HORTICULTURAL CROPS PRODUCTION

Level-II

Learning Guide-66

Unit of Competence: Treat Weeds, Plant Insects, Diseases and Disorders

Module Title: Treating Weeds, Plant Insects, Diseases and Disorders

LG Code: AGR HCP2 M16 LO1-LG-66

TTLM Code: AGR HCP2 TTLM 0120v1

LO1. Prepare to treat weeds, insects, diseases and disorders

Instruction Sheet	Learning Guide 66

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

- Recognizing weeds, insects, diseases and disorders
- Recording and reporting details of the weeds, plant insects, diseases and disorders
- Selecting treatment methods
- Selecting and preparing equipment
- Identifying OHS hazard

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

- Recognize weeds, insects, diseases and disorders
- Record and report details of the weeds, plant insects, diseases and disorders occurrence
- Select treatment methods
- Select and prepare equipment
- Identify, risks assess and report Occupational Health and Safety hazards

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, 2, 3, 4 and 5”.
4. Accomplish the “Self-check 1, 2, 3, 4 and 5”.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, 2 and 3.
6. Do the “LAP test” for each operation sheet.

Information Sheet-1	Recognizing Weeds, Insects, Diseases and Disorders

1.1. Identifying weeds

Weeds can be defined as; any plants, which grow where they are not wanted or any plants that interfere the activities of human beings. Weed interference with crop production:

- competing for water, nutrients, light, and space,
- contaminating the product at harvest,
- harboring pest insects, mites, vertebrates, or plant disease causing agents,
- releasing toxic substances in to the soil that inhibit growth of desirable plants.

Characteristics of **weeds** are:

a. They are persistent and resistant to control and eradication
b. Immense capacity to produce large number of seeds and their growth is prolific
c. Remain viable or dormant for long duration and in some species up to 30 – 40 years
d. Hardy and able to withstand adverse soil, climate and disease conditions
e. Some have very deep root systems some times as deep as 8 – 10 meters
f. Some are similar to crop seeds in shape and size and their separation becomes difficult
g. Many have morphological similarities with crop plants

1.1.1. Weed classification

Weeds are classified in to different groups based on various criteria.

A. Based on plant morphology

Classification of weeds based on morphology is very important and useful in weed control.

i. Grasses

- Botanically: Plants of the family poaceae (Graminea)
- Grasses are monocots and are propagated by seeds; rhizomes, stolons and stem cuttings.

e.g *Cynodon dactylon* (Bermuda grass), *Sorghum halepense* (johason grass), *Digitaria spp*; and wild oat (*Avena fatua)*.

ii. **Sedges**

- Monocots and the stems are solid and triangular in cross section
- Propagation is through modified rhizomes

  e.g Cyperus spp

iii. **Broad leaved weeds**

- These weed species are dicotyledonous plants
- The leaves are usually broad with netted veins.

  E.g. *Amaranthus spp. Chenopodium album, Convoulus arvensis.*

B. Based on life span

i. **Annuals**: These weeds complete their life cycle in one season.

- Propagation is through seeds, which are produced in a single growing season.
- Most annual weeds are easy to control. The prime concern is to prevent these weeds from going to seed.

  E.g *Commelna beghalensis*

ii. **Biennials**: These weeds complete their life cycle in two years or two growing seasons.

- In the first season they produce flowers and seeds.
- More effective when the plants are in the rosette stage of their first season of growth.

  E.g. wild carrot (*Daucas carrota)*

iii. **Perennials**: These weeds live in more than two years, propagated by seeds or asexual means.

- They store food in the subterranean part which produce new shoot when condition is favorable.
- These weeds are very difficult to control by common methods.

  E.g. *Cynodom dactylen* – stolen; *Cyperus spp* – tuber

C. Based on their habitat

i. **Terrestrial weeds**

- Economic important weeds;
- Found in cultivated and uncultivated fields where the soils are not waterlogged

  E,g *Amaranthus spp*

ii. Aquatic weeds

Weeds of this group grow and complete a part of their life cycle in water.

