

Module 2: INTEGRATED PEST MANAGEMENT

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*Facilitator’s Guide:*

Integrated Pest Management (IPM)   
and Fumigation Safety



***Facilitator’s Guide:***

Integrated Pest Management (IPM) and Fumigation Safety Training

**Module 2:**

**Integrated Pest Management**

The Technical and Operational Performance Support (TOPS) Program is the USAID/Food for Peace-funded learning mechanism that generates, captures, disseminates, and applies the highest quality information, knowledge, and promising practices in development food assistance programming, to ensure that more communities and households benefit from the U.S. Government’s investment in fighting global hunger. Through technical capacity strengthening, documentation and innovation, and an in-person and online community of practice (the Food Security and Nutrition [FSN] Network), The TOPS Program empowers food security implementers and the donor community to make lasting impact for millions of the world’s most vulnerable people.

The original TOPS Program was a consortium of five partner organizations: CORE Group, Food for the Hungry, Mercy Corps, Save the Children, and TANGO International. The original TOPS Program ended in January of 2018, but was extended through an activity called TOPS Bridge. The TOPS Bridge activity maintains a few key TOPS functions and provides important services to the food security and nutrition community, focusing on knowledge management, commodity management, and theory of change. The TOPS Bridge activity includes two partner organizations: CORE Group (through November 2018) and Save the Children (ongoing).

**Disclaimer:**

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# Abbreviations and Acronyms

CFR U.S. Code of Federal Regulation

CM commodity management

CSB corn-soy blend

EMMP Environmental Mitigation and Monitoring Plan

FFP USAID Office of Food for Peace

FIFO first in first out

FMP Fumigation Management Plan

FSN food security and nutrition

IEE Initial Environmental Examination

IPM integrated pest management

NGO non-governmental organization

PCI Project Concern International

PEA programmatic environmental assessment

PERSUAP Pesticide Evaluation Report and Safer Use Action Plan

PPE personal protective equipment

PVO private voluntary organization

SUAP Safer Use Action Plan (part of the PERSUAP)

TOPS Technical and Operational Performance Support

USAID U.S. Agency for International Development

# Acknowledgements

The TOPS Program would like to thank Project Concern International (PCI) for their efforts to raise awareness on fumigation safety*.* With a TOPS Small Grant, and in coordination with the Department of Grain Science and Industry at Kansas State University, they organized an Integrated Pest Management (IPM) and Fumigation Safety training workshop, which provided the raw material for this facilitator’s guide. They also produced most of the videos that accompany this guide.

The TOPS Program would also like to thank all participants of the IPM and Fumigation Safety training workshops held during 2017 and 2018 in Bangladesh, Ethiopia, DRC, and Malawi. Their questions and insights helped refine the materials presented here.

# Introduction

This guide is one piece of a **larger curriculum** designed to assist non-governmental organization (NGO) staff decrease losses of stored food commodities due to pests. The curriculum includes a Workshop Design Guide and the three technical modules summarized below.

| **Module** | **Time Required** | **Performance Objective[[1]](#footnote-1)**  *(What learners can DO as a result of training)* | **Target Audience**  *(Who NEEDS to know material presented)* |
| --- | --- | --- | --- |
| 1. **Pesticide Compliance** | 3 hours | Complete a Safer Use Action Plan (SUAP) and a Fumigation Management Plan (FMP) for phosphine, per USAID requirements | Senior program and commodity management staff and all staff who will be contracting, supervising, or monitoring fumigation service providers |
| 1. **Integrated Pest Management (IPM)** | 3½ hours | Identify and implement appropriate practices to minimize commodity loss due to pests in the warehouse | Commodity management and **all warehouse staff** |
| 1. **Phosphine Fumigation** | 3½ hours | Monitor service providers to ensure safe and effective phosphine fumigation of stored commodities | Commodity management and all staff who will supervise or monitor fumigation service providers |

All three modules can be delivered sequentially in a two-day training workshop. A single module can also be delivered on its own to a specific target audience. Each technical module is therefore presented in its own stand-alone guide.

This **Module 2** guide introduces the learner to the minimum standard IPM practices that should be implemented in every warehouse to reduce commodity loss due to pest infestations and thereby reduce the need for phosphine fumigation. **USAID regulations require** all partners managing commodity to implement and document **IPM practices** in their warehouses.

All guides provide detailed session plans for facilitating either a **Presentation** or an **Activity**. A sample agenda for this module is located in Annex 1.

**Handouts** for distribution to learners (such as small group activity instructions) are illustrated immediately after the session plan to which they apply. External materials to support these guides can be found in the following four separate folders. Annex 2 provides a complete list of these materials.

| **Folder Name** | **Contents** |
| --- | --- |
| **PRESENTATIONS** | PowerPoint slide decks corresponding to each presentation. |
| **HANDOUTS** | MS Word versions of the handouts illustrated in the guides, for adaptation to local context and printing for distribution. |
| **VIDEOS** | Twelve videos illustrating proper fumigation procedures and use of safety equipment. Applicable to Module 3. |
| **RESOURCES** | Reference materials that can be provided to learners electronically. |

The guides use the following icons for ease of access to specific information:

|  |  |
| --- | --- |
| **Icon of clock** | **Time**: An estimated total time recommended for the corresponding session. Most sessions are very interactive and actual time will depend on the number of learners participating. The more learners, the longer the session. |
| **Icon of dartboard with bullseye** | **Module objective:** What a learner should be able to *do* in the workplace once she or he masters the content delivered in the module.  **Learning objective:** The knowledge or skill a learner should be able to demonstrate at the end of the session (usually measured with a post-test).  **Purpose:** Rationale for including a specific small group activity. |
| **Icon of pens, Post-Its, and scissors** | **Materials:** Theapplicable PowerPoint slide deck for a facilitator’s presentation or supplies necessary for activities (such as markers, Post-Its). |
| Icon of paper with text | **Handouts:** Additional information that should be printed and distributed to learners. Where applicable, the session plan provides information on **when to distribute** a handout. |
| **Icon of clipboard with checkmark** | **Methodology:** A description of necessary preparation and the suggested training delivery methods, talking points for a presentation, or step-by-step instructions for an activity. |
| **Icon of a key** | **Key Facilitator Notes:** Additional information or helpful hints to ensure smooth facilitation of a session. |

# Module 2: Integrated Pest Management

Overview

|  |  |
| --- | --- |
| This module introduces the learner to the minimum standard integrated pest management (IPM) practices that should be implemented in every warehouse to reduce commodity loss due to pest infestations. IPM is essential to reduce the need for phosphine fumigation. Remember, the USAID Safer Use Action Plan requires all partners to documents and implement IPM practices.  Seven categories of IPM practices are covered. As each includes a considerable amount of material, the module has been divided into three separate PowerPoint presentations, or “**Parts.**” All seven categories of practices are introduced in Part 1, which also covers the first four practices in greater detail. Part 2 presents the next two practices in detail and Part 3 covers the final practice.  To fully address the performance objective of this module, **it is advised to organize a field visit to a warehouse storing food commodity**, where the following two additional activities can be facilitated:   * Small groups use an *IPM Practices & Inspection Checklist* to assess warehouse conditions and jointly discuss findings and recommendation. * Qualified person provides a demonstration of the proper storage, mixing, and spraying of residual (contact) pesticides. | |
| icon of clock | **Allow 3½ hours to complete the delivery of material in this module.**  Additional time is required for field visit activities. |
| **Icon of dartboard with bullseye** | **Module objective:** Identify and implement appropriate practices to minimize commodity loss due to pests in the warehouse. |
| Icon of clipboard with checkmark | The module includes three PowerPoint guided presentations/discussions and four small group activities. |

Presentation: Part 1

|  |  |
| --- | --- |
| Icon of clock | 1½ hour (including Activities 2.1 and 2.2) |
| **Icon of dartboard with bullseye** | At the end of this session learners, will be able to describe the four most basic IPM practices: exclusion, stock management, sanitation, and inspection. |
| Icon of pens, Post-Its, and scissors | * Slide deck: *Module 2\_IPM Part 1* |
| Icon of paper with text | * *IPM Part 1 HANDOUT* (printed copy of PowerPoint slides for note-taking)   Note: As the HANDOUT contains answers to the first small group activity, **DO NOT distribute it until completion of Activity 2.1.** |
| Icon of clipboard with checkmark | PowerPoint guidedplenary discussion with two small group activities. The presentation begins with an overview of the entire module, then continues with a series of photos or illustrations.  See the **Slide Narration** section below for details of key messages for slides in the PowerPoint deck. |
| **Icon of a key** | Practice the PowerPoint presentation in “Slide Show” mode to become familiar with the animation built into the slide deck.  To keep learners engaged, rather than simply telling them what each slide deck photo illustrates, let learners take turns trying to identify the issue(s). |

