestation is indicated).

i. Provide tools for evaluation of the current pest management program.

j. Supplement other existing surveillance programs.

k. Reduce the time needed to inspect stored products for signs and symptoms of pests.

2) Factors to Consider When Using PFATs.

a. Some traps will collect insects other than the target species; this can be advantageous under certain circumstances.

b. Collected specimens in sticky traps may be difficult to remove intact for identification.

c. Some trap designs do not work well in dusty areas.

d. Floor-placed traps may frequently be lost or damaged.

3) Trap Selection.

a. Pheromone lures have been developed for several stored-product insects (Tables 1

& 2). Currently, sex pheromone lures developed for species with short-lived adults have proven to be more effective than those baited with aggregation pheromones. Good results have been attained with the lure for the Indian meal moth (*Plodia interpunctella*) and its close relatives, as well as the cigarette beetle (*Lasioderma serricorne*), dermestid beetles (khapra beetle/warehouse beetles, *Trogoderma* spp.), and the lesser grain borer (*Rhyzopertha dominica*). Pheromone traps baited with these lures should be used in dry subsistence storage areas. In addition, traps baited with aggregation pheromone should be used for flour beetles (*Tribolium* spp.). Beetle traps are generally also baited with food attractant to enhance capture. An oil-based food attractant will also attract other pest species, such as the sawtoothed grain beetle (*Orizaephilus surinamensis*), merchant grain beetle (*O. mercator*), khapra beetle/warehouse beetles (*Trogoderma* spp.), and carpet beetles (*Attagenus* spp. and *Anthrenus* spp.). Food attractants are especially effective for long-lived insects and may aid in the capture of larvae. Oil baits should not be used beyond their indicated shelf life.

(1) Oil lures oxidize and solidify over time. Collected specimens may have to be freed from the oil before they can be identified. Polymerized oils need to be dissolved using an aromatic solvent, such as xylene.

(2) Researchers have used sesame oil in khapra beetle traps as a substitute for the standard oil lure. Sesame oil can be quickly dissolved with a 5% detergent solution (a non-sudsing detergent such as automatic dishwasher detergent must be used for vacuum filtration of the rinsate). This method removes most of the oil from the collected specimens.

b. Lures for different species can be combined into a single trap.

(1) Lures for the cigarette beetle, warehouse beetle, lesser grain borer and flour beetles can be combined, because these insects tend to be active on floors or at relatively low levels in warehouses. Lures for species that are active fliers can also be combined in a single trap (e.g., wing or hanging delta trap). Some traps are designed to hold as many as four different pheromones plus a food oil attractant in order to maximize their effectiveness.

(2) The lures for red/confused flour beetles (*Tribolium* spp.) and Indian meal moth (*Plodia interpunctella*) should not be combined due to differences in the flight activity of these insects. The Indian meal moth readily flies, red flour beetles can only fly short distances, and the confused flour beetle does not fly. Therefore, trap placement and subsequent capture may not provide an accurate representation of the density/distribution of each of these species.

(3) Dermestid beetles (khapra beetle/warehouse beetles, *Trogoderma* spp.) are generally small, mostly black insects and as a group may become serious pests of stored commodities. Dermestids naturally feed on dead carcasses or carrion. Accordingly, they may infest and damage woolens, stored foods, stuffed animals, and household furnishings, especially those made with animal products.

Table 1. Surveillance information for moths commonly infesting stored products (see Figures 1 & 2).