D. Special weeds

i. Poisonous weeds

Poisonous to both humans and animals. E.g. *Datura stramonium* (Jamestown weed), *Sorghum halepense* (Johnson grass) – containing at its tillering stage enough prussic acid to poison cattle.

ii. Problem or noxious weeds are difficult weeds to control which

- Persist in adverse condition.
- Reduce yield even at very low density because of their high competitive nature
- Hard to control.

  E.g. *Cyperus rotundus* (purple nutsedge), *Cynodon dactylon* (Bermuda grass), *Parthenium hysterophorus* (congress weed).

iii. Parasitic weeds

Weeds that depend entirely or partly on the host for their existence are called parasitic weeds.

E.g. *Cuscuta spp* e.g dodders

Orobanche spp e.g. witch-weeds

Striga spp

1. Chenopodium Species

2. *Amaranthus spp*

2. **Witch weed (Striga spp)**


3. Broomrape (Orobanche spp) 4.Dodder (cuscuta spp) 5. Digitaria tarnata



6. Parthenium (congress weed)

Fig 1.1 Different weed species

1.2. Identifying insects

Insects are subdivision of animal kingdom called phylum Arthropods, as adults, particularly they posses' three distinct body regions: **Head, Thorax, and Abdomen**; three pair of thoracic legs; a pair of antenna (except order Prothura). The number of body segments consists of 19-20 in most insect species.

Some insects are beneficial as pollinators of flowers and as predators which feed on destructive insects. Other types of insects are directly harmful as pest of crops, as carriers of diseases and as destroyers of stored food. Insect damages on crops can be direct or indirect damages. The direct damages of insects are leaf defoliation, distraction growing points, boring tunnelling of the stem of the plants, suck for the phloem sap. Indirect damages of insects may be transmitting diseases from crops to crops.

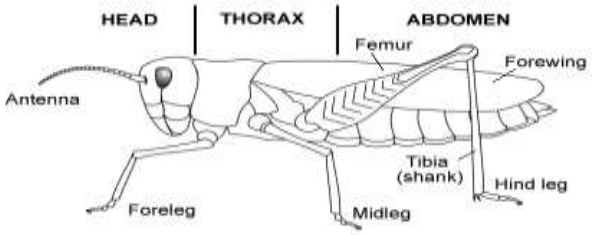

Fig1.2 Body sections of insects

1.2.1 External structures and life cycle

A. Head

The head of the insect is the part where the organs for ingestion, sensory and coordination of bodily activities are located. These include:

i. **Antennae**: this is used as a sensory organ for feeling. Its size and shape vary and can be helpful in the identification of the insects.

ii. Mouth parts: there are four general types of mouth parts. These are chewing – biting mouth, piercing – sucking, sponging, siphoning mouth parts.

a. **Chewing mouth parts**: contain toothed jaws that bite and tear. E.g. cockroaches, Ants, beetles, caterpillars, and grasshoppers are in this group.

b. **Piercing – sucking mouth parts:** consist of a long slender tube that is forced into plant or animal tissue to suck out fluids or blood. E.g. stable flies, sucking lice, bed bugs, aphids.

c. **Sponging mouth parts**: Is tubular tongue like structures with a spongy tip to suck up liquids or soluble foods. E.g. flesh flies, blow flies, and house flies.

d**. Siphoning mouth parts**: are formed into a long coiling tube for sucking nectar. Butterflies and moths have this type of mouth parts.

iii. Eyes: there are compound eyes and simple eyes. They detect motion only and can not see clear images.

B. Thorax

This is the locomotion center of the insect. It is divided into three parts called the pro – thorax, meso – thorax and Meta – thorax. Three pairs of legs and often a pair of wings are attached to the thorax.