**Slide Narration**

| **Slide** | **Key Messages** |
| --- | --- |
| **Image of slide 1; Title slide: Integrated Pest Management** | Slide 1 |
| Image of slide 2; Performance Objective: Identify and implement appropriate practices to minimize commodity loss due to pests in the warehouse. | Slide 2  This is the performance objective for the entire module. Remember, the Safer Use Action Plan within the PERSUAP requires all partners to document and implement IPM practices. |
| Image of slide 3; IPM Definition: Use of all available knowledge (methods) to keep pest populations below economically damaging levels in a manner that causes no harm to human health and the environment. | Slide 3  Emphasize the underlined phrases:   * There is no single method (including fumigation) that will prevent commodity loss due to pests. IPM includes a variety of prevention and control techniques. * Pest “control” focuses on elimination. IPM recognizes pests can never be completely eliminated. Therefore, the “management” part of IPM implies maintaining pest population at an acceptable level. * The use of chemicals is part of IPM, but caution must always be taken to avoid any harm to humans or the environment. |
| Image of Slide 4 with illustration of pyramid divided into 7 levels listed simply number 1 to number 7. | Slide 4  There are 7 common methods to reduce stored commodity loss due to pest infestation. |
| Image of Slide 5 with instructions. Each group has 7 cards, each with a different IPM method or technique listed on it. Groups place cards in order from 1 to 7, as shown on pyramid, where 1 is the most basic, fundamental method, and 7 is the least used method. | Slide 5  Pause the presentation and follow Activity 2.1 instructions. The small group instructions on this slide are also available as a handout for this activity. |
| Image of Slide 6 with Illustration of pyramid divided into 7 levels listed simply number 1 to number 7. | Slide 6  After completing the activity, resume the presentation by providing the seven common methods to reduce stored commodity loss due to pest infestation. These “methods” appear one at a time, with a mouse click.  Explain that there is **NO right or wrong answer for this exercise**. In general, the order presented on the slides is based on how often the method is used, but each warehouse may vary. What is important is to become familiar with these methods. |
| Image of Slide 7 with pyramid with the “methods” revealed one at a time, starting in level 1 with Exclusion, followed by Stock Management, Sanitation, Inspection, Trapping, Monitoring and finally Pesticides as number 7. | Slide 7  Each method has advantages and limitations. All methods need to be implemented for successful IPM. Each will be discussed in detail in this module.  **Distribute** *IPM Part 1 HANDOUT* to assist learners taking notes. |
| Image of Slide 8 with three parts of IPM listed as Part 1: Exclusion to Inspection. Part 2: Trapping and Monitoring. Part 3: Pesticides | Slide 8  Because there is so much material to cover, it will be split into three parts. The learning objective for Part 1 is: to be able to describe the four most basic IPM practices: exclusion, stock management, sanitation, and inspection. |
| **Image of Slide 9; Title slide: Integrated Pest Management Part 1** | Slide 9 |
| Image of Slide 10; Exclusion | Slide 10  There are four physical factors to consider when attempting to exclude pests from a commodity warehouse: site location, openings in the warehouse that allow pests to enter, lighting both inside and outside the warehouse, and ventilation.  Explain that a series of photos illustrating IPM issues will be shown. Each photo has a red positive (+) or negative (-) sign in upper right hand corner. Learners should identify the positive or negative factor in the photo. |
| Image of Slide 11-Location with aerial photo of a compound with multiple warehouses, and a negative sign in right hand corner. | Slide 11  Selection of a warehouse next to a commercial one that is always infested will make it very hard to control infestations in your warehouse. |
| Image of Slide 12-Location with photo of open field with a negative sign in right hand corner. | Slide 12  Open fields adjacent to your warehouse will breed insects and rodents. Be vigilant when crops are grown and during rainy season. Increase your number of rodent bait stations. |
| Image of Slide 13-Openings. Photo of an opened warehouse door revealing the commodity stacks inside, and a negative sign in right hand corner. | Slide 13  Exclude what you can by keeping doors closed as much as possible. |
| Image of Slide 14- Openings. Photos of a screened warehouse door and plastic strips over another warehouse door, and a positive sign in right hand corner. | Slide 14  Good pest exclusion practice is to cover warehouse doors with netting or strips of plastic. These will provide some ventilation and access while reducing pest entrance. |
| Image of Slide 15- Openings. Photos illustrating the gaps between the bottom of warehouse doors and the warehouse floor, and a negative sign in right hand corner. | Slide 15  Ensure there is a good seal around each closed door because mice can enter through a 5 mm gap and rats a 1 cm gap. |
| Image of Slide 16- Other Pest Entry Points. with photos illustrating a warehouse side door and a window standing open, and a gap in wall caulking. | Slide 16  For some deterrence, consider step-over rodent guard panels (i.e. a board ½ meter high) for personnel doors that stand open.  Screen vents and windows with 200 micrometer mesh to keep birds from entering. Bird droppings are a good substrate for fungi, salmonella, and E. coli.  Insect screening requirements for stored product insects may be too fine to be practical. Instead consider residual insecticide treatments to discourage invaders. Don’t forget to screen vents in walls and roof.  All gaps in walls need to be sealed. |
| Image of Slide 17- Lighting. Photo of warehouse ceiling with large windows and lights, and a positive sign in right hand corner. | Slide 17  Good interior lighting discourages rodents. |
| Image of Slide 18-Lighting. Photo of exterior warehouse door with light fixture directly above it, and a negative sign in right hand corner. | Slide 18  Lights on or above doors will attract insects. Instead, place lights on the ground shining up.  Use white lights away from buildings and high pressure sodium lights near buildings. |
| Image of Slide 19-Ventilation. Photos of warehouse ceilings with large air vents and a fan, and a positive sign in right hand corner. | Slide 19  Good ventilation and air movement (including supplemental fans) will promote a dry storage environment and discourage certain insects. |
| Image of Slide 20- Exclusion Summary. | Slide 20   * Keep doors closed – tight * Seal all gaps – from below ground to rooftop * Screen vents and windows * Well-lighted interior spaces discourage rodents * Exterior lights on ground shining up, not on or above doors * Good ventilation and air movement will discourage certain insects |
| Image of Slide 21- Stock Management. | Slide 21  As an IPM practice, stock management includes stack layout and stock movement, both aimed at ensuring any pests that have entered do not thrive. |
| Image of Slide 22 with photo of very tall stack of commodity in warehouse, and a negative sign in right hand corner. | Slide 22  Excessively high stacks will place strain on the seams of bags on the bottom. |
| Image of Slide 23 | Slide 23 (photo of magnification of stitching holes, stretched due to weight of commodity in bags above)  This strain can create holes around stiches big enough for insects to enter. |
| Image of Slide 24 | Slide 24 (photo of bags on pallets, but some pallets are broken)  Use pallets to allow air circulation and facilitate cleaning underneath the stacks. A vacuum to perform this cleaning can be included in ITSH costs.  Plastic sheeting under stacks will accumulate grain and should therefore be avoided. |
| Image of Slide 25 with photo of commodity bags completely filling a warehouse to the point the door cannot be closed, and a negative sign in right hand corner. | Slide 25  Allow adequate space for alleys between stacks and between stacks and walls. This is essential to promote air circulation and facilitate inspections. |
| Image of Slide 26 with graphic of two forklifts facing each other with the words “In” and “Out”, and directional arrows, between them. Move commodity rapidly! | Slide 26  Use fumigated grain within one month. If necessary, pass it through a 2 mm sieve before dispatch if insects are present.  (*IPM Practices & Inspection Checklist* section D. Commodities, under “weekly,” #3 states first in first out [FIFO] should be practiced.) |
| Image of Slide 27-Reproductive potential of stored-product insects. Photo of a jar half filled with grain and the caption: at 0 days. | Slide 27 (photo of jar with grain at 0 days)  The following slides illustrate why it is so important to distribute commodity as quickly as possible.  An experiment was set up by placing 100 adult “internal feeder” insects in a jar of grain. The jar was maintained at 30oC for 7 days. During that time, the females each potentially laid 300 to 500 eggs. The adults were removed, but the eggs that were laid inside the grains remain. |
| Image of Slide 28 with photo of a second jar with the caption “28 days” next to the jar labeled “0 days”. In the second jar a whitish substance is visible. | Slide 28 (photo of jar with grain at 0 and at 28 days)  The white substance in the second jar is waste that remains after the eggs developed into larvae and ‘ate’ their way out of the grain. These second generation insects mature to adults in 28 days and lay eggs of their own. |
| Image of Slide 29 with photos of six jars with grain at 0, 28, 56, 76, 106 and 128 days. Each jar has progressively more white waste replacing grain. The jar at 128 days contains nothing but waste product. | Slide 29  Each 28 days a new generation is born, eats the grain, and begins to reproduce. Within 128 days (six months), insects had consumed all the grain, leaving only waste behind.  Discuss the implications of this in a commodity warehouse. |
| **Image of Slide 30-STOCK MANAGEMENT Summary.** | Slide 30   * Strain on seams of bags creates holes big enough for insects to enter. * Pallets allow air circulation and cleaning underneath stacks. * Allow adequate space for alleys between stacks. * Keep storage time for any commodity as short as possible; always practice FIFO. |
| **Image of Slide 31-Sanitation. Deprive pests of what they need: food, water, and harborage.** | Slide 31  Sanitation alone will NOT control insects. Beetles live for several months to a year without food. But sanitation puts stress on insects, and stressed insects are easier to kill with chemicals.  **Always** apply an insecticide to empty warehouses or to floors after sanitation. |
| Image of Slide 32 with photos of exterior trash against warehouse and tall weeds, and a negative sign in right hand corner. | Slide 32 (photos of exterior trash against warehouse and tall weeds)  Clutter and tall grass/weeds provide harborage and breeding areas for many pests. Harborage refers to locations where pests can hide or seek shelter. Sanitation is necessary both indoors and outdoors. |
| Image of Slide 33 with photos of stagnant water collecting in puddles along exterior warehouse walls, and a negative sign in right hand corner. | Slide 33 (photos of exterior water collection)  Eliminate standing water outdoors. Places that collect water provide breeding grounds for insects. |
| Image of Slide 34 with photo of rough, pitted concrete warehouse floor, and a negative sign in right hand corner. | Slide 34 (photo of rough, pitted warehouse floor)  Warehouse floors should be smooth, not pitted or rough. Rough floors collect dust and grain.  Seal cracks so grain or flour dust does not accumulate, providing food (and protection) for insects. |
| Image of Slide 35 with photo of grain spilled between bags in stack of commodity bags, and a negative sign in right hand corner | Slide 35  Broken bags and spillage will attract pests. |
| Image of Slide 36 | Slide 36 (photo of stack with several single slack bags on floor)  Segregate open and infested bags as necessary. Beware of importing infestations. |
| Image of Slide 37 SANITATION Summary. | Slide 37   * Deprive pests of what they need. Sanitation is 90% of IPM. * Clean outdoors and indoors. * Beware of importing infestations. Segregate commodities as necessary. * Rough floors collect dust and grain that attracts insects. |
| Image of Slide 38. Inspection: Look, Listen, Touch, Smell. | Slide 38  At least four senses are required to conduct a warehouse inspection for pests: sight, hearing, touch, smell. |
| Image of Slide 39. Small Group Activity Instrustions.  Part 1 1. Form 4 groups. 2. Brainstorm items to be on any IPM Inspection Template (which is a checklist to guide staff).  Part 2 3. Compare your list to USAID IPM Practices & Inspection Checklist. 4. In plenary, describe any concerns with the USAID Checklist. | Slide 39  Pause the presentation and follow Activity 2.2 instructions. The small group instructions on this slide are also available as a handout for this activity.  Part 1 instructions appear when slide first appears.  Part 2 instructions appear on <click>. |
| Image of Slide 40- Look. Photos showing the space underneath a pallet, someone looking at the seam of a bag, and birds at the top of a warehouse. | Slide 40  Always check under stacks.  Look for insect traces on bag seams.  Look up to check for birds. |
| Image of Slide 41-Look. Photo of person with a flashlight looking at spaces between stacks; photo of urine stains on floor illuminated by UV light. | Slide 41  A flashlight is an essential tool for inspection.  A UV light will show rodent urine and make it easier to locate rodent entry points. |
| Image of Slide 42. Where do larvae feed? Photos of internal feeding insects emerging from kernels or grain and external feeding insects walking on grain kernels. | Slide 42  Internal grain feeders:   * Larvae develop **inside** whole kernels. * They create an entry point for fungi and external feeding insects. * Some species penetrate packages.   External grain feeders:   * Larvae develop on broken kernels, fine material, flour, and fungi. * Most moths are external feeders. Only the Angoumois grain moth (Sitotroga cerealella), a short-lived species, is an internal feeder. |
| Image of Slide 43 | Slide 43 (x-ray of grain showing internal feeders’ larvae)  It is not always possible to see internal feeders with a visual inspection. As this x-ray illustrates, the larvae are still developing within the grain and adults have not emerged. |
| Image of Slide 44 with photo of grain bags with illustrations of an ear, hand, and nose superimposed. | Slide 44  That is why it is important to use senses other than sight during an inspection.   * (ear) Listen for any crackling from inside bags. * (hand) Feel for vibration and/or warmth of bags. * (nose) Note any musty grain, mold, or rodent dropping smells. |
| Image of Slide 45. Plenary Activity. When does inspection begin? Answer: Inspect empty warehouse before receiving first commodity.  How often should inspection be conducted? Answer: Inspect all commodity as it arrives at warehouse. Stacks should be inspected weekly, at minimum. | Slide 45  Pose the questions on the slide in plenary (one at a time) and facilitate a discussion. **Note:** Answers appear on <click>.  Stacks should be inspected weekly, at minimum. |
| Image of Slide 46 INSPECTION Summary. | Slide 46   * Look, listen, touch, and smell. * Don’t bring infestation in; inspect arriving commodities. * Identify conditions that can be corrected before problems develop. * Localized pest activity can be managed before spreading. |
| Image of Slide 47. Pyramid with the first 4 levels (or methods) labeled: Exclusion, Stock management, Sanitation, Inspection. | Slide 47  There are seven common methods to reduce stored commodity loss due to pest infestation. These first four should already be standard operating procedures in every warehouse. |

