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Ministry of Labor and Skills

Crop production

Level-III

Based on April 2022, Version I Occupational standard

Module Title: - Applying crop pest management and disorders

LG Code: AGR CRP3 M06 LO (1-4) LG (27-30)

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Table of Contents

Introduction to the Module

This module covers the knowledge, skills and attitude to assess/survey pest infestation, plan for the implementation of pest control measures, implement control measures and monitor effectiveness of control measures.

LG #1	LO #1- Survey pest infestation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Preparing survey equipment
- Assessing scope and size for infestation and level of damage
- Recording and reporting plants pests, disorders, beneficial organisms and natural enemies
- Determination of economic threshold level
- Integrated pest management (IPM) strategy

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Prepare survey equipment
- Assess scope and size for infestation and level of damage
- Record and report plants pests, disorders, beneficial organisms and natural enemies
- Determine of economic threshold level
- Integrate pest management (IPM) strategy

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 1

Definition of terms:

- **Pest**: In crop protection, pests can be defined as any form of plant or animal life, or any pathogenic agent, which is injurious or potentially injurious to crop or crop products.
- **Plant disease:** A plant disease is a physiological or structural abnormality that affects the plant, or reduces its economic value. Any biotic, abiotic & biotic agent that causes damage on crops, animals humans & his possessions.
- **Plant disorder:** Plant disorder is a term used to describe any condition or abnormality that affects the growth, development, or overall health of a plant. Plant disorders can have a range of causes such as pests, diseases, abiotic stresses (such as drought or extreme temperatures), pollution, or genetic abnormalities.

1.1.**Preparing survey equipment**

Surveying for pest infestation involves a thorough inspection of a property to identify if there is any evidence of pests such as insects, rodents, or other animals. Pest surveying can be done by trained professionals and pest control companies who use specialized equipment to look for signs of pest activity. They will typically check areas where pests are known to be most active, such as basements, attics, kitchens, and bathrooms. The survey will identify any areas of the property that may be conducive to pest activity, such as cracks in the walls or leaks in pipes. The surveyor will also look for signs of pest damage, such as gnaw marks or droppings, as well as any entry points that pests may be using to gain access to the property.

Equipment used for surveying for pest infestation can include:

- **Flashlight**: A flashlight is essential for illuminating dark areas of a property where pests may be hiding.

Figure 1.1. flash light

- **Inspection mirrors**: Inspection mirrors allow surveyors to see over and behind obstacles such as pipes, walls, or ceiling tiles so they can inspect hard-to-see areas.

Figure 1.2. Inspection mirrors

- **Moisture meter**: A moisture meter allows surveyors to detect damp or humid conditions that may attract pests.

Figure 1.3. Moisture meter

- **Borescope**: A borescope is a flexible camera that can be inserted into narrow spaces to inspect pipes, ducts, and other hard-to-see areas.

Figure 1.4. Borescope

- **Infrared thermometer**: Infrared thermometers are used to measure the temperature in different areas of a property, which can help identify warm or cool spots that may indicate pest activity.

Figure 1.5. Infrared thermometer

- **Traps**: Surveyors may use sticky traps or other types of pest traps to capture and identify pests in a property.
- **Hand lens or magnifying glass**: These tools can be used to examine small areas in detail, such as insect eggs or larvae.

Figure 1.6. Hand lens

Preparing survey equipment for surveying pest infestations requires a few key steps to ensure that the data collected is accurate and reliable. Here are some steps to follow:

- Gather the necessary equipment. This may include traps, lures, binoculars, GPS, and cameras.
- Inspect and calibrate the equipment to ensure it is in proper working condition.
- Identify the type of pests you are looking for and determine the appropriate survey method and equipment needed for that pest.
- Review the survey area and plan the survey route, taking into consideration areas where pests are most likely to be found.
- Conduct the survey, using the equipment and methods identified in step 3.
- Document all data collected using clear and concise notation methods.
- Review the data collected to identify patterns and trends to determine pest infestation levels.

1.1 1. Timing of the survey

Choosing when and how often to survey is another critical step.

When to survey

Ideally, the survey should be performed when the pest is most likely to be present and in an identifiable state.

The timing of survey procedures may be determined by:

- The life cycle of the pest
- The phenology of the pest and its hosts
- The timing of pest management programs
- Whether the pest is best detected on crops in active growth or in the harvested crop.

Other factors that may determine the timing of your survey are:

- When the pest is most active
- Accessibility, and availability of vehicles
- Time of local festivals or community events
- Time of sowing, seedling emergence, flowering, fruit maturation and harvesting of hosts
- Time of flowering for weeds
- Time of obvious symptoms.

The timing of a survey is particularly important when developing pest lists, as it is critical that host plants are examined throughout their life cycle since different pests prefer different stages of the host development. The minimum stages of development that should be surveyed are:

- Seedling emergence
- Vegetative flushing stage
- Flowering stage
- Fruiting stage.

1.1.2. Frequency of the survey

Some surveys need to be performed several times. For example, this may be every 2 weeks when managing a pest in a crop, or annually during harvest to support a pest-free-area status, or according to periods in the pest's life cycle.

If trading partners are involved, the frequency would need to be agreed upon. Also, there may be need to revise the timing and frequency if they are dependent on weather conditions or **events.**

1.2.**Assessing scope and size for infestation and level of damage**

To assess the size of infestation and level of damage caused by pests, you can conduct a thorough inspection of the affected area. Look for signs of damage to plants or property, as well as dead insects or other evidence of their presence. You can also use traps or baits to gauge the number of pests in the area. It may be helpful to consult with a professional pest control service for a more accurate assessment and treatment plan.

1.2.1 Scope of pest infestation

The scope of a pest infestation refers to the extent or range of the infestation. In other words, it is the size of the area that is affected by the pest problem. The scope of an infestation can varies widely depending on several factors, including the type of pest, how long the infestation has been present, and how quickly it is spreading. For example, a termite infestation may be localized to a single room in a house, while a bed bug infestation can easily spread to multiple rooms or even entire buildings. When assessing the scope of a pest infestation, it is important to consider not just the area where pests are currently present, but also any areas where they may be hiding or laying

eggs. Additionally, you should consider any factors that may attract pests to the area and address those as part of your treatment plan.