Different insects have different forewing texture. These include:

- Hard and shell like wings (elytra) E.g. beetles
- Leathery wings E.g. grasshoppers
- Membranous wings E.g. flies
- Part membranous and part hardened wings (hemi – elytra) E.g. bugs
- Membranous but covered with scales. E.g. moths and butterflies.

C. Abdomen

This is the metabolism and the reproduction center of the insect. It is composed of 11 segments but 8 or fewer segments may be visible. Spiracles are found along each side of most of the segments through which the insect breathes. External reproduction organs such as ovipositors (female), male (copulatory organs) are found in the abdomen. The tip end of the abdomen has tail – like appendages called circus for sensory purposes.

2.1.2 Life cycle of insects

A. Normal sexual reproduction: this involves mating between the sexes (male and female) followed by egg lying.

B. Variation to the normal pattern of reproduction may include;

a) **Parthenogenesis:** production of eggs without fertilization.
b) **Viviparity:** fertilized eggs are retained in the oviduct of the female until they are hatched and active young larvae or nymphs are deposited rather than eggs.
c) Sometimes **parthenogenesis and viviparity** occur together. E.g. aphids during summer all individuals are female and give rise to living young without mating.
d) **Poly embryony:** a single egg divides and subdivides several times before embryonic development commences so that a number of young are produced.

C. **Molting (ecdysis)**

- Insect sheds its skin at intervals and grow a new one in a larger size.
- Each growth stage of an insect between molts is referred to as instars.

Different insect undergo molts differently.

Metamorphosis

Metamorphosis is a series of changes through which an insect passes in its growth from egg adult.

- **Incomplete metamorphosis** is a process in which the insect passes through three different stages of development before reaching maturity (egg, nymph and adult). E.g. grasshoppers, aphids and bugs.

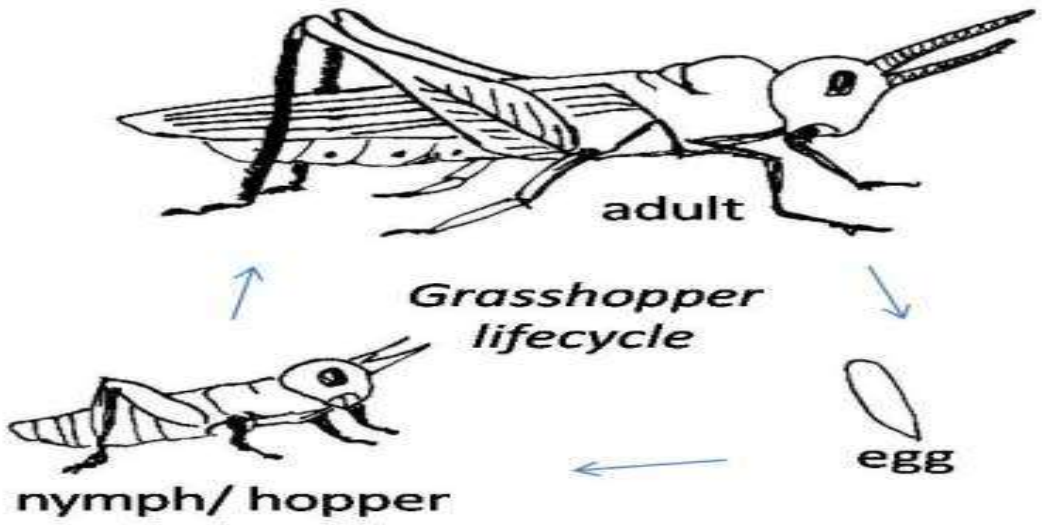

Fig 1.3 Incomplete metamorphosis of grasshopper

- **Complete metamorphosis** is a process in which the insect passes through four stages of development (egg, larva, pupa, & adult). E.g. beetles, butterflies, flies, mosquitoes, fleas, bees, and ants.