Activity 2.1: IPM Pyramid

|  |  |  |
| --- | --- | --- |
| **Icon of clock** | | 20 minutes (depending on group size) |
| **Icon of dartboard with bullseye** | | **Purpose:** To help learners begin to think about possible IPM methods. This sets the stage for subsequent learning. |
| Icon of paper with text | | * *Activity 2.1\_IPM Methods* (or simply display the instruction on slide 5 of the presentation PowerPoint deck) * *Activity 2.1\_IPM Pyramid Cards* |
| **Icon of clipboard with checkmark** | | This activity is conducted at the start of the presentation. Learners complete their task in small groups, then the facilitator resumes the presentation to provide the proposed answers. |
| **Step 1:** | **Preparation**: The file *Activity 2.1\_IPM Pyramid Cards* (located in the HANDOUTS folder) consists of seven pages. Each page has one of the following IPM methods printed on it: Exclusion, Inspection, Monitoring, Pesticides, Sanitation, Stock Management, or Trapping. Print a set on A4-sized card stock for **each group**. | |
| **Step 2:** | Divide learners into three or four groups and present each group with a “shuffeled” set of IPM Pyramid Cards.  Either distribute printed copies of the handout *Activity 2.1\_IPM Methods* or simply read the small group activity instructions on slide 5 of the PowerPoint deck to the groups. | |
| **Step 3** | Allow groups 10-15 minutes to place the cards in order from the most basic and fundamental method to the least used method. Groups may lay cards out on a table or the floor so all can see and reorder as necessary after discussion. | |
| **Step 4:** | The facilitator and other learners “visit” each group’s final order. Group members may only be asked to explain their reasoning for the order they selected. **This is NOT the time to discuss or defend the “correctness” of any selected order.** | |
| **Step 5:** | After each group’s output has been viewed, the facilitator presents the order on slides 6-7 of the presentation PowerPoint deck. | |
| **Icon of a key** | | IPM methods/techniques/practices can be divided into many different categories. The seven presented here were chosen simply for ease of understanding and to include minimum required practices per USAID. |

**Handout: Activity 2.1 IPM Methods**

**Instructions:**

1. Each group has 7 cards. Each card has a different IPM method / technique printed on it.
2. Place the cards in order from 1 to 7, as shown on pyramid.