1.2.2. Size of a pest infestation

The size of a pest infestation refers to the number of pests present in an area. Here are three levels of pest infestation:

- **Light infestation**: A light pest infestation typically involves a few pests in a limited area. For example, you may notice a few ants around your kitchen sink or a small group of aphids on a single plant.
- **Moderate infestation**: A moderate pest infestation involves a larger number of pests and/or extends over a wider area. Signs of moderate infestations may include multiple ant trails inside your home or significant damage to several plants.
- **Heavy infestation**: A heavy pest infestation involves a large number of pests and can cause significant damage to crops or structures. For example, a heavy termite infestation can cause serious structural damage to a building, while a heavy rodent infestation can leave droppings throughout an entire home.

1.2.3. Level of damage of pest

The level of damage caused by pests can vary depending on the type of pest and the extent of the infestation. Here are three levels of pest damage:

- **Mild damage**: Mild damage is typically localized and limited to a small area. Common signs of mild pest damage include slight discoloration or distortion of leaves or crops, or minor structural damage to property.
- **Moderate damage**: Moderate pest damage can affect a larger area and may require more intervention to control. Signs of moderate damage often include stunted growth in plants, wilting leaves, and more significant property damage.
- **Severe damage**: Severe pest damage can have a devastating impact on crops and structures, requiring immediate intervention to prevent further damage. Signs of severe damage may include widespread plant death, structural collapse, and extensive property damage.

Assessing the scope and size of a pest infestation and the level of damage caused requires a systematic approach that involves gathering and analyzing data from various sources. Here are some steps to follow:

- Conduct a thorough visual inspection of the area to identify signs of infestation such as droppings, damage to structures or crops, and pest activity.
- Use monitoring tools such as traps to capture and identify pests present in the area
- Survey neighboring properties to determine if the infestation has spread beyond the initial area of concern
- Consult local experts, such as pest control professionals or university extension offices, to identify the specific type of pest and their typical behavior
- Analyze the level of damage caused by the pests by assessing the extent of damage to structures or crops

1.3. Recording and reporting plants pests, disorders, beneficial organisms and natural enemies

1.3.1. Plant pest

Pests are any organism which interferes with the activities of human being by reducing the quality and quantity of crops. In crop protection, pests can be defined as any form of plant or animal life, or any pathogenic agent, which is injurious or potentially injurious to crop or crop products.

Plant pests are organisms that cause damage crops/plants by feeding and / or reproductive habits lead to a reduction in the quantity and quality of the crop produced. It includes insects, diseases, weeds, rodents, birds, and mammals.

Pests can be divided into the following groups:

- Insects, such as roaches, termites, mosquitoes, aphids, beetles, fleas, and caterpillars,
- Insect-like organisms, such as mites, ticks, and spiders,
- Microbial organisms, such as bacteria, fungi, nematodes, viruses,
- Weeds, which are any plants growing where they are not wanted, such as pigweeds, wild oats, tropical finger weeds.
- Mollusks, such as snails, slugs, and shipworms, and
- Vertebrates, such as rats, mice, other rodents, birds, fish, and snakes.

According to pests' damages to crops, pests can be divided into two types.

A. **Economic pests** mean pests cause a crop loss of about 5-10%, or even more in a definite field.
B. **Non-economic pests** mean pests cause a crop loss of less than 5% in a definite field.

1.3.1.1. The most Insect pests in crop production

Table 1.3. Insect pests in crop production

Name of insect's pests	**The injury caused**	**Picture**
Aphids	Causing loss of vigour, and in some cases yellowing, stunting or distortion of plant parts	
Beetles	Chewing the leaves of crop plants, sucking out plant juices, boring within the roots, stems or leaves, and spreading plant pathogens.	
Snails	Damage plant seeds, seedlings, underground tubers, leaves and fruit	
Trips:	Damage fruit, leaves, and shoots and very noticeably affect plants' cosmetic appearance.	
Caterpillar	Damage plants by chewing on leaves, flowers, shoots, and fruit and sometimes other parts of the plant.	

Moth	Damage the crowns or growing points of young plants or Brussels sprouts.	
Leaf hoppers	Reduces the photosynthetic capacity of affected leaves,	 
Saw fly	Reduces the plant's vascular efficiency and results in fewer kernels per head and lower kernel weight.	

1.3.2. Plant Disease

A plant disease can be described as an impairment of the plant's physiological functions through organisms such as fungi, bacteria or viruses. It is a harmful alteration of the normal physiological and biological development of a plant. For a disease to occur three conditions have to be fulfilled at the same time. This is commonly known as disease triangle.

- A virulent pathogen should be present
- A plant should be susceptible
- The environment should be suitable

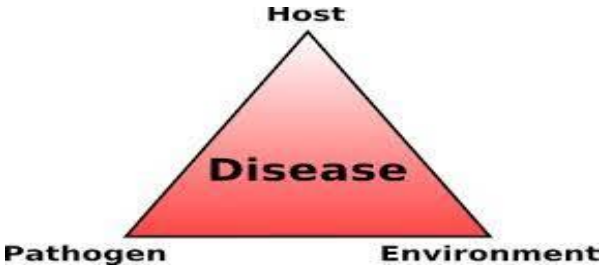

Figure:1.3 Disease triangle

If one of the three appears late, or early or missing, the disease will not occur. Therefore, any practice which disturbs any of the three conditions or break the triangle will be considered as a disease management method.

1.3.2.2. Significance of plant diseases

Plant diseases are significant of humans because they cause damage to plants & products. The major effects of plant disease include:

- May limit crop choice
- Reduce the quantity & quality of products in the field & during storage.
- Increase the cost of production
- Cause economic loss to growth
- Increase prices of crop for consumers
- Destroy the beauty of nature

1.3.2.3. Causes of plant diseases

A. Infectious/biotic plant disease

Infectious diseases are plant diseases those caused by biotic organisms. They grow and multiply in host, and transmit from one plant to other plant. These include:

- Diseases caused by fungi
- Diseases caused by bacteria
- Diseases caused by parasitic higher plants
- Diseases caused by viruses and viroid
- Diseases caused by nematodes
- Diseases caused by parasitic higher plants

B. Non-infectious/abiotic diseases

Noninfectious diseases are diseases those are caused by non-living, environmental factor. Non-infectious disease is sometimes termed as **disorders**. They are characterized by:

- Occurred in the absence of the pathogen (no sign of disease);
- Can't transmit from diseased plant to the healthy plant;
- Infect the plant in all stage (seed, seedling, and mature plant);
- Distribute evenly in the field (no diseases center, no disease developing factors.)