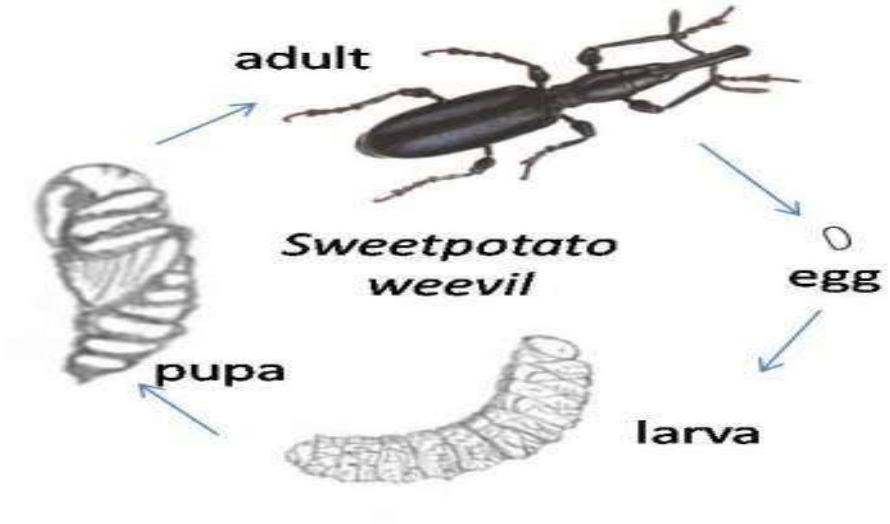

Fig 1.4 **Complete metamorphosis of sweet potato weevil**

Thus, studying life cycle is very important for treatment and focus on

- ✓ At which stage pests controlled easily
- ✓ Which stage create serious problem

2.1.3. Some important Horticultural insects' pests

a) Butterflies and moths

- they are the **most dangerous group** of pests in crop production
- mostly larval stage damages crops
- but also adult **damage** leaves by eating

Fig1.5. Butterfly egg, larva and adult stage

b) beetles

They affect both underground plant parts (root) and above ground parts.

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Examples: garden beetles, grain weevil, sweet potato weevil etc

Fig 1.6. Different species of beetle

c) Aphids

- damage crops by sucking the plant sap
- they damage cabbage, maize, pea, apple,
- Rarely obvious, except in screen houses, but transmit some viruses


Fig 1.7 Cabbage aphids

d) flies

- they are known to damage fruits crops, wheat,
- Populations are often high in the dry season and transmit some viruses
- Feed by sucking sap from the leaves of plants
- Characteristic wilting, yellowing, defoliation of leaves
- Secretion of honeydew by the pest encourages sooty mold growth
- Interferes with the photosynthesis and reduce plant vigor


Fig 1.8 Whiteflies

e) Cut Worms

- Damage occur early in the season when the plants are small
- Clipping off seedling stems or young plants near or just below the soil surface
- Entire row of plants might be cut off during the night
- Climbing caterpillars can damage foliage, buds and shoot

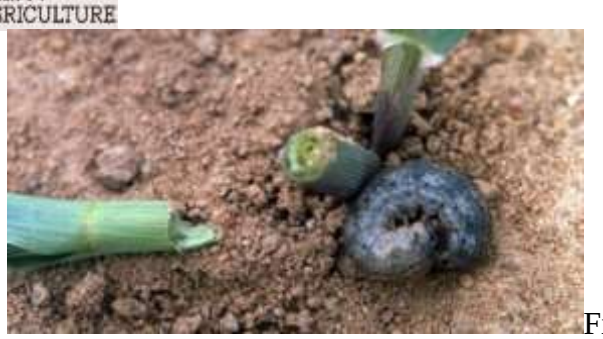

Fig 1.9 Cut worms

f) Ants

- they are soil insects
- they damage roots and stems of plants by cutting
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g) Plant bugs

- they damage vegetables by cutting

h) Termites

- they are soil insects
- they damage roots and stems of plants by cutting

i) American Ball worm

- Attack maize, tomato, cotton, pea, many others
- Damage ear, fruit, ball, pod

j) Sweet potato Weevil

- Early damage to crops
- Attack to the stem at crown
- Attack roots in the field and during storage
- **Roots attacked by weevil** contain toxic, bitter compounds which are **NOT** good for human health.