#1 is the most basic, fundamental method

#7 is the least used method

Activity 2.2: Inspection Checklist

|  |  |  |
| --- | --- | --- |
| **Icon of clock** | | 40 minutes |
| **Icon of dartboard with bullseye** | | **Purpose:** To both introduce the USAID Template and reinforce the required IPM practices. |
| Icon of paper with text | | * *Activity 2.2\_Part 1; Activity 2.2\_Part 2* (OR simply display the instruction on slide 39 of the presentation PowerPoint deck) * *IPM Practices & Inspection Checklist* |
| **Icon of clipboard with checkmark** | | Small group work with plenary presentations.  Either distribute printed copies of the handout *Activity 2.2\_Part 1* or simply read the small group activity instructions on slide 39. Part 1 instructions appear when slide 39 first appears. Part 2 instructions appear on <click>. |
| **Step 1**: | Form small groups of three to six members but no more than four groups. Each group brainstorms items to be on an IPM inspection list, in other words, a checklist to guide staff in conducting a regular inspection of IPM practices at their commodity warehouses. (10-15 minutes) | |
| **Step 2:** | Distribute *IPM Practices & Inspection Checklist* for USAID-funded commodities and warehouses. Ask group members to read through the handout, compare it to the list they produced in Step 1, and record the following (15-20 minutes):   * How is your checklist different? * What will you need to change to meet compliance (i.e. follow the *IPM Practices & Inspection Checklist*)? | |
| **Step 3:** | In plenary groups describe any concerns they have with the *IPM Practices & Inspection Checklist*. (10-15 minutes) | |
| **Icon of a key** | | Remind learners that the Safer Use Action Plan (part of the PERSUAP) requires compliance with the practices listed in the *IPM Practices & Inspection Checklist*. What should staff do if unable to meet the standards listed in this checklist? |

**Handout: Activity 2.2 Part 1**

**Instructions:**

**Part 1**

1. Form small groups.
2. Brainstorm items to be on an IPM Inspection checklist (in other words, a checklist to guide your staff in conducting a regular inspection of IPM practices in your commodity warehouses).

**Handout: Activity 2.2 Part 2**

**Instructions:**

**Part 2**

1. Compare your list to the USAID *IPM Practices & Inspection Checklist*.

* How is your checklist different?
* What will you need to change to meet compliance?

1. In plenary, describe any concerns with the USAID Checklist.

**Handout: IPM Practices & Inspection Checklist**

**For USAID-Funded Commodities and Warehouses**

Adapted from *Annex T-6* in Commodity Protection by Phosphine Fumigation in USAID Food Aid Programs, Programmatic Environmental Assessment Tools Annex, Office of Food For Peace, updated December 2015, pages 39-40.

**STORAGE INSPECTION CHECKLIST**

|  |  |
| --- | --- |
| Date: |  |
| Inspected by: |  |
| Warehouse: |  |

**A. YARD AREA SURROUNDING WAREHOUSE**

On at least a weekly basis:

1. Inspect the yard for signs of rodents (i.e., fecal pellets, tracks, burrows in the ground, holes, signs of feeding).

2. Check to see that conditions do not attract insects (i.e., spilled commodities or other edible materials, empty containers, shrubs and trees, bird nests, weeds, trash, piled or damaged packing materials).

3. Remove trash and unnecessary equipment and supplies regularly.

4. Check the general security of the yard area surrounding the warehouse.

5. Remove weeds from the perimeter of the warehouse.

6. Check if water ponds at the perimeter of the warehouse and along access roads. If water ponds after a rain, grade the area to prevent water accumulation.

**B. WAREHOUSE**

For proper inspections, the warehouse should be well lit. Inspectors should conduct inspections using a flashlight (torch). Warehouse cleaning should be done daily; warehouse inspections should be carried out at least weekly.

1. Check screens at the vents and other openings of the warehouse. If there are no screens, place screens at any openings into the warehouse. Use wire netting with mesh no larger than 6.35 mm or steel wool. Check for structural damage; use concrete to seal the opening.

2. Check doors. Doors should be tightly fitting metal; make sure there are no gaps.

3. Check for roof leaks.

4. Check for holes in the walls.

5. Ensure that the floor is sufficiently hard-packed to prevent burrowing by rodents.

6. Check to see that the warehouse is well lit (as above, good lighting is required for proper inspections).

7. Clean and service the anticoagulant and rodent bait stations regularly, and keep them filled with fresh bait (exterior use only). Bait stations should be tamper proof and secured to the ground with a concrete block and placed every 15-30 meters.

8. Check rodent tracking powders (these should be placed on the exterior of the warehouse only).

9. Check mousetraps (they should be emptied of dead mice **daily)**. Only multiple-catch mouse traps, snap traps, and glue boards should be used in the interior of the warehouse. These should be placed every 15 meters along the floor wall junctions inside the warehouse and also underneath pallets if an infestation is suspected.

10. Make sure that commodity stacks are positioned at least one meter from walls and other stacks to facilitate inspections.

11. Ensure passageways are clean of spilled grain and debris.

12. (For large and very large warehouses) Ensure three to four meter wide central aisles.

13. Ensure stacks are at a reasonable height for ease of handling and to prevent damage to containers by crushing or falling from stacks.

14. Ensure sides of stacks are flush.

15. Ensure air spaces are provided between individual stacks.

16. Ensure clean, unused packing material is neatly stacked.

17. Ensure broken packing material is removed.

18. Ensure the top of packing materials is covered to prevent spillage of food from damaged containers to ground or floor below.

**C. DURING WORKING DAILY HOURS, CHECK THAT:**

1. Workers are lifting bags by the body instead of corners (to prevent tearing or weakening of the bag).

2. Workers place bags on stacks; they do not throw bags.

3. Workers clean empty bags and pallets thoroughly before they are reused and stack them neatly.

4. When workers reconstitute/re-bag commodities from damaged container into good containers, they are adequately stitching the opening and weighing for correct quantity before stacking.

5. Spilled commodity is not swept up into the reconstituted bag. This will help ensure that commodity will not be contaminated with pesticides that may have been sprayed in the empty warehouse.

6. Warehouse doors and windows of are kept closed to discourage entry of insects, birds, and rodents.

**D. COMMODITIES**

**On a daily basis, check whether:**

1. Insects are present on damaged containers. Report presence of insects to warehouse supervisor.

2. The exterior of stacked food containers is clean and free of mold, insects, rodents, and birds. Report presence of any of these to warehouse supervisor.

3. Spoiled/infested food commodity is stored away from good commodity.

4. Damaged commodities are removed promptly and rebagged. Use tape to seal small tears in paper bags.

5. All floor sweepings are discarded and not re-bagged or otherwise used for human or animal consumption, as they may contain insecticide residue. If fumigating, discard all floor sweepings by placing them under fumigated tarps to kill any insects and discard after aeration.

**At least on a weekly basis, inspect that:**

1. Individual commodities are stacked separately from one another.

2. Food stacks are separated from non-food stocks.

3. Records are current and adequate to document program of stock rotation (i.e., what is first in, is first out, or FIFO).

4. Check to see that commodities are stacked on pallets to keep off the floor in both small and large warehouses.

5. Pallets are not chipped nor are nails sticking out, which could tear bags or injure workers.

REVIEW & APPROVAL

Name:

Signed:

Date:

Presentation: Part 2

|  |  |
| --- | --- |
| **Icon of clock** | 1 hour (including one brief small group activity) |
| **Icon of dartboard with bullseye** | At the end of this session learners will be able to describe the importance of two IPM practices: trapping and monitoring. |
| **Icon of pens, Post-Its, and scissors** | * Slide deck: *Module 2\_IPM Part 2* |
| Icon of paper with text | * *IPM Part 2 HANDOUT* (printed copy of PowerPoint slides for notetaking) * *Insect\_Poster.pdf* (**printed on A3 paper**) * *Top 10 Stored-Product Insect Species.docx* (**printed in color**) * *Data Interpretation for Insect Trapping Programs* |
| **Icon of clipboard with checkmark** | PowerPoint guidedplenary discussion.  See the **Slide Narration** section below for details of key messages for slides in the deck: *Module 2\_IPM Part 2*. |