The following factors will cause noninfectious diseases:

- Too low or too high a temperature, e.g., scorching, freezing;
- Injury by air physical phenomena, e.g., wind, rain, thunder;

- Lack or excess of water or moisture in soil or air e.g., drought, waterlogging.
- Diseases caused by chemical factors:
- Lack or excess of nutrient element;
- Air pollution;
- Misuse of pesticides or chemical products;
- Improper cultural practices.

1.3.2.4.Major types of plant diseases

- **Leaf diseases**

The most common types of leaf diseases in plants include:

- ✓ **Blights**. When plants suffer from blight, leaves or branches suddenly wither, stop growing, and die. Later, plant parts may rot.
- ✓ **Anthracnose.** Anthracnose is a fungal disease that over-winters on old leaves or cankers on branches. The water-borne spores are spread by splashing by rain or overhead irrigation. The fungal spores infect young leaves and branches, causing dead spots and dieback. **Damage:** Dead spots develop where the anthracnose fungus enters leaves.
- ✓ **Powdery Mildew.** Powdery mildew can affect many types of plants, such as squash and all cucurbits, phlox, roses, dogwoods, and crepe myrtles. Powdery mildew is also different from many fungal diseases because **it does not require leaf wetness** for infection to take place.
- ✓ **Rust**. Infection takes place during **wet weather**, and these develop into pustules on **the under sides of leaves.** Leaves infected with rust may be spotted or mottled in color and may become twisted and distorted. In severe cases, leave s may fall off.

- **Stem diseases**

  - ✓ **Cankers.**

Canker sores, also called aphthous ulcers, are small, painful sores that appear inside the mouth on the lips, cheeks, on the gums, and tongue. They are appropriately named, too: In Greek, aphthae (root of aphthous) mean "to set on fire." Canker sores are not contagious and can't be spread through saliva.

Cankers usually form on woody stems and may be: -

- Cracks,
- Sunken areas, or raised areas of dead or abnormal tissue.
- Ooze conspicuously.
- Girdle shoots or trunks

- **Phytophthora rot**

Phytophthora is most commonly associated with root rot disease. However, this pathogen can also damage above-ground plant parts such as fruit and leaves. The disease is known as buckeye rot in tomatoes and leather rot in strawberries. The soil-borne oomycete Phytophthora spp. Steam heat is effective to kill Phytophthora in contaminated soil, media or on planting containers such as pots.

✓ **Pod and stem blight**

- Pod and stem blight occurs primarily on plants nearing maturity.
- Damage is most severe in wet seasons when harvest is delayed.
- Seed infection is greater in densely populated fields, due to lodging of plants.

- **Root disease**

Root disease is referred to as "a disease of the site" because the fungi colonize dead and dying trees and remain in dead roots and soils for many years. Many of these fungi have the ability to act as both pathogens in live trees and saprophytes in dead wood material.

The major root diseases are:

✓ **Brown root disease**: Phellinus noxious (Fumes noxious)

Brown root disease: is a disease of woody plants that causes decline and death of trees throughout the tropics. The name brown root rot refers to a dark brown crust formed by the fungus, Phellinus noxious (Corner) Cunningham, on exposed roots and lower plant stems.

✓ **White root disease**: Rigidoporus lignosus (Fomes lignosus)

As the disease progresses, the infected tissue becomes rotten. Trees develop a generally unthrifty appearance with leaf yellowing, halted root growth, wilt, small leaves, early leaf fall and small, shrivelled fruit. Infected trees will eventually die.

- ✓ **Black root disease**: Rosellinia pepo Pat

Black root rot is also called Thielaviopsis root rot. Plants are stunted and grow poorly. Infected roots may initially have small dark brown to black bands where infection has taken place. As the disease progresses, roots can become badly rotted.

1.3.3. Plant disorder

A plant disorder refers to any abnormality that occurs in a plant's growth, structure, or function. This can be caused by a variety of factors such as environmental stressors like changes in temperature, humidity, or soil composition, biotic stressors like pests and diseases, or genetic factors. Plant disorders can manifest themselves in many different ways, such as stunted growth, discoloration, or wilting.

1.3.4. Beneficial organisms

In agriculture, beneficial organisms are organisms that contribute positively by their habits, for example by feeding on pest organisms or by pollinating flowers to enable fruit development. In other word, beneficial organisms are volunteer or cultivated plants, insects, spiders and microorganisms that out-compete and/or parasitize or predate on the pests and disease relevant to the IPM program.

1.4. Determination of economic threshold level

Economic threshold level can be defined as the pest density at which the cost of controlling the pest is equal to the value of the crop being protected. In order to determine the economic threshold level for a specific pest, there are a number of factors that need to be taken into consideration, such as the crop being grown, local market prices for the crop, cost of pest control methods, and other factors.

Economic thresholds can be expressed in a variety of ways including, number of insects per plant or per square meter, the amount of leaf surface damage, etc. It is important to identify the insect and to determine its status as a pest. In many cases thresholds have been established through

scientific research. Unfortunately, not all combinations of pests and crops have been studied, and some reported thresholds are merely educated estimates.

Economic thresholds can fluctuate depending on a combination of factors including the pest, crop, stage of the crop, cost of control and the final market prospects for the product. The economic threshold may also vary with growing conditions. When conditions are ideal, a vigorously growing crop may be able to withstand a higher pest population with little yield loss, depending on the stage of the plant. Conversely, relatively fewer insects may significantly damage a stressed crop.

1.4.1. **Types of IPM Thresholds**

- **Preventative Threshold**

A preventative threshold is a pest population density at which action is taken to prevent pests from reaching economic damage levels.