Adult weevil weevil damaged roots weevil damaged vines

Fig 1.10 Sweet potato adult weevil and damaged part of root and stem**.**

k) **Grasshoppers**:

- Can seriously defoliate if populations are high
- Damage eating leaves and other parts

fig 1.12 Grasshopper

1.3. Identifying diseases

A plant disease can be defined as the malfunctioning of host cells and tissues those resulted from the continuous irritation by a pathogenic agent or environmental factor and leads to the development of symptoms. It can also be defined alternatively as 'the physical and/or the physiological not well being of plants'. The physiological functions of plants include:

- Normal cell division, differentiation, and development
- Absorption of moisture and minerals from soil and translocation to whole plant parts.
- Photosynthesis and translocation; and their results.
- Reproduction
- Storage of food
- Respiration anything that causes a disturbance of these is a **disease**.

Plant pathology is a science which studies the causes and control of plant diseases including:

- The living, non living and environmental causes of diseases.
- The mechanism of disease development by pathogens.
- The interaction between pathogens and host.
- The method of control of the diseases.

There are two categories of plant diseases. These are infectious and non infectious diseases.

A. Infectious diseases

- Able to grow and multiply in the host.
- Transmit from one plant to other plant;
- Caused by biological organisms – plant pathogens such as bacteria, fungi, nematodes and viruses. **A pathogen** is a disease causing organism.

B. Noninfectious diseases

- Occur in the absence of the pathogen (no sign of disease);
- Cannot be transmitted from diseased plant to the healthy plant
- Infect the plant at all stage (seed, seedling and mature plant);
- Caused by environmental factors (non-living factors or non pathogenic factors)
- Are evenly distributed in the field.

1.3.1. Symptoms of plant diseases

Symptom: is a visible abnormal change as a result of pathogenic infection.

a). Discoloration: change of color in the affected plant. E.g. symptoms produced by systemic virus infections (Mosaic by (TMV), ring spots)

Fig 1.3.1 Chlorosis along Veins

b). Wilting: a secondary symptom in which leaves or shoots lose their turgidity and drop because of a disturbance in the vascular system of the root or of the stem often caused by bacteria or fungi.

Fig 1.3.2 1. Wilting of cabbage followed by reddening 2. Potato wilt

c) Malformation: hypotrophy and hypoplasia (stunting) of the plant organs or entire plants. And hyperplasia (excessive growth) of plant parts or whole plant. These include the following:

a. Club root – enlarged roots appearing like spindles or clubs.


Fig 1.3.3. Club root of cauliflower

b. Gall – enlarged portions of plants usually filled with fungus mycelium.


Fig 1.3.4 Crown galls on pear seedlings

c. Leaf curls – distortion, thickening and curling of leaves.


1. Leaf curl of tomato virus


2. Leaf distortion of sweet potato virus

c) Necrosis: dead plant cells or tissue. These include the following:

a. leaf spots – localized lesion on host leaves

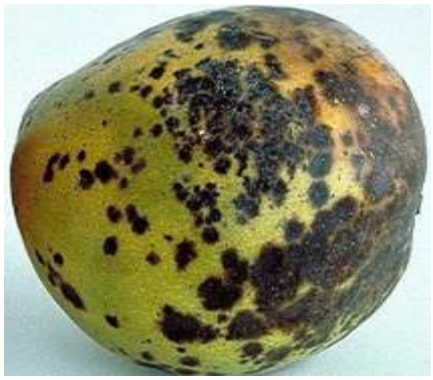

Leaf spot

b. blight – general rapid browning of leave, branches, twigs and floral organs resulting in their death.