**Slide Narration**

| **Slide** | **Key Messages** |
| --- | --- |
| Image of Slide 1. Title slide: Integrated Pest Management Part 2. | Slide 1 |
| Image of Slide 2. Illustration of pyramid divided into 7 levels. | Slide 2  Ask learners to list the first four IPM methods already covered. These methods appear on mouse <click>. |
| Image of Slide 3. Pyramid with the first 6 levels (or methods) labeled: Exclusion, Stock management, Sanitation, Inspection, Trapping, Monitoring. | Slide 3  The next two methods are monitoring and trapping, which are closely related. They will be covered in this current Part. |
| Image of Slide 4. Trapping. | Slide 4  There are two types of trapping in IPM, based on the purpose of the trapping. Trapping for **control** focuses on elimination of the pest. Trapping as an **integral part of MONITORING** focuses on maintaining pest populations at an acceptable level. |
| Image of Slide 5. Trapping for control applies to rodents. Photo of cats being fed inside warehouse. | Slide 5  Cats are NEVER a good idea in a warehouse as their urine and fecal matter can contaminate commodities. |
| Image of Slide 6 with photos of snap traps, glue boards, multiple catch traps. Photo of man placing bucket full of water in warehouse. | Slide 6  Inside a warehouse **only** mechanical devices (snap traps, glue boards, multiple catch traps) should be used.  Rodents require daily water, but water bucket traps only seem to work in dry areas. |
| Image of Slide 7. . Interior Trap Placement. Graphic of warehouse with traps evenly spaced along exterior wall. | Slide 7  Rodent trapping for control requires three rings of defense. In addition to the double rings of exterior bait stations **outside** the warehouse,  <click> a “ring” of mechanical devices should be used inside the warehouse.  Remember, **DO NOT** use bait stations, which contain poison, inside the warehouse. Instead, use only mechanical devices such as snap traps, glue boards, and/or multiple catch traps. |
| Image of Slide 8. Questions? | Slide 8 |
| Image of Slide 9. Monitoring. There are three components of monitoring: sampling, trapping, and data interpretation. | Slide 9  There are three components of monitoring: sampling, trapping, and data interpretation  Without monitoring information, one can commit two errors:   * Respond unnecessarily when there is no problem. * Not respond when necessary. Monitoring will aid in early detection of problems. |
| Image of Slide 10. Sampling: Definition. | Slide 10  Sampling is the process of taking a representative portion of stored grain to make inferences about the population or an attribute of the population (such as density or number of insects, % of commodity that is infested, etc.). |
| Image of Slide 11. Sampling 3 Types. 1. Visual Inspection. 2. Indirect Sampling. Photo of a hanging trap to catch flying insects. 3. Direct Sampling. Photo of sampling probe being pushed into a bag of commodity. | Slide 11  There are three types of sampling for insects. |
| Image of Slide 12 with illustrations of an ear, a hand and eyes. | Slide 12  Visual inspection is a type of sampling the warehouse and commodity bags with the naked eye.   * Spend more time in areas where there are problems. (Spending more time at a location is the same as taking more samples.) * Always record the number of locations inspected.   A limitation of visual inspections alone is that they may not provide sufficient information about **emerging** insect pest problems. That is because insects often are sedentary during the day (when inspections are conducted) and active at night (when staff are not present) as they search for food, mates, and shelter. |
| Image of Slide 13. Photo of grain being weighed on scale. Weigh the samples.  Photos of grain in sieves. Extract insects from samples.  Photo of tiny insects being counted by hand. Identify and count. | Slide 13  Direct sampling can provide **absolute population estimates** (the number of insects per kg or per cubic meter).   * As a rule of thumb, collect samples from five bags plus 10 percent of total bags in a stack up to a maximum of 30 bags. * When using a 12” probe, sample diagonally in the bag from both ends to get one sample. * If using a larger probe, one sample per bag is usually sufficient. |
| Image of Slide 14, Sampling for Insects. | Slide 14  Trapping is considered indirect sampling because the area from which the insects were drawn into the trap is not known (in other words, there is no defined ‘space’). This method can only provide **relative population estimates** (or number of insects per trap).  If the purpose of trapping is simply to make inferences about the |
| presence or absence of insects in the stored grain (and perhaps monitor changes in insect density over time or space), relative population estimates are adequate.  As indirect sampling is faster, cheaper, and easier, it is more likely to be used by warehouse staff.  Traps work 24 hours a day, seven days a week. They should be used to complement ongoing pest management inspections, not to replace them.  There are two types of traps intended for insects of stored commodity that are applicable to our warehouses: aerial traps and surface traps. | |
| Image of Slide 15 with photos of hanging triangle and Delta traps. | Slide 15  Aerial traps are suspended in the air to capture flying adult insects such as moths and active beetles. Insects that enter the trap become entangled in the sticky interior coating.  The many varieties of these traps have small openings to reduce excess dust accumulation, which is important because dust decreases trapping efficiency.  They are usually made from heavy cardboard and are better for indoor trapping as weather can degrade outside traps.  Sticky traps can be scraped cleaned with a putty knife and redeployed multiple times following a fresh application of trapping adhesive. |
| Image of Slide 16 with photos of dome harborage trap, pitfall trap, and sticky traps. | Slide 16  Surface traps are small, low profile traps intended to rest on horizontal surfaces. They will capture adults (and occasionally wandering immatures) of a wide variety of species. They are highly variable in appearance but typically constructed to take advantage of an insect’s preference for seeking shelter and hiding in dark crevices.  In pitfall traps, insects crawl up the inclined side and fall into the trap that contains oil (to suffocate them). |
| Image of Slide 17 with photo of plate of food covered in ants. | Slide 17  Both types of traps work best with an “attractant” to draw insects to the trap. Attractants can be food, a food odor attractant (or kairomone), or pheromones (industrially produced mimics of insect communication agents that are non-toxic and easy to use) formulated in insect-specific lures that are placed into chosen traps. Pheromone components also may be impregnated into the glue in sticky traps. |
| Image of Slide 18 | Slide 18 (photo of corrugated cardboard)  Commercially produced traps, especially those infused with pheromones or other attractants, are expensive and may be difficult to obtain at rural warehouses. In most cases, simple homemade traps are sufficient to make inferences about the presence or absence of insects or to monitor changes in insect density over time or space.  An effective handmade trap can be made by cutting corrugated cardboard boxes into 10-15 cm strips, rolling each strip into a spiral, and sprinkling a small amount of grain meal or flour (as attractant) into the air spaces between layers. |
| Image of Slide 19, Developing and Managing a Trapping Program. | Slide 19  No universal recommendations exist for insect trap use. Practical, economic, and ecological considerations require experimentation before understanding how to implement a trapping program in a given warehouse.  Start first by answering five fundamental questions: |
| 1. **What type of trap should be used**? Determine if adult presents as a flying or crawling insect. If unsure of the insect species, ask local university or Department/Ministry of Agriculture staff. 2. **Should pheromone lures and oil attractants be used?** Pheromone lures are often single species specific, costly, and need frequent replacement to be effective. Also, the amount of pheromone in a given lure varies with manufacturer so it is important not to change lure manufacturers in the middle of a trapping program. Ensure that spare lures are stored in unopened foil packages in a freezer to prevent premature degradation. 3. **How many traps are necessary?** If the purpose is to monitor changes in insect trap captures over time, continuous service of 10-20 traps may be sufficient for a given warehouse. Considerations such as warehouse size, complexity of trapping environment, and variety of commodities are all good reasons to increase the number of traps. In other words, 30-40 traps may be necessary in a large warehouse. 4. **Where should traps be located?** As insects prefer to seek shelter and hide in dark crevices, traps positioned in corners, along walls, and under or next to stacks capture more insects. Four to fifteen meter spacing between traps is a good starting point. Always map the location of all traps! 5. **How often should traps be checked?** Frequency depends on temperature. Check every:  * One week if temperature is above 26oC * Two weeks if temperature is 20-26oC * Four weeks if temperature is below 20oC   Also, check all traps on the **same day**. Change food and/or oil every four weeks. If using cardboard replace food every time trap is checked. | |
| Image of Slide 20. Is every insect trapped important? Photos of a variety of beetles, flies, and moths. | Slide 20  Not all insect species captured in traps infest grain or processed foods. There are only about 50 economically important pest species worldwide.  The type of commodity and warehouse location will often dictate which insects may appear in your warehouse. Proper identification (by a qualified entomologist) will:   * Limit your concern to real threats. * Provide insight on IPM tools you can use.   **Distribute** the*Insect\_Poster* and *Top Ten Stored-Product Insect Species* handouts and facilitate a discussion on the difficulty in identifying pests. Explain where to seek assistance locally. |
| **Image of Slide 21. Data Interpretation. Photo of insects on warehouse floor. Photo of person looking at insects on the seam of a commodity bag.** | Slide 21  Stress the importance of **data analysis from routine visual inspections** first.  If insects or insect trails are found, apply residual pesticide spray to the floor around stacks and walls (to 2 meters high) every 15 to 30 days.  If insect dust is found inside bags or on seams, directly sample bags to determine level of infestation. |
| **Image of Slide 22. Data interpretation from direct sampling.** | Slide 22  If insects are found in less than 50% of bags (1-49% of bags have insects), wait six weeks and resample. If insects are found in 50% of bags or more, fumigate. |
| **Image of Slide 23. Small Group Activity.** | Slide 23  Distribute **Data Interpretation for Insect Trapping Programs** handout. Allow small groups (by table) five to 10 minutes to read each statement and jointly determine if it is TRUE or FALSE.  Before answering each question (on the subsequent slides) ask groups to provide their response. |
| **Image of Slide 24. Data Interpretation. For monitoring purposes, the number of insects found in each trap should be recorded.** | Slide 24  **True**, but remember we are NOT trying to calculate the number of insects present in a defined unit of space (volume or weight) like we would in direct sampling. We simply want to identify problem areas where vigilance or corrective action is needed.  Instead of counting the number of insects captured, one practical approach to interpretation is to focus on the **proportion of empty traps**. It is much easier and faster to determine the percentage of empty traps than to count how many insects were caught in each trap. |
| **Image of Slide 25. Data Interpretation. Traps with no insects means that insects are not present in the warehouse.** | Slide 25  **False**, all it means is that insects failed to come to the tarp and be captured. |
| **Image of Slide 26. Data Interpretation. The number of insects captured changes in direct response to changes in insect population density. In other words, one should be twice as concerned with a trap containing 10 moths as compared to a trap containing 5 moths.** | Slide 26  **False**, because many interacting factors can be responsible for an increase or decrease in trap captures.   * **Species**: Fast moving insects are likely to be captured more than slow moving insects. * **Environmental conditions**: Dust accumulation in both sticky traps and surface traps is a common problem and will decrease capture. * **Sanitation**: All food baits used in traps are essentially competing with attractive odors from other food sources within the warehouse. A lack of food due to increased sanitation will cause insects to search larger areas, which will increase trap captures. * **Temperature**: Few insects will be captured when the air temperature is less than 15.5°C. |
| **Image of Slide 27. Data Interpretation. In addition to insects captured, monitors should record information on temperature, any recent sanitation activities, or movement of commodities.** | Slide 27  **True**, for all the reason stated above. |
| **Image of Slide 28. The essence of monitoring is the analysis of data over time. Illustration of table with Date on the x axis and Trap number on the y axis.** | Slide 28  A simple analysis system is a spreadsheet to record presence of insects in traps.   * Give each trap a unique number. * Check all traps on the same day. * If the trap contains insects, enter “Y.” If the trap is empty, enter “N.”   Every manager must determine their own baseline threshold, or the percentage of empty traps that triggers action. To start: if 50% of traps have one or more insects, do something. Unusual changes in capture rates should trigger additional investigation to identify and address problem areas. |
| **Image of Slide 29. Summary. Map trap locations. Keep food fresh. Check traps weekly if above 26 degree C and bi-weekly if 20 to 26 degree C. Set a threshold, for example % of empty traps. Act when threshold exceeded. Develop protocols.** | Slide 29 |
| **Image of Slide 30. Seven IPM Methods Review.** | Slide 30  Ask learners to identify the methods covered so far, in order, and state a few of the most important concepts for each. |