Moths	Adult Stage	Trap Type	Lure Type	Lure Duration	Effectiveness	NSN (3740-01-xxx-xxxx)	Notes
Almond Moth (*Ephestia cautella*)	3-7 days	W, D, SR	Sex	≈12 weeks	Good	414-8117 (kit-3 traps) 414-8118 (25 lures) 418-1929 (100 lures) 418-5107 (100 wing traps) 418-5110 (25 wing traps)	
Angoumois Grain Moth *(Sitotroga cerealella)*	2-14 days	W, D	Sex	4 weeks	Good	Open purchase	Use any wing or diamond trap
Indian meal Moth *(Plodia interpunctella)*	7-25 days	W, D, SR	Sex	≈ 3 months	Good	414-8117 (kit-3 traps) 414-8118 (25 lures) 418-1929 (100 lures) 418-5107 (100 wing traps) 418-5110 (25 wing traps)	
Mediterranean Flour Moth (*Anagasta kuehniella*)	9-14 days	W, D	Sex	≈ 3 months	Good	414-8117 (kit-3 traps) 414-8118 (25 lures) 418-1929 (100 lures) 418-5107 (100 wing traps) 418-5110 (25 wing traps)	
Raisin Moth *(Ephestia figulella)*	7-14 days	W, D	Sex	≈ 3 months	Moderate	414-8117 (kit-3 traps) 414-8118 (25 lures) 418-1929 (100 lures) 418-5107 (100 wing traps) 418-5110 (25 wing traps)	
Tobacco Moth *(Ephestia elutella)*	3-14 days	W, D, SR	Sex	≈ 3 months	Good	414-8117 (kit-3 traps) 414-8118 (25 lures) 418-1929 (100 lures) 418-5107 (100 wing traps) 418-5110 (25 wing traps)	

Trap Type: W = Wing; D = Diamond; SR = Short range (SP locator)

Table 2: Surveillance information for beetles commonly infesting stored products (see Figures 1 & 3).

Beetles	Adult Stage (days)	Trap Type	Lure Type	Lure Duration	Effectiveness	NSN (3740-01-xxx-xxxx)	Notes
Black Carpet Beetle *(Attagenus megatoma*)	30-60	P, D	Sex/food	4 to 8 weeks	Good	Open purchase	Use with any diamond trap or addition to Dometrap
Common Carpet Beetle *(Anthrenus scrophulariae)*	30-60	P, D	Sex/food	4 to 8 weeks	Good	Open purchase	Use with any diamond trap or addition to Dome trap
Cigarette Beetle *(Lasioderma serricorne)*	14-42	P, W, D	Sex/food	4 weeks	Good	414-9397 (25 lures)	Use with any wing trap or addition to Dome trap
Drugstore Beetle *(Stegobium paniceum*)	14-60	P, D	Sex	4 weeks	Good	Open purchase	Use with any diamond trap or addition to Dome trap
Flour Beetles *(Tribolium* spp.)	180-1,080	P,	Food/ag.	4 weeks	Good	414-9393 (Dome trap kit) 414-8123 (25 lures)	
Lesser Grain Borer *(Rhyzopertha dominica)*	90-180	P, W, D	Sex/ag.	8 weeks	Good	414-9399 (25 lures)	Use with any wing trap
Merchant Grain Beetle (*Oryzaephilus mercator*)	90-125	P	Food	Replace as needed	Good	414-9395 (Dome trap kit)	
Sawtoothed Grain Beetle *(Oryzaephilus surinamensis*)	130-1,100	P, GB	Food	Replace as needed	Good	414-9395 (Dome trap kit)	Rodent glue board also works as monitoring tool
Warehouse Beetle	14-28	P, W, D	Sex/food	4 weeks	Good . 414-8124 (25 lures)	414-9391 (kit) (*Trogoderma* spp.)	

Trap Type: W = Wing; D = Diamond; P = Pitfall (Dome trap); GB = glueboard; sex/ag. = sex and aggregation

Species in the genus *Trogoderma* are among the most destructive dermestids that infest stored commodities. *Trogoderma granarium,* or khapra beetle, is particularly destructive, in addition to being a potential medical threat. The exuviae (shed skins) of the larvae are known to cause contact dermatitis in some people, and their barbed setae may pose a health hazard if swallowed in contaminated grain. Khapra beetle infestations are notoriously difficult to control. This is largely because they require little moisture or food and they are resistant to many insecticides and fumigants.