- **Action Threshold**

An action threshold is a pest population density at which control measures are taken to prevent pests from reaching economically damaging levels or causing economically significant damage. The action threshold enables farmers to monitor crop conditions and pest populations and take preventive measures before pest populations become too high.

- **Economic Injury Level (EIL)**

The Economic Injury Level is the pest population density at which the cost of damage to the crop equals the cost of control measures. If the pest population is below this level, no management action will be taken. The EIL helps farmers determine the need for control measures and can help them avoid unnecessary pesticide applications.

Economic injury: is the lowest-level population density that causes economic damage which differs according seasons, crop and areas.

- **Economic Threshold**

The Economic Threshold is the pest population or level of damage at which control measures are undertaken to minimize further economic damage. It is more commonly used in agricultural pest management than the EIL.

- **Damage Thresholds**

Damage thresholds are the maximum damage a crop can sustain without yield loss. It is generally used for plant diseases. Since disease pathogens are too small to be easily seen, counting their numbers is impractical, so an estimate is made of the amount of damage caused by them.

Economic damage: is the amount of damage done to a crop which is financially justified the cost of taking artificial control measures which is different from crop to crop. Examples:

- ✓ counting diseased leaf petioles for soybean pod and stem blight
- ✓ estimating the percentage of whole plant infection caused by fungal leaf blights in corn

- **Aesthetic Thresholds**

Aesthetic thresholds are the level at which a pest causes an undesirable change in the appearance of something, typically ornamental plants. This threshold can be used by homeowners, in parks and other public areas and can be highly personal to the user or users.

Aesthetic injury level: is the level at which the amenity benefits of pest control become acceptable. Example: - box elder bug: a harmless insect, except its tendency to aggregate in masse on the exterior of homes makes people fearful of it.

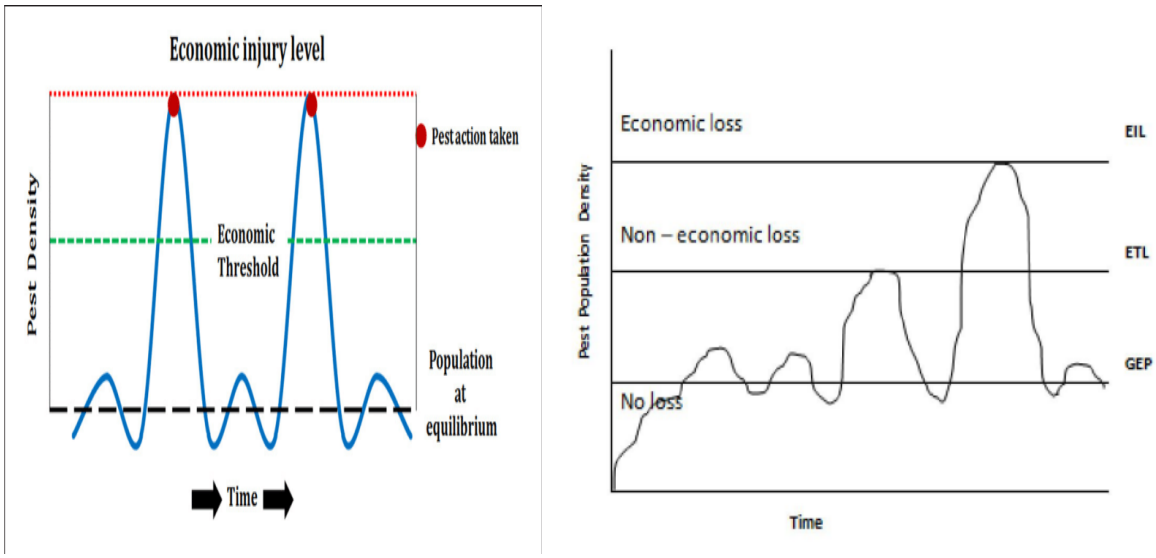

Figure:1.4. Economic Threshold level

Importance of Thresholds

- For decision making on scheduling of control and control methods
- To establish the optimal amount of control which can be used to minimize risk of economic damage and environmental hazards

1.5.**Integrated pest management (IPM) strategy**

Integrated Pest Management (IPM) is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties.

IPM strategy involves four main steps:

- **Monitoring**: Regular monitoring of pest populations to identify potential problems before they become severe.
- **Prevention:** Implementing a range of preventive measures, such as proper sanitation, exclusion, and habitat modification, to reduce pest populations and prevent infestations.
- **Control**: Using a range of control methods, such as cultural methods (e.g., crop rotation), mechanical methods (e.g., trapping), biological methods (e.g., using natural predators), and chemical methods (e.g., using pesticides when necessary), to reduce pest populations.
- **Evaluation**: Regular evaluation of the effectiveness of IPM strategies to identify areas for improvement and make necessary adjustments.

By using an integrated approach that combines multiple pest management techniques, IPM can effectively control pests while reducing the need for harmful pesticides and minimizing risks to human health and the environment.

1.5.1. IPM Programs

These IPM principles and practices are combined to create IPM programs. While each situation is different, six major components are common to all IPM programs:

- Pest identification
- Monitoring and assessing pest numbers and damage

- Guidelines for when management action is needed
- Preventing pest problems
- Using a combination of biological, cultural, physical/mechanical and chemical management tools
- After action is taken, assessing the effect of pest management

The goals of an IPM program

- Optimize profits (over the long term).
- Sustain resource (agricultural or natural; over the long term).
- Rational use of pesticides.
- Reduce environmental contamination and costs — soil, ground water, surface water, pollinators, wildlife, endangered species.
- Utilize natural biological controls — conserve and augment; use selective pesticides, proper timing of applications.
- Minimize pesticide resistance problems.
- Minimize pest resurgence and secondary pest outbreaks (often caused by elimination of natural enemies with pesticides).
- Food safety — reduce residues of pesticides on food products.
- Worker safety — rely on pest management tactics that are safe for workers.

1.5.2. Advantage of IPM

There are several advantages of using an Integrated Pest Management (IPM) approach in agriculture:

- **Reduced Need for Pesticides** - By utilizing a range of pest management strategies, IPM reduces the need to rely solely on pesticides, which can be expensive, harmful to the environment, and can lead to the development of pesticide-resistant pest populations.
- **Lower Costs** - Because IPM relies on a combination of pest management strategies, it can often be more cost-effective than relying on pesticides alone.
- **Improved Crop Quality and Yield** - IPM focuses on maintaining crop health and minimizing pest damage, which can result in higher crop quality and yield.