**Handout: Data Interpretation for Insect Trapping Programs**

Read each question and determine if it is TRUE or FALSE.

1. **TRUE** or **FALSE:** For monitoring purposes, the number of insects found in each trap should be recorded.
2. **TRUE** or **FALSE:** Traps with no insects means that insects are not present in the warehouse.
3. **TRUE** or **FALSE:** The number of insects captured changes in direct response to changes in insect population density. In other words, one should be twice as concerned with a trap containing 10 moths as compared to a trap containing 5 moths.
4. **TRUE** or **FALSE:** In addition to insects captured, monitors should record information on temperature, any recent sanitation activities, or movement of commodities.

Presentation: Part 3

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| --- | --- |
| **Icon of clock** | 1 hour (including Activity 2.3) |
| **Icon of dartboard with bullseye** | At the end of this session, learners will be able to describe the differences between three types of pesticides: rodenticides, residuals, and fumigants. |
| **Icon of pens, Post-Its, and scissors** | * Slide deck: *Module 2\_IPM Part 3* |
| Icon of paper with text | * *IPM Part 3 HANDOUT* (printed copy of PowerPoint slides for note-taking)   Note: As the HANDOUT contains answers to the small group activity, **DO NOT distribute it until completion of small group work portion of Activity 2.3.**   * *Residual Pesticide Best Management Practices* |
| **Icon of clipboard with checkmark** | PowerPoint guidedplenary discussion with one small group activity.  This is a short, yet dense presentation. After defining the term “pesticide,” small groups are asked to answerquestions on their current knowledge of various pesticides. Answers to these questions are provided in the subsequent slides.  See the **Slide Narration** section below for details of key messages for slides in the deck: *Module 2\_IPM Part 3*. |

**Slide Narration**

| **Slide** | **Key Messages** |
| --- | --- |
| Image of Slide 1. Title slide: Integrated Pest management Part 3. | Slide 1 |
| Image of Slide 2. Pesticides. Illustration of pyramid divided into 7 levels (or methods) labeled from bottom to top as follows: Exclusion, Stock management, Sanitation, Inspection, Trapping, Monitoring, Pesticides. | Slide 2  Pesticides are the last line of defense. Once insect infestation has become severe, control with pesticides is MUCH more difficult. That is why a broom (for sanitation activities) is a more valuable and useful piece of equipment than a sprayer. |
| Image of Slide 3. | Slide 3  Three types of pesticides are covered in this module: rodenticides, residual insecticides, and fumigants. |
| Image of Slide 4. US Federal Insecticide Fungicide Rodenticide Act (FIFRA) defines pesticides as compounds intended to control, repel, mitigate a pest… The word pest simply means any organism out of place or undesirable. | Slide 4  “Pesticide” is a legal designation. When other IPM options are of limited effectiveness, pesticide use becomes a bigger part of the program.  The pesticide modern era began in World War II with DDT, a miraculous discovery for which the inventor received a Nobel Prize. But resistance developed quickly, and bio-accumulation was a problem.  Too much reliance on DDT and other pesticides taught us there are no “silver bullets.” Pest management requires realistic expectations and an integrated program with all available tools and techniques. |
| Image of Slide 5. Pesticide Small Group Activity. Activity 2.3 instructions:  1. Form 4 groups. 2. Answer the questions for your group presented on the next slide. 3. Report to plenary. | Slide 5  Pause the presentation and follow Activity 2.3 instructions. |
| Image of Slide 6.  Group Blue. What are rodenticides? How should we use them safely? Group Green. What are residual insecticides used for? How are they applied? Group Brown. What are the limitations & safety issue associated with using residual insecticides? Group Red. What are fumigants? How do they differ from residuals? | Slide 6  The small group questions on this slide are also available as a handout for this activity.  **Before proceeding to slide 7, ask the Blue Group to report back.**  **Slides 7-10 refer to rodenticides and provide answers to questions posed to Blue Group**. |
| Image of Slide 7. | Slide 7 (photos of rat poisons)  **Distribute** *IPM Part 3 HANDOUT*.  Generally rodenticides consist of poisons in grain mixtures formed into paraffin blocks or pellets (baits). They may also be available as a liquid. Rodenticides are dangerous; always wear gloves when handling them!  Common rodenticides include: |
| Anticoagulants:   * Multiple-dose (Diphacinone, Chlorophacinone, Warfarin) kill rodents in 3-18 days * Single-dose (Brodifacoum, Bromadiolone, Difethialone), 1-2 grams will kill rodents after a single feeding   Non-anticoagulants:   * Bromethalin (2.5-8 grams) kills rodents in 12 hours-4 days * Zinc Phosphide kills rodents in 12-24 hours * Cholecalciferol (Vitamin D3) | |
| Image of Slide 8. Photos of bait boxes from outside, and opened to show placement of bait, or poisons in grain mixtures formed into paraffin blocks or pellets. | Slide 8 (photos of bait boxes)  All baits must be secured in tamper-proof “bait boxes.” The bait boxes should be immovable. Affix to ground or on a cement block. Place a sheet on wall indicating bait box location and number. |
| Image of Slide 9. Exterior Placement of rodenticides. Graphic of warehouse surrounded by bait boxes spaced every 15 to 30 meters along exterior wall, and a second ring of bait boxes space every 15 to 30 meters along perimeter of warehouse compound. | Slide 9 (warehouse itself is shown in brown in illustration)  Place two rows of bait boxes every 15-30 meters **outside** of warehouse.  Monitor feeding and keep baits fresh. |
| Image of Slide 10. | Slide 10  Remember, DO NOT use bait stations, which contain poison, inside the warehouse. Instead, use only mechanical devices such as snap traps, glue boards, and/or multiple catch traps.  **Before proceeding to slide 11, ask the Green Group to report back.**  **Slides 11-14 provide answers to Green Group questions**. |
| Image of Slide 11. Residual insecticide Use. Photo of a man with a backpack sprayer applying insecticide to a warehouse floor. | Slide 11 (residual insecticide use)  Residual (also called contact) insecticides are surface treatment pesticides used indoors and out to reduce the number of existing insects and (depending on formulation) discourage invaders for 3-4 weeks.  They are applied to floors and pallets before building stacks.  They are also applied around stacks and directly to any cracks or crevices following sanitation..  Sanitation and the use of residual insecticides should ALWAYS be a combined approach. |
| Image of Slide 12. Illustration of a measuring cup, a photo of a container of liquid Malathion, and a photo of a backpack sprayer. | Slide 12 (residual insecticide application)  Sprays are prepared of emulsifiable concentrates (EC) or wettable powder formulations and applied to warehouse floors, walls, and bag stacks.  Pirimiphos-methyl is the most widespread active ingredient used for this type of application. Other popular products include Malathion, pyrethrin, deltamethrin, and cyflluthrin. Trade names vary with countries.  Cover everything to avoid oily residue. |
| Image of Slide 13. Photo of person with wearing boots, coveralls, and long rubber gloves operating a mobile pump sprayer. | Slide 13 (residual insecticide application)  Manually operated or motor driven knapsack sprayers or mobile pump sprayers are used. By selecting the size and type of nozzle, the size of droplets can be manipulated.  The proper concentration of insecticide can be determined following the directions on the product label. It is recommended just to mix the quantity which is really needed for the treatment. Leftovers should be avoided! |
| Image of Slide 14. Residual insecticides – Fogging. Photo of a fogger in operation. | Slide 14  Fogging is a ‘contact’ insecticide. That means the insecticide is applied directly to the insect, it penetrates the body, and the insect is killed.  Insecticide formulations are applied using foggers. This method works with very small droplets (aerosols) that are hanging in the air for a certain period of time. It is particularly suited for dealing with flying insects, especially moths, but of no use against infestation with beetles, larvae, or eggs. |
| It provides short-term protection only, so should be repeated every second week or in monthly intervals (depending on the climatic conditions) in order to break the life cycle of flying insects.  Areas to be fogged should be adequately sealed for good result. The applicator must wear a respiratory mask with adequate filter. The doors of the treated warehouse should be locked and marked with warning signs. Ventilate the warehouse after treatment before allowing workers to enter. Fogging with dichlorvos (“Warning” signal word) requires longer evacuation than other aerosols.  **Before proceeding to slide 15, ask the Brown Group to report back.**  **Slides 15-16 provide answers to Brown Group** **question.** | |
| Image of Slide 15. Slide 15. Residual insecticides Limitations. | Slide 15  Residual insecticides only kill exposed flying or crawling insects. They do not penetrate packaging or grain itself.  Identification of insect pest is essential to determine which insecticide to use because not all species respond equally to every chemical. |
| Residual insecticides can give satisfactory results only if the surfaces to be treated are clean. Thick dust cover provides excellent hiding places for insect pests and protect the insect against penetration of insecticides. Also, the presence of food material increases the survival of exposed insects. Sanitation and the use of residual insecticides should be a combined approach. | |
| Image of Slide 16. Residual Pesticide Best Practices  1. Proper storage. 2. Mixing guidelines. 3. Application procedures. 4. Pesticide container disposal. | Slide 16  **Distribute** *Residual Pesticide Best Management Practices* handout.  **Before proceeding to slide 17, ask the Red Group to report back.**  **Slide 17 provides answers to Red Group questions.** |
| Image of Slide 17. Fumigants. Illustrations of a skull and an explosion. Fumigants are pesticides active in the gas state. | Slide 17  Penetration is not as quick or thorough as people think!  Because fumigants dissipate quickly to degrade in the atmosphere, pests can re-infest immediately.  Applicators and bystanders must be protected! |
| Image of Slide 18. Photos of methyl bromide and sulfuryl floride canisters. | Slide 18  There are currently three options for fumigants. Due to research showing it contributes to ozone layer depletion (leading to increased UV sun radiation), methyl bromide has been banned for use in all but quarantine fumigations (of commercial crops).  Phosphine is commonly applied as solid aluminum or magnesium phosphide which reacts with humidity to produce phosphine gas (hydrogen phosphide, PH3). |
| Sulfuryl fluoride (trade names Profume or Vikane® for termites) has a different mode of action than Phosphine.  Fumigants and fumigation procedures are covered in detail in Module 3. | |
| Image of Slide 19. Quesitons? | Slide 19 |