Facilities that monitor specifically for khapra beetle can place *Trogoderma* lures in suspended traps as well as wall-mounted or floor traps. Since khapra beetles are not known to fly, the suspended traps will attract non-khapra species of *Trogoderma* (e.g., warehouse beetles), thus reducing the number of beetles requiring identification. Because the khapra beetle is a quarantinable insect, if suspected, its identity must be confirmed by an expert in khapra beetle taxonomy. Unless a CONUS facility receives material from another region of the world, especially northeastern Africa or southwestern Asia, it is unlikely the facility would have khapra beetle. However, any collected specimens suspected of being khapra beetle should be positively identified.

d. There are a variety of trap designs available that are effective for monitoring stored-product pests (Appendix A). Some more commonly used examples are shown in Figure 1. The adhesive surface of some traps is exposed (wing type, e.g., Serrico, Thin Line and Sanitrap) and can quickly become coated with dust and dirt. For dusty areas, the pitfall, funnel or other covered trap design would be more appropriate.

a. Pitfall dome trap.

b. Glue board.

c. Wing trap.

d. Diamond trap.

Figure 1. Traps for monitoring stored-product pests.

4) PFAT Placement in food warehouses with infestible products.

a. Initial trap deployment density will vary according to the species of insect and the

pheromone used. For Indian meal moth, trap density should be about 1 per 25,000 cu ft. Beetle traps should be arranged in a grid pattern at intervals of 25 ft or less. Infestations can be pinpointed by increasing the trap density around areas suspected of containing infested stores.

b. Traps may be placed outside the warehouse and away from the building to determine if infestations are originating from an external source. Accurate identification of the species is critical if outside monitoring is conducted.

c. To reduce the chance of attracting insects from outside the facility, traps should not be placed within 30 feet of exterior doors or open windows.

d. Traps should be placed to minimize damage to the traps from normal facility operations.

(1) Most beetle traps are designed to lie flat. However, depending upon design, some traps can be mounted on vertical structures/walls, pallet rack systems or pillars.

(2) Wing type and most funnel traps should be suspended above the floor, which can limit their placement in warehouses. Nevertheless, they should be placed as close to dry pet food and breakfast cereal areas as possible because these products are prone to infestation by Indian meal moth. The traps can be hung from small pulleys over or near pallets, allowing them to be out of the way but still accessible. The trap placement height for Indian meal moth can range from 6 to 30 ft.

e. If highly infestible products are consolidated in only a few areas, trap placement should be concentrated in those areas.

5) Trap Monitoring.

a. In temperate climates, PFATs should be used from at least April through October. In warm climates or where heated warehouses are used, year-round monitoring is recommended and traps or lures should be changed more frequently because they tend to lose attractiveness over a shorter period of time.

b. Pest management personnel should maintain an accurate map or listing of trap locations.

c. Traps should be checked on a weekly basis, and a log or record sheet of catches maintained. Trap and/or lure replacement and other actions should be documented for maintenance purposes or precision targeting.

d. For traps that contain insects:

(1) Determine if target stored-product insects were collected.

(2) Record the number of each species or type collected.

(3) To prevent specimens from being recounted on sticky traps, they should be removed, marked, or the trap should be replaced.

(4) If justified (paragraph 3.A.7), trap density should be increased in the area where activity is evident. This will help pinpoint the location of the infestation. These additional traps should be checked daily.

(5) Appropriate pest management procedures should be implemented when a stored-product infestation is located. After the insect source is eliminated, monitor the facility at the former trap density.

(6) Representative samples of collected specimens and a DD Form 1222 (Appendix C) should be sent to a military laboratory for identification.

(7) Traps will also collect non-target insects. It is advisable to have a verified, representative reference specimen collection available to aid in identifications or in separating target from non-target insects.

(8) The presence of large numbers of a non-stored-product insect (e.g., Phoridae, Psychodidae, Drosophilidae) in traps indicates other potential pest management problems (e.g., leaking product, dirty drains, etc.) that need to be located and eliminated.