- **Reduced Environmental Impact** - By minimizing the use of pesticides and focusing on ecological practices, IPM can help to reduce the negative impact of agriculture on the environment.
- **Sustainable Pest Management** - Unlike conventional pest management strategies that focus solely on pest elimination, IPM is a sustainable approach that balances the need for pest control with the need for environmental protection, human health, and economic profitability.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer

1. Which of the following is **not** part of disease triangle

   A. Pathogen
   B. Host
   C. Insect
   D. The environment

2. Which of the following is **not** part of infectious/biotic plant disease

   A. Fungi
   B. Imbalance of nutrient
   C. Bacteria
   D. Nematodes

Test II: Short Answer Questions

1. List equipment used for surveying for pest infestation
2. Define pest, plant disease and plant disorder
3. List three size of a pest infestation
4. Write types of IPM Thresholds
5. Elaborate advantage of IPM

Operation Sheet -1

1.1 Techniques of Survey pest infestation

A. Tools and equipments

- Flashlight
- Inspection mirrors
- Moisture meter
- Borescope
- Infrared thermometer
- Traps
- Hand lens or magnifying glass

B. Procedures/Steps/Techniques

1. Gather the necessary equipment.
2. Inspect and calibrate the equipment
3. Identify the type of pests you are looking for and determine the appropriate survey method and equipment needed for that pest.
4. Review the survey area and plan the survey route
5. Conduct the survey, using the equipment and methods identified in step 3.
6. Document all data collected using clear and concise notation methods.
7. Review the data collected to identify patterns and trends to determine pest infestation levels.

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LAP TEST-1	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **3** hours. The project is expected from each student to do it.

Task-1 Perform Survey pest infestation

LG #2	LO #2- Plan for the implementation of pest control measures

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Pest control measures
- Selecting tools, equipment and machinery
- OHS hazard, risks assessment and control
- Selecting, using, maintaining and storing PPE
- Selecting control measures based on social and environmental implications
- Risk associated to pesticide for horticultural crop

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Pest control measures
- Select tools, equipment and machinery
- OHS hazard, risks assessment and control
- Select, use, maintain and store PPE
- Select control measures based on social and environmental implications
- Risk associated to pesticide for horticultural crop

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1. Read the specific objectives of this Learning Guide.
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Information Sheet 2

2.1.Pest control measures

Pest control measures are essential to prevent the spread of pests and ensure a safe and healthy environment. Various measures can be taken to control pests, including chemical, mechanical, cultural, biological methods and genetic control.

I. Chemical methods

Involve the use of pesticides, insecticides or herbicides to kill pests which can be effective in controlling pests but can also have negative impacts on human health and the environment. Therefore, it is important to follow proper safety precautions when using these methods.

II. Mechanical methods

Involve the use of physical barriers or traps to prevent pests from entering a particular space or to capture them. This method is typically more environmentally friendly than chemical methods, although it may not be as effective in controlling large infestations.

III. Cultural methods

Involve changing the physical or environmental conditions in order to discourage pests from inhabiting a particular area. For example, crop rotation, proper sanitation practices can help prevent the accumulation of food waste which can attract pests like rodents and cockroaches. Additionally, proper storage and disposal of waste can also aid in pest prevention.

IV. Biological methods

Utilize natural predators and parasites to control pest populations. This method can be effective in reducing pest populations without causing harm to human health or the environment. However, proper research is necessary before implementing biological control methods to ensure that the predator is compatible with the local ecosystem and does not create additional problems.

V. Genetic control

This method involves modifying the genetic makeup of pests to reduce their ability to reproduce or their susceptibility to certain kinds of pesticides.

N.B. These methods can be used in combination as part of an integrated pest management strategy to minimize the negative impact of pests on human health, crops, and the environment.

2.2. **Selecting tools, equipment and machinery**

The selection of tools, equipment, and machinery for pest control will depend on several factors, such as the type of pests to be controlled, the location and size of the area to be treated, and the severity of the infestation. Here are some examples of tools and equipment that may be used for pest control:

Sprayers: Handheld or backpack sprayers can be used to apply pesticides to targeted areas. Larger sprayers mounted on vehicles can be used for larger areas.

Figure: 2.1. Knapsack sprayer

Traps: A variety of traps are available for catching pests, including snap traps, glue traps, and live-catch traps.

Figure 2.2. Traps

Pesticide application equipment: This includes equipment like foggers or ULV sprayers, which produce a fine mist to reach pests hiding in cracks and crevices.

Figure: 2.3.ULV sprayer

Protective gear: When using certain pesticides, protective gear such as gloves, goggles, and respirators may be required to protect the applicator from exposure.

Figure 2.4.PPE

Heat treatments: Heat can also be used to control some pests. Specialized equipment like heat chambers and portable heaters can kill pests and their eggs.

When selecting the appropriate pest control equipment, it is important to consider factors such as the effectiveness of the equipment, its safety for both users and the environment, as well as its cost-effectiveness and suitability for the specific pest problem at hand. It is also important to follow all instructions and safety precautions when using any pest control tool or equipment.

2.3. **OHS hazard, risks assessment and control**

- During identifying agricultural crop pest, some activities can be potentially toxic or hazardous to human beings and pollutant environmental conditions.
- Occupational and environmental hazards may be occurred through:
  - ✓ chemicals and hazardous substances
  - ✓ Manual handling
  - ✓ Dust, and noise
  - ✓ The contamination of off-site ground water or soils from solids, debris, nutrients or chemicals
  - ✓ Land disturbance
  - ✓ Spread of noxious weeds and water run-off.

1.3.1. Types of hazards

- **Physical hazards**:

These are tangible objects or conditions that can harm people, such as sharp edges, electrical power sources, and unsafe equipment. The physical hazards can be:

Noise: absorbed through the ear: Noise from farm tools and machinery can cause permanent hearing loss. Hearing loss may be temporary at first, but repeated exposure will lead to permanent damage

Vibration: In fact, **high frequency, low amplitude vibration** is absorbed and damped by the layers of muscle that envelop the skeleton.