Activity 2.3: Pesticides

|  |  |  |
| --- | --- | --- |
| **Icon of clock** | | 10 minutes (for small group work; plenary feedback incorporated into presentation) |
| **Icon of dartboard with bullseye** | | **Purpose:** To help learners set the stage for incorporating new knowledge onpesticides and identify any current “poor practices” they are implementing. |
| **Icon of pens, Post-Its, and scissors** | | * Four sheets of flipchart paper |
| Icon of paper with text | | * *Activity 2.3\_Pesticides* |
| **Icon of clipboard with checkmark** | | Learners will work in small groups to answer one or two assigned questions and record their answers on one flipchart paper. After a group presents their answers in plenary, the facilitator presents the corresponding slides and discusses any difference between slides and the groups’ answers. |
| **Step 1:** | Assign four groups (can be by table): **Blue**, **Green**, **Brown**, and **Red**. | |
| **Step 2:** | Distribute *Activity 2.3\_Pesticides* handout or display the questions on **slide 6**. Allow groups 5-10 minutes to discuss their assigned question(s) and write the answer(s) on one sheet of flipchart paper per group. | |
| **Step 3:** | Collect the four sheets of flipcharts with answers, place them in order, and attach all to flipchart stand in the front of the room. | |
| **Step 4:** | Ask the Blue Group to present their flipchart in plenary and then return to their seat. Present the corresponding slides from the *Module 2\_IPM Part 3* as listed below.  Repeat for the remaining three group.  Blue Group: slides 7-10  Green Group: slides 11-14  Brown Group: slides 15-16  Red Group: slide 17 | |

**Handout: Activity 2.3 Pesticides**

**Instructions:**

You have each been assigned to a group: Blue, Green, Brown, or Red.

1. As individuals, spend a few minutes jotting down answers to the **two questions for YOUR group.**
2. As a small group, discuss and agree on the answers to the **two questions for YOUR small group**.
3. Record your answers on **one sheet of flipchart paper**.
4. When requested, report your answers in plenary.

**Small Group Questions**

**Blue Group:**

1. **What are rodenticides?**
2. **How should we use them safely?**

**Green Group:**

1. **What are residual insecticides used for?**
2. **How are they applied?**

**Brown Group:**

1. **What are the limitations and safety issue associated with using residual insecticides?**

**Red Group:**

1. **What are fumigants?**
2. **How do they differ from residuals?**

**Handout: Residual Pesticide Best Management Practices**

Adapted from *ANNEX T-7* in Commodity Protection by Phosphine Fumigation in USAID Food Aid Programs, Programmatic Environmental Assessment Tools Annex, Office of Food For Peace, updated December 2015, pages 41-53.

**Proper Storage of Pesticide Containers**

Proper storage of pesticides is essential to protect human health and well-being and to protect against environmental contamination. Proper storage will also extend the shelf life of pesticides.

1. A separate, isolated building should be dedicated for pesticide storage. The entrance to the storage area should be labeled/placarded as shown below in English and local language(s).

|  |  |  |
| --- | --- | --- |
|  | **DANGER**  **PESTICIDE STORAGE**  **FIRE WILL CAUSE TOXIC FUMES** |  |

1. The storage building should be constructed of fire-resistant material and should contain a portable fire extinguisher and, if feasible, a sprinkler system.
2. Make sure the storage area is not leaky and does not get wet during rain. Vents should be closed in case of rain.
3. The storage area should be well ventilated. High temperatures may cause some pesticide drumheads to bulge and leak. High temperatures may also cause emission of toxic fumes.
4. All pesticides must be stored in their original, labeled containers. Pesticides must never be stored in food, feed, or beverage containers.
5. Keep similar pesticides together, and separate them from other types of pesticides.
6. The lids of pesticide containers must be closed when they are not being used.
7. Place liquid containers on pallets to avoid corrosion of flooring.
8. Protect pesticide dusts from humidity to prevent caking.
9. Check containers periodically (at least monthly) for leaks or tears.
10. Make an inventory of all pesticides, including expiration dates, and keep records of use.
11. If multiple containers of a particular pesticide are stored, use the one closest to expiration first.
12. Do not store pesticide solutions in sprayers in the storehouse; use all of the mixed formulation.
13. **Do not** store food, feed, water, or beverages in the pesticide storage area.
14. **Do not** store clothes, respirators, or other protective equipment in the pesticide storage area.
15. The storage area should have plenty of water and soap and an eye station in case of an accidental spill on hands or eyes.
16. Do not store pesticides for more than one year as they lose their activity.

**Mixing Pesticides**

Spills and splashes can occur when mixing pesticides with water in sprayers. The following safety instructions should be observed during the mixing and loading of pesticides:

1. After selecting a pesticide for spraying the warehouse, follow label directions for using correct amount of the pesticide and do not exceed label rates.
2. Wear protective clothing and respirator as stated by the label, and have first aid equipment available.
3. Never work alone when handling highly hazardous pesticides.
4. Mix chemicals outside or in a well-ventilated area and not inside the warehouse.
5. Mixing should occur at least 50 meters away from surface water.
6. Always stand upwind when mixing or loading pesticides.
7. The measuring containers should be thoroughly cleaned after each use.
8. First add water to the spray tank, then add the pesticide and fill the spray tank to the desired level.
9. Clean up spilled pesticides immediately. If the pesticide is accidentally spilled on skin, immediately wash it off with soap and water. Notify supervisor to ensure that appropriate procedures are taken to avoid injury.
10. If the pesticide is spilled on clothing, change clothing as soon as possible and wash clothes before using them again.
11. Protective gloves should be washed before removing them.
12. Persons mixing, handling, or applying pesticides should never smoke, eat, or drink until after they have thoroughly washed their hands with soap and water.
13. Never use your mouth to siphon a pesticide from a container.