6) Trap Maintenance.

a. Replace damaged and dirty traps as necessary. Lures from such traps should be reused if possible. Moth lures may be used up to 6 months and beetle lures 1 to 3.5 months, depending on the specific lure. Damaged or unusable lures must be destroyed and not left on or near the premises because these lures can attract insects and thus create a pest problem.

b. Lures should be handled with tweezers (forceps) or rubber gloves to avoid contamination of the lure. Staples or other fastening methods that damage the surface of a lure can reduce its longevity and/or effectiveness.

c. Unused lures should be stored in a refrigerator or freezer to reduce oxidation and to maintain their shelf life of approximately 2+ years. Refer to the manufacturer's instructions that accompany the lures for specific product information.

d. Traps require regular monitoring and good maintenance of the bait or attractant. If neglected, traps may become the foci for infestations. The more rapid monitoring techniques used in precision targeting may eliminate the need for trap maintenance.

7) Interpretation of Trap Catch for Target Species.

a. Catch over time for the trap at each location is evaluated instead of the total catch for all traps in a warehouse or bay. The trends and patterns for collections in each trap are what are important.

b. 1 to 2 specimens collected in a week at scattered locations likely indicate the catch is incidental. The specimens probably wandered in or came in on pallets or packaging. Monitoring should continue.

c. A few (2-5) specimens collected on a regular basis in the same location probably represent a small infestation. The trap density in the area of the suspected infestation should be increased and product inspection considered. An exception to this general rule is for dermestid larvae, where the trigger level is lower. A catch of more than 1 dermestid larva in a week requires greater scrutiny of an area and a catch of greater than 2 should be considered a probable infestation.

d. Several (6-9) specimens collected weekly indicate that a small to moderate infestation may be present. Trap density and monitoring frequency should be increased to identify the extent of the infestation. Product inspection should be initiated.

e. Numerous (10+) specimens collected in a trap indicate that an active infestation is present and that immediate action should be taken to isolate and control the stored-product pest. Often, this situation results from an already infested pallet of material being brought into the warehouse. Pinpointing the source of such infestations quickly will help minimize the spread of the infestation. Product inspection is necessary. Additional traps should be placed in the area to aid in determining the extent of the infestation.

Note: The specimen densities indicated above are only intended to serve as guidelines. There are no "magic" or standardized numbers to correlate trap catches to actual infestation levels. Each storage facility must be evaluated individually. Generally, any deviation from a normal trend or baseline indicates a point where additional integrated pest management actions are necessary. The type of product and the species collected should also be considered when determining the severity of an infestation. Additionally, if Khapra beetles are collected and verified from a CONUS facility, USDA eradication procedures must be followed.

f. Trap catches may also be used to determine the seasonality and migration of the target species at a storage facility. This information can be used in refining the pest management programs for the facility. For example, insects may migrate into the facility from surrounding areas during seasonal change (fall) or environmental modification (harvest activities). This may require additional attention by the pest manager to avoid the establishment of insect populations.

B. Limited Control/Suppression. Specialized lures with a higher concentration/release rate of sex pheromone have been developed for Indian meal moth. This higher release rate saturates an area with the pheromone, causing disruption of mating resulting in suppression of an infestation. It does not eliminate an infestation.

C. Glue Boards. In addition to rodent and cockroach surveillance, glue boards may be used to monitor stored-product insects (e.g., flour beetles and sawtoothed grain beetles). Glue boards must be deployed at a higher density than that required for PFATs when used for monitoring stored-product insects. They can also be used to supplement PFAT or to target specific areas (e.g., areas surrounding an identified infested product location). There

have been reports of insect repellency by some types of glue boards, which may be due to minor variations in individual glue lots. Trap effectiveness may be increased by placing a small amount of product (i.e., pasta, dry pet food, peanut butter, etc.) in the center of the glue board.