Heat: The ill effects of work in a hot climate are associated with the deficiency or exhaustion of the thermoregulatory mechanisms. In a hot climate, beside the heat resulting from metabolic processes, the organism has to get rid of heat from the environment also.

- **Chemical hazards**

These involve exposure to toxic substances, such as chemicals, gases, and heavy metals. **Chemical hazards include the followings; -**

Dusts: Are substances consisting of **solid particles** that has been reduced to small size by some mechanical process. E.g., silica, coal, asbestos, lead cotton, wood, cement.

Mist: Suspension in air of very small drops usually formed by mechanical means E.g., acid mists

Gases: Substance that will diffuse to evenly occupy the space in which it is enclosed. A gas does not appear in the solid state or liquid state at standard temperature and pressure.

Fumes: Substances composed of solid particles formed by condensation from a gaseous state, these particles are microscopically small (odorous) E.g., smoke

Vapors: Gaseous form of a substance that is normally a liquid, or solid. E.g., alcohols

- **Biological hazards**

These are organisms or substances that can cause infectious diseases, such as bacteria or viruses.

- **Ergonomic hazards**

These involve physical factors in the workplace environment that can lead to discomfort or injury, such as repetitive motions, awkward positions, and heavy lifting.

- **Psychosocial hazards**

These involve stressors in the workplace, such as bullying, harassment, and violence.

2.4. **Selecting, using, maintaining and storing PPE**

During identifying agricultural crop pest, you should have to follow safety required to avoid hazards. Which may be toxicants during clearing, working with sharp machinery and use of other chemical substances must be avoided. Wearing of persons engages like: -hat, boots, overalls, gloves, goggles, respirator or face mask, hearing protection, and sunscreen lotion is a must.

Selecting PPE based on the PPE Hazard Assessment

- Consider these factors when selecting PPE:
  - ✓ Type of hazardous materials, processes, and equipment involved
  - ✓ Routes of potential exposure (ingestion, inhalation, injection, or dermal contact)
  - ✓ Correct size for maximum protection

- ✓ Minimal interference with movement

- **Personal protective clothing and equipment may include**:

1. Boots
2. Hat/hard hat
3. Overalls
4. Gloves
5. Protective eyewear
6. Hearing protection
7. Respirator or face mask
8. Sun protection, e.g., sun hat, sunscreen

Table: 2.4. Personal protective equipment's

NO	Name of equipment's	Picture	Its use
1	Boot		To protect feet from chemical spills and sharp objects.
2	Eye glass		Use safety glasses for minor splash hazards, goggles for moderate hazards, and goggles combined with a face shield for severe hazards.
3	Glove		Hand protection is indicated for the possibility of severe cuts, lacerations, or abrasions, punctures, temperature extremes, and chemical hazards.
4	Overall		Protect head from injuries and disease pathogens and any other when there is a danger of objects falling from above.

5	Helmet		Protect head from injuries and disease pathogens and any other when there is a danger of objects falling from above.

2.5. **Selecting control measures based on social and environmental implications**

Selecting pest control measures that are appropriate from social and environmental perspectives can be a complex process. Some important considerations to keep in mind include:

- **Safety:** Any pest control measures must be safe for people and pets, and not cause harm to the environment. This includes ensuring that any pesticides used are non-toxic to non-target species.
- **Effectiveness**: The chosen pest control measure must be effective in controlling the target pest. This may vary depending on the type of pest and the severity of the infestation.
- **Cost**: The cost of the control measure may be a factor, particularly for large-scale or ongoing pest control efforts.
- **Sustainability**: An emphasis on sustainable practices may inform the types of pest control measures used. This might involve choosing methods that have minimal environmental impact and/or promote healthy ecosystems.
- **Community buy-in**: The local community may have preferences or concerns about particular pest control measures, which should be taken into account.

Environmental implications associated with controlling plant pests, diseases and disorders include

- Beneficial environmental impacts
- Where reduced and informed targeting of chemicals, fertilizers and water to the site and recycling within the system, result in minimal escape of contaminants to the external environment

- Beneficial impacts may also result from improved production, healthier ecosystems, more efficient water and nutrient utilisation, and reduced pest numbers
- Detrimental environmental impacts may arise where IPM activities produce excess noise, dust or water, or the systems do not function effectively because of inadequate implementation techniques.

Hence, the control measures for plant pests, diseases and disorders should be selected in full consideration of these environmental implications.

2.6.Risk associated to pesticide for horticultural crop

Pesticides are commonly used in horticultural crop production to manage pests and diseases that can damage plants and reduce yields. While pesticides can be effective in controlling pests, they also have the potential to cause harm to the environment and human health, as well as disrupt natural ecosystems. One of the main ways that pesticides can affect horticultural crops is by killing beneficial insects and pollinators. This can lead to reduced yields or poor-quality fruits and vegetables due to lack of pollination. Additionally, improper use or overuse of pesticides can result in residues on crops that exceed safety limits, leading to potential health risks for consumers.

The use of pesticides in horticulture can pose various risks, both to human health and the environment. Pesticides are chemical substances that are designed to kill or control pests, but they can also have negative effects on other living organisms, such as animals, plants, and microorganisms. Here are some of the risks associated with pesticide use in horticultural crops:

- **Health hazards to humans**: Pesticides can be harmful to human health, especially when they are applied improperly or in excessive amounts. Exposure to pesticides can cause skin irritation, respiratory problems, reproductive system damage, and even cancer.
- **Environmental pollution**: When pesticides are sprayed onto crops, they can contaminate the soil, waterways, and air. This can lead to the death of non-target organisms like beneficial insects, birds, and microorganisms which are important for the ecosystem.
- **Pesticide resistance**: Overuse of pesticides can lead to the development of resistance in pest populations, making it more difficult to control them in the future. This can result in increased pesticide use and higher costs for farmers.
- **Residue in food**: Pesticide residues on crops can end up in the food we eat, which can be harmful to human health. Long-term exposure to low levels of pesticide residues has been

associated with chronic health problems such as cancer, developmental disorders and reproductive problems.