**Spraying Warehouse Structures and Surrounding Areas**[[2]](#footnote-2)

Consider spraying the empty warehouse (floor, walls, roofs, etc.) and surrounding areas before receipt of food commodities to kill any live insets. The perimeter of the warehouse on the outside should also be sprayed. (The aim of spraying before fumigation is to kill insects that might escape the fumigation.)

USAID partners must submit a PERSUAP to USAID that requests specific pesticides. That PERSUAP must specify practices at least as stringent as those below.

1. Clean empty warehouse of all food grains and debris. This will increase insecticide effectiveness.
2. Ensure spray equipment is well maintained and make repairs prior to spraying.
3. Give prior notice of the spraying to warehouse staff whose work is likely to be disrupted.
4. Calculate the area to be sprayed (recommended rate is two to five liters of water/100 square meters) and provide sufficient insecticide (recommended dosage rate is 2% active ingredient in the solution or as recommended by the label). Ensure adequate water and sprayers are available and that protective clothing and washing water and soap is available.
5. Protective clothing, including boots, long sleeve shirts, pants, disposable gloves, goggles, and coveralls should be worn by applicators. In some cases, cartridge type of masks should be worn to protect against inhaling spray droplets. Check label for respiratory protection needed.
6. Calibrate sprayer by adjusting volume of water needed to cover a known amount of floor area.
7. Provide clear instructions to applicators as to the parts of the warehouse to be treated and an estimate of the area to be covered with one knapsack sprayer of pesticide.
8. Give special instructions, for example, about applying heavier than normal dosages of spray to places where insects might be concentrated (i.e., cracks and crevices in walls and floors).
9. Notify applicators about hazards such as electrical equipment, dimly lit areas, and slippery floors.
10. Mix pesticides in a well-ventilated area using disposable gloves and goggles. If a pest management service provider is used for spraying, pesticides should be mixed off-site before arriving on warehouse grounds.
11. Do not spray near waterways; spray at least 50 meters away from the edge of a surface water body. An approved contact pesticide must be used.
12. Inspect immediately after spraying that all areas have been properly treated. Any surplus spray remaining in the sprayers should be applied to walls to use it up. Diluted water-based sprays should not be retained in the sprayer for longer than one day since the insecticide may deteriorate rapidly.
13. Empty the sprayers and wash thoroughly with clean water. Dismantle and clean nozzles. Drain and dry spray tanks, hoses, and lances. Triple rinse sprayers and collect rinse water and dispose safely and securely, preferably in an area designated for this waste, in an area where it will not affect non-target organisms. Empty insecticide containers should be disposed of safely by crushing them and placed in a safe, secure pit/landfill, and covered.
14. Applicators should wash hands thoroughly with soap and warm water. Clothes worn during application should be washed with soap and water. Do not reuse disposable gloves. Goggles should be thoroughly washed in soap and water and dried.
15. As required by PVO procedures, report the area of a warehouse sprayed and the type and quantity of pesticides used.

**Pesticide Container Disposal**

Human/animal poisonings and environmental contamination may occur if pesticides and pesticide containers are not disposed of properly. In some countries, unused pesticide solutions can be taken to a designated collection place for incineration or disposal. In countries receiving food aid, such a facility may not exist. Therefore, all of the mixed chemical in a sprayer or a duster should be completely used. In the case of phosphine, all tablets/pellets in an opened container should be used for fumigation.

1. In the case of liquid pesticides, the empty container should be drained vertically for 30 seconds.
2. Triple rinse the container, each time using 1 liter of water for a sprayer of 3.84 L capacity. Allow 30 seconds for draining each time. The rinse water should be collected into a container and disposed of in an area away from any surface or ground water, following any local requirements.
3. Crush or break the container and dispose it in an approved manner, and do not reuse the container.

# Annex 1: Sample Agenda

**Module 2: Integrated Pest Management**

|  |  |
| --- | --- |
| 08:30 – 09:00 | **Workshop Opening** (Introductions, Pre-Test, Ground Rules, Expectations, Objectives, Agenda) |
| 09:00 – 10:30 | **Part 1: Methods 1-4** |
| 10:30 – 10:45 | *Pause/Break* |
| 10:45 – 11:45 | **Part 2: Methods 5-6** |
| 11:45 – 12:45 | **Part 3: Method 7** |
| 12:45 – 13:15 | **Workshop Closure** |

# Annex 2: List of External Materials

**PRESENTATIONS**

Module 1\_Compliance.pptx

Module 2\_IPM Part 1.pptx

Module 2\_IPM Part 2.pptx

Module 2\_IPM Part 3.pptx

Module 3\_Fumigation Part 1.pptx

Module 3\_Fumigation Part 2.pptx

Module 3\_Fumigation Part 3.pptx

**HANDOUTS**

**Workshop Design**

Post-Workshop Satisfaction Survey.docx

Pre- and Post-Test Sample Questions.docx

Sample Two-Day Agenda for All Three Modules.docx

**Module 1: Pesticide Compliance**

Activity 1.1

Activity 1.1\_Group 1.docx

Activity 1.1\_Group 2.docx

Activity 1.1\_Group 3.docx

Activity 1.1\_Group 4.docx

Activity 1.2

Activity 1.2\_Group 1.docx

Activity 1.2\_Group 2.docx

Activity 1.2\_Group 3.docx

Activity 1.2\_Group 4.docx

Activity 1.2\_Group 5.docx

Activity 1.2\_Group 6.docx

Compliance HANDOUT.pdf

Fumigation Management Plan Template.docx

Guidelines for Fumigation Compliance Processes for USAID Partners.pdf

PERSUAP for Phosphine Template.pdf

**Module 2: Integrated Pest Management**

**PART 1**

Activity 2.1

Activity 2.1\_IPM Methods.doc

Activity 2.1\_IPM Pyramid Cards.docx

Activity 2.2

Activity 2.2\_PART 1

Activity 2.2\_PART 2

IPM Practices & Inspection Checklist

IPM Part 1 HANDOUT.pdf

**PART 2**

Data Interpretation for Insect Trapping Programs.docx

Insect\_Poster.pdf

IPM Part 2 HANDOUT.pdf

Top 10 Stored-Product Insect Species.docx

**PART 3**

Activity 2.3\_Pesticides.docx

IPM Part 3 HANDOUT.pdf

Residual Pesticide Best Management Practices.docx

**Module 3: Phosphine Fumigation**

**PART 1**

Activity 3.1\_Concepts Review Game.docx

Fumigation Part 1 HANDOUT.pdf

**PART 2**

FMP Annexes.docx

Fumigation Part 2 HANDOUT.pdf

**PART 3**

Annex A-6 Gas Monitoring & Respiratory Protection Equipment.pdf

Annex A-7 Guidelines for Phosphine Gas Exposure First Aid.pdf

Fumigation Part 3 HANDOUT.pdf

Safe Disposal of Fumigation Containers.docx

**VIDEOS**

**Module 3: Phosphine Fumigation**

GOOD\_PRACTICE\_for\_PHOSPHINE\_FUMIGATION\_(part\_1).mp4

GOOD\_PRACTICE\_for\_PHOSPHINE\_FUMIGATION\_(part\_2).mp4

1. Efficacy Monitoring\_Bellows Pump.mp4

2. Efficacy Monitoring\_Containers.mp4

3. Efficacy Monitoring\_Stacks.mp4

4. PPE Gloves.mp4

5. PPE Protective Clothing.mp4

6. PPE Dust Masks.mp4

7. PPE Respiratory Protection.mp4

8. PPE Gas Detection Equipment.mp4

9. PPE Electronic Safety Monitor.mp4

10. PPE Safety Gas Monitoring Recap.mp4

**RESOURCES**

**Module 1: Pesticide Compliance**

EMMP FactSheet.pdf

USAID Phosphine Fumigation PEA Annex A TOOLS.pdf

Warehouse Staff Safety Guide 11-16-14.doc

1. Additional post-training support may be needed to fully achieve performance objectives. **Learning objectives**, on the other hand, describe what will be taught in a module. [↑](#footnote-ref-1)
2. Modified from World Food Program Standard Operating Procedures. [↑](#footnote-ref-2)