D. Acoustics. Use of acoustics to monitor stored-product pests is still experimental and is not a practical or accepted method for use in DoD at this time. Some researchers have shown it is possible to detect insect activity in certain packaged commodities at depths of 2-6 cm using highly sensitive microphones. Problems that still need to be overcome include poor sound transmitting characteristics of some commodities, detection of the smaller species of stored-product insects, and the separation of background noise from insect-generated noise. **Until acoustical detection is validated and becomes an established procedure in the food industry, the AFPMB does not recognize it as a practical method for monitoring stored-product insects at DoD installations.**

E. Light Traps. Research on the effectiveness of light traps for monitoring and suppressing stored-product pest populations has involved two basic types of light traps, 1) Devices for Electrocution of Flying Insects (DEFLIs) (Figure 2) and 2) suction traps (Figure 3). The limitations of light must be kept in mind. In general, light traps primarily collect flies and few stored-product pests. Although light trap data may provide some useful information, there are no direct correlations with other monitoring data. **Light traps must be kept clean or they can become a source of infestations**.

Figure 2. An example of a DEFLI.

Figure 3. An example of a suction trap fitted with a UV light.

1) DEFLIs are usually installed to help control flies but can also be useful in monitoring stored-product insects. Collected specimens are frequently damaged and may be difficult to identify to species. DEFLIs must be thoroughly cleaned on a regular basis to prevent breeding of scavenging insects, particularly dermestids.

2) Suction light traps are useful for monitoring stored-product pests and insects associated with poor sanitation. When used, these traps should be placed approximately six feet above the floor to minimize interference with normal warehouse operations. These traps:

a. **require regular removal and identification of the collected insects!**

b. collect a wide variety of flying insects that generally require submission to an entomology laboratory for identification.

c. are only monitoring devices that do not control infestations.

d. are reported to collect <1% of some stored-product species.

e. do not collect sawtoothed grain beetles or other non-flying stored-product insects.

f. must be located near a power source.

3) The most practical locations for use of light traps at DoD installations would be in commissary storage areas because of the variety of infestible commercial products that

are typically present in those facilities.

F. Insect Fragment Analysis. *This* is the current approved method used by USDA for determining the presence of insects or insect parts in grain and milled products. The numbers of insects and insect parts per unit of product are counted. This method involves extraction procedures that are time-consuming and require highly trained personnel using Food and Drug Administration (FDA) approved procedures, and it is not used by the DoD.

G. Immunoassay. Molecular tools such as immunoassay analysis are becoming increasing sophisticated and are gaining more widespread use. Immunoassay detection of stored product insects is a relatively new technique for monitoring infestations. One procedure uses an enzyme-linked immunosorbent assay (ELISA) designed to detect grain insect pest contamination. This is a simple but highly sensitive method of detecting minute quantities of specific insect protein in grain and milled grain. The test is intended for use by the grain industry, FDA, and USDA. It is not used by the DoD.

H. Carbon Dioxide (CO_2). Infrared CO_2 analysis can detect CO_2 emitted by insects inside or outside kernels of grain. The procedure has been reported as being better at detecting infestations than present USDA Federal Grain Inspection Service (FGIS) standard procedures. However, it is more time consuming than traditional monitoring methods. The most likely use of this method would be in monitoring bulk grain storage. Its use by DoD is not considered to be practical at this time.

I. Product Incubation. This method of monitoring can be used to confirm an in-product infestation. Samples of suspect product are collected (preferably at receipt) and held at a temperature and humidity that would optimize insect development. The product should be overwrapped with a heavy, clear plastic bag. The bag can be quickly checked for the presence of insects or the product can be sieved. A major drawback of this method is that it may take a few weeks before insects are observed. Additionally, an environmental chamber, temperature cabinet, or similar equipment may be needed to incubate the samples.

Section 4. Selected Bibliography

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Appendix A

Examples of Pheromone Traps Used for Monitoring Stored-Product Insects

1. Cardboard Beetle Traps: The trap has a corrugated cardboard insert that holds the lure(s) and a plastic tray for the food attractant.

a. Vertically mounted trap. This trap is designed primarily to trap khapra beetle and other *Trogoderma* species. It uses a food oil to attract larvae, and pheromone for adult males. The trap mounts on walls and pillars and is less likely to be damaged by activities in its environs.

b. Horizontally positioned traps. This style of trap uses food oil lure to attract larvae or beetles with long adult stages (e.g., sawtoothed grain beetle and *Tribolium* spp.) and up to 4 lures. The trap needs to lie flat to prevent spillage of the oil attractant.