Therefore, it is important for horticultural producers and farmers to use pesticides carefully and judiciously to minimize potential risks to human health and the environment. Integrated Pest Management (IPM) strategies that incorporate various methods of pest control such as biological control, cultural and mechanical methods while minimizing the use of chemical pesticides, can help reduce the risks associated with pesticide use in horticultural crops.

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Multiple choice

1. Which of the following is physical hazards

   A. Noise
   B. Gas
   C. Bacteria
   D. Stress

2. Important considerations while selecting pest control measures

   A. Effectiveness
   B. Safety
   C. Cost
   D. All

Test II: Short Answer **Questions**

1. List pest control measures
2. Write risk associated to pesticide for horticultural crop
3. List tools and equipment that may be used for pest control

Operation Sheet -2

2.1. Techniques of use/wear personal protective equipments and personal hygiene

A. Tools and equipment's

- Boots
- Overalls
- Gloves
- Respirator
- Facemask
- Sunscreen
- Hat
- goggles

B. Procedures/Steps/Techniques

1. Identify chemical which needs protective equipment and which does not need
2. Identify different types of protective equipment
3. Carry out how to wear protective equipments and clothing, never wear leather products which absorbs chemicals
4. Mix one of the chemical and apply
5. In case of a pesticides spill or splash at work site, wash your body immediately after contact.
6. Clean protective equipments and clothing after application
7. Wash your hands or take shower at the end of the application.

LAP TEST-2	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2** hours. The project is expected from each student to do it.

Task-1 Perform wear personal protective equipments and personal hygiene

LG #3 LO #3- Implement control measures

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Integrated pest management (IPM) activities
- Deciding pest control methods
- Maintaining clean and safe work area

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Integrated pest management (IPM) activities
- Decide pest control methods
- Maintain clean and safe work area

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test”

Information Sheet 3

3.1.Integrated pest management (IPM) activities

Integrated Pest Management (IPM) is a sustainable approach to pest control in crop production that utilizes a combination of practices for efficient pest management while minimizing chemical use. Some common IPM activities include:

- **Crop monitoring**: Regular monitoring of crops helps identify pests and determine if action needs to be taken.
- **Prevention**: Practices such as crop rotation, soil cultivation, and seed treatment can prevent or reduce the likelihood of pest infestation.
- **Biological control**: Natural predators can be introduced into an ecosystem to control pests and reduce their population.
- **Cultural controls**: Altering cultural practices such as irrigation, pruning, or planting time can reduce pest problems.
- **Chemical control**: Using pesticides is an option but should be considered only after non-chemical methods have been used.
- **Record keeping**: farmers can monitor pest populations using data management devices which entails accurate records and tracking of pests, diseases, treatments, and yields related to the specific crop and location. Implementing IPM activities into horticultural crop production is an effective way to effectively manage pests while reducing the risk of environmental hazards and potential health risks for consumers.

3.2.Deciding pest control methods

When deciding on the pest control methods to use in crop production, there are several factors to consider:

- **Identification of the pest**: The type and severity of the pest problem must be identified so that the appropriate control method can be chosen.
- **Environmental impact**: The potential impact of the method on the environment, human health and non-targeted species should be considered before implementing a control method.

- **Economic impact**: The cost, efficiency, and practicality of each method should be considered to determine its economic feasibility.
- **Legal regulations**: The use of some pesticides may be restricted by government regulations. Farmers should check their local regulations to ensure they comply with any restrictions.
- **Resistance development**: Overuse of a single pesticide can lead to resistance development; hence, farmers should develop proper rotation program or integration of effective natural controls.
- **Effectiveness**: The chosen pest control method should be effective against the target pest or disease problem. Considering these factors can help farmers to choose the most effective and sustainable pest control methods for their horticultural crops with regards to costs, environmental impacts, and efficacy in mitigating pest pressure.

3.3. Maintaining clean and safe work area

Here are some tips on maintaining a clean and safe work area after pest control

- Wait for the recommended amount of time before entering the treated area. This will ensure that the pesticides have dried and it's safe to enter.
- Open windows and doors to allow fresh air to circulate through the area, and use fans to help dry any wet spots.
- Clean up any dead pests or debris left behind by the treatment. Vacuuming is a good way to do this, but make sure to dispose of the bag or contents properly.
- Wipe down any surfaces that may have been exposed to pesticides with a damp cloth. Be sure to dispose of the cloth carefully.
- Dispose of any food that may have been left out during the treatment, and clean surfaces where food is prepared or consumed thoroughly.
- Keep pets and children away from the treated area until it's deemed safe.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Write true/false

1. Integrated Pest Management (IPM) is a sustainable approach to pest control in crop production
2. Using pesticides is an option but should be considered only after non-chemical methods have been used
3. The potential impact of the method on the environment, human health and non-targeted species should be considered before implementing a control method.
4. Regular monitoring of crops helps identify pests and determine if action needs to be taken

Test II: Short Answer Questions

1. Explain factors to consider when deciding on the pest control methods to use in crop production
2. Elaborate some common IPM activities
3. Write some tips on maintaining a clean and safe work area after pest control

LG #4	LO #4- Monitor effectiveness of control measures

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Monitoring control operations efficiency
- Identifying and monitoring control methods
- Assessing effectiveness of control methods
- Implementing adjustments to IPM measures
- Maintaining records

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- Monitor control operations efficiency
- Identify and monitoring control methods
- Assess effectiveness of control methods
- Implement adjustments to IPM measures
- Maintain records

Learning Instructions:

- Read the specific objectives of this Learning Guide.
- Follow the instructions described below.
- Read the information written in the information Sheets
- Accomplish the Self-checks
- Perform Operation Sheets
- Do the “LAP test”

Information Sheet -4

4.1 Monitoring control operations efficiency

Monitoring pest control operation efficiency refers to regularly tracking and evaluating the effectiveness of pest control activities and procedures used to eliminate pests. This includes keeping track of the amount and type of pesticides used, assessing the condition of pest-infested areas, recording the time taken for each operation, and using technology such as GPS tracking to ensure timely and efficient service. By monitoring pest control operation efficiency, one can identify areas for improvement, ensure that pests are being properly controlled, and ultimately reduce the risk of future infestations.