2. Other Beetle Traps:

a. Cigarette beetle trap. This trap was designed specifically for the cigarette beetle. The trap needs to stand upright and should not be used in dusty areas.

b. Dome trap. This trap is for *Tribolium* spp., *Oryzaephilus* spp., and *Lasioderma* spp. The trap can be placed on the floor or mounted on a shelf. It is a modified pitfall trap that incorporates a pheromone bait and food attractant. This trap works well in dusty areas.

3. Hanging Traps: These traps are designed primarily for moths but will also collect flying beetles (e.g., cigarette beetle, lesser grain borer, flying species of *Trogoderma*). Multiple lures can be placed in each trap.

a. Delta trap. A durable trap design that uses replaceable glue-coated inserts for collecting insects. Open on the ends only.

b. Wing trap. A three-piece trap. The bottoms are replaceable and available with grids.

c. Diamond trap. The trap is a one-piece design.

d. Hanging pitfall trap. This trap is constructed of rigid plastic. It is designed for long-term use and has a large capacity. The trap requires either liquid or other material (e.g., a piece of “no-pest strip”) in the bottom to kill the collected insects. The pheromone lure mounts in the top of the trap.

Appendix B

Standard Insect Monitoring Systems, Pheromones, and Replacement Kits

National Stock Number	Manufacturer & Part Number	Comments
3740-01-473-1038	Trece 3311-00	Indian meal Moth Lures; 100/bx
3740-01-473-1042	Trece 3653-25	Indian meal Moth; 25 lures and 25 traps/bx.
3740-01-473-1039	Trece IMM-10	Indian meal Moth; 10 lures/pkg.
3740-01-418-1929	Trece 122514	Indian meal Moth, 100 lures/bg
3740-01-414-8117	Trece 3653-13	Pherocon 1C trap kit: 3 traps, 3 sticky liners, and 3 IMM lures.
3740-01-414-8118	Trece 3153-25	25IMM lures per bag. 1 year shelf life at room temperature, 2 years if refrigerated, and 3 years if frozen.
3740-01-414-8123	Trece 3156-25	25 CFB/RFB lures per bag. 1 year shelf life at room temperature.
3740-01-414-8124	Trece 3155-25	25 KB/WB per bag. 1 year shelf life at room temperature.
3740-01-414-9391	Trece 3565-01	Dome kit for khapra and warehouse beetles. 1 year shelf life. Kit contains 5 traps, 5 lures, and food oil attractant.
3740-01-414-9393	Trece 3566-01	Dome kit for red and confused flour beetles. 1 year shelf life. Kit contains 5 traps, 5 lures, and food oil attractant.
3740-01-414-9395	Trece 3567-01	Dome kit for sawtoothed grain and merchant beetles. Kit contains 5 traps and oil food attractant (no pheromone lures).

National Stock Number	Manufacturer & Part Number	Comments
3740-01-414-9397	Trece 3162-25	25 CB lures per bag. 2 year shelf life if refrigerated or frozen.
3740-01-414-9399	Trece 3158-25	25 LGB lures per bag. 1 year shelf life at room temperature.
3740-01-418-5107	Trece 3302-00	Pherocon IC traps. 100 per case.
3740-01-418-5110	Trece 3303-25	

CFB/RFB: confused flour beetle/red flour beetle
KB/WB: khapra beetle/warehouse beetle
CB: cigarette beetle
LGB: lesser grain borer/larger grain borer

Additional commercial pheromone trap information:

1. Trece STORGARD: www.trece.com
2. Insects Limited: www.insectslimited.com

Appendix C

DD Form 1222, Request for and Results of Tests

This form is available on the DoD Publications web site at
http://www.dtic.mil/whs/directives/forms/eforms/dd1222.pdf