To monitor the efficiency of pest control operations, you can use the following methods:

- Keep track of the amount and type of pesticides used: This helps in understanding the effectiveness of the chosen pesticide against the targeted pests. You should note which pesticides work best under which conditions to maximize their efficacy.
- Monitor the condition of pest-infested areas: By regularly inspecting and assessing the pest-infested areas, you can determine if treatment is sufficient or if further measures need to be taken. Keep track of time taken for each operation: This will help evaluate if the operations are efficient in terms of time management and scheduling.
- Use GPS tracking technology: GPS tracking allows you to track your pest control fleet in real-time, ensure that your team is following correct procedures and verify that they are servicing all accounts in a timely manner.
- Keep detailed records: Proper record-keeping will help in identifying problems, comparing different methods' effectiveness, and providing information for customers regarding pest infestations and treatment measures. By implementing these methods, you can efficiently monitor and improve your pest control operations' effectiveness.

4.2 Identifying and monitoring control methods

Identifying and monitoring control methods of pests involves a variety of techniques. One important step is to identify the type of pest that is present in order to determine the most effective control method. Monitoring the pest population and tracking its movements can also help to determine when and where control measures should be applied. Control methods for pests can vary depending on the pest species, severity of the infestation, and environmental factors. Some common control methods include using pesticides, implementing physical barriers such as netting or screens, introducing predators or parasites to target specific pests, or simply removing or destroying infested plants or materials. Regular inspections and maintenance of facilities and equipment can also help prevent or reduce the presence of pests. It's important to work with a knowledgeable pest control professional to determine the most effective control methods for specific pest problems.

Monitoring control methods of pests involves assessing the effectiveness of different pest control strategies over time. This can involve several steps such as inspecting the area for signs of pests, determining the severity of the infestation, and implementing control measures. Once control measures are put in place, regular monitoring and evaluation are necessary to ensure that they are effectively reducing the pest population. This monitoring process may involve a variety of techniques such as visual inspection, trapping, using pheromone bait, or implementing automated sensor-based systems. By monitoring the success of pest control methods over time, changes can be made to the approach if needed. For example, if a pesticide is applied but it does not appear to be reducing the pest population, additional or alternative control measures may need to be implemented. By closely monitoring the situation and adjusting control methods as needed, it's possible to effectively manage and reduce pest populations over time.

4.3 Assessing effectiveness of control methods

Assessing the effectiveness of control methods is important to ensure that pest populations are effectively managed and reduced over time. There are several factors that can be considered when evaluating the success of different control methods, including:

- **Pest population reduction**: The most obvious measure of success is a visible reduction in the pest population over time. This can be measured through regular inspections and counts, as well as tracking the number of pests caught in traps or other monitoring methods.

- **Preventive measures**: An effective pest control strategy should also focus on preventing future infestations. This might include implementing physical barriers, improving hygiene and sanitation practices, or using pest-resistant building materials or planting pest-resistant crops.
- **Cost-effectiveness**: Controlling pest populations can be expensive, so it's important to assess whether the cost of different control methods is justified by the benefits they provide. This might involve calculating the cost per unit of pest reduction, or comparing the cost of different control strategies with their relative effectiveness.
- **Safety and environmental impact**: It's also important to consider the safety and environmental impact of different control methods. For example, some pesticides may pose health risks to humans or wildlife, or cause harm to non-target species. Evaluating these factors can help determine the most appropriate control methods for a given situation.

  By carefully assessing these and other factors, it's possible to develop an effective pest control strategy that reduces pest populations while minimizing negative impacts on people, animals, and the environment.

4.4 Implementing adjustments to IPM measures

When implementing adjustments to IPM measures, it's important to follow a systematic and well-planned approach. Here are some steps you can take to ensure that the adjustments are effective:

- Identify the existing pest problem and determine the cause and extent of the infestation.
- Determine the optimal time for applying adjustments to control the pest problem effectively.
- Identify the most appropriate and effective control measures using the principles of IPM.
- Evaluate the advantages and disadvantages of each chosen measure and select those that are most effective and environmentally friendly.
- Implement the chosen measures, such as sanitation, cultural controls, biological controls, or use of chemical pesticides, as planned.
- Monitor the effectiveness of the chosen control measures regularly.
- Collect data using monitoring techniques like traps or visual surveys to evaluate the pest populations and determine whether the adjustments were effective.

- If the control measures are not effective, re-assess the situation to identify the cause of the problem and consider alternative control measures that may be more effective.

4.5 Maintaining records

Maintaining records for pest control generally involves keeping track of any pest-related issues, treatments, and inspections that take place on a particular property. This can include documentation of any pest sightings, along with details on the type of pest and location of the sighting. Records may also include information on treatments that have been carried out, such as the types of pesticides used and the dates of application. Additionally, regular inspections and monitoring may be documented in these records to help identify any potential issues before they become larger problems. The ultimate goal is to create a comprehensive history of pest-related activity on a particular property that can be used to inform future pest control efforts and help prevent infestations from occurring in the first place.

A template for maintaining pest control records:

- Date: ----------
- Location: ----------
- Pests: ----------
- Control method: ----------
- Product used: ----------
- Effectiveness: ----------
- Follow-up required: ----------
- Additional notes: ----------

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Write true /false

1. Maintaining records for pest control includes date, location, control method
2. Monitoring control methods of pests involves assessing the effectiveness of different pest control strategies over time

Test II: Short Answer Questions

1. Elaborate factors that can be considered when evaluating the success of different control methods of pest
2. Write method of monitor the efficiency of pest control operations

Operation Sheet -4

4.1. Techniques of maintaining pest control records

A. Tools and equipments

- Note/Paper
- Pen
- Pesticide

B. Procedures/Steps/Techniques

- Date: ----------
- Location: ----------
- Pests: ----------
- Control method: ----------
- Product used: ----------
- Effectiveness: ----------
- Follow-up required: ----------
- Additional notes: ----------

LAP TEST-4	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **2** hours. The project is expected from each student to do it.

Task-1 Perform maintaining pest control records

Reference Materials

Books:

Pest and Disease Management Handbook 1st Edition by David V. Alford (Editor)

Pest and Disease Control Handbook (1989).

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