1. Late blight of tomato

2. Late blight of potato

c. Anthracnose – a necrotic and sunken ulcer – like lesions in the stem, leaf, fruit or flower of the host plant.



1. Tomato Anthracnose 2. Mango Anthracnose

d). rot: disintegration or decay of plant tissues. These include:

i. Root rot: disintegration or decay of part or all of the root system of a plant


Root rotting

ii. Basal stem rot: disintegration of the lower part of the stem.


The stem damping off seedling

e. Feathery mottle virus: transmitted by aphids

Fig Sweet potato feathery mottle virus

f. Chlorotic stunt virus: transmitted by whiteflies

Fig Sweet potato Chlorotic stunt virus

h) Dieback: progressive death of shoots, branches, and roots generally starting at the tip.

1. Dieback of lemon

2. Dieback of avocado

i) Scorch: burning of leaf margins as a result of infections or unfavorable environmental condition.

Scorching

j). Cabbage rust

k). Onion Downey mildew

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Table 1.1. Summary of some of disease with their symptoms

Disease Name	Hosts	Infected Plant Part	Pathogen	Symptoms	Source of Inoculums	Management Options
Late blight (Phytophtra infestans)	Potato and tomato	Foliage, fruits, tubers on the field and in the store	Fungi	Irregular or circular, water-soaked lesions. In cloudy or humid weather, the lesions increase quickly and form dark brown, blighted areas with indefinite borders.	infected tubers and plant parts left on the field, infected soil	Resistance varieties, Field sanitation, fungicidal sprays
Bacterial wilt (pseudomonas solanacearu)	Potato, tomato, banana, tobacco and ground nut	stems, roots, tubers eyes, leaves, seeds	Bacteria	Wilting, stunting and yellowing of leaves followed by collapse of the entire plant.	Infected crop debris, infected soil and seed	Resistance varieties, Field sanitation, crop rotation

Bacterial Cancer (corynebacterium michiganense)	Tomato	stems, fruits, leaves, seeds	Bacteria	Leaf veins turn brown, wilt and finally die out. Brown streaks develop on the stems that may crack to reveal brown discoloration of internal tissues.	Infected crop debris, infected seed	Field sanitation, disease free seeds and transplants, hot water treatment, Resistance varieties, Field sanitation, crop rotation
Downy mildew (Peronospora destructor)	Onion, Garlic, leek, Shallot	stems and leaves	Fungi	At first, yellowish spots on the upper half of the leaves appear. When the humidity gets higher the fungus grows and appears as bluish-grey, hairy mildew. Spot lesions enlarge and merge. Finally, the affected leaves wilt and die.	Infected bulbs, soil and seed	Clean cultivation, crop rotation, seed dressing, and fungicides.
Purple blotch (Alternaria porri)	Onion, Garlic, and Leek	stems and leaves	Fungi	First, small white lesions with purple center appear on the leaves. Later the lesions enlarge rapidly, girdling leaf and stem that fall down. Bulb rotting will follow in the storage.	Infected soil and seed, crop debris	Field sanitation, Resistance varieties, increase spacing, seed dressing, and fungicides .
Onion rust (Puccinia alli)	Onion, Garlic, leek, Shallot	stems and leaves	Fungi	Longitudinal pustules on the leaves, which up on rupturing expose yellowish-brown spores. Black pustules are produced at later stages.	Volunteer onion crops	Field sanitation, Resistance varieties, soil drainage, roughing infected plants and fungicides.

1.4. Identifying Disorders

Disorders are called noninfectious diseases and caused by:

- Plants themselves' inheritance factors (gens).
- Physical factors include.
    - ♦ Too low or too high a temperature, e.g. scorching, freezing;

- Lack or excess of nutrient element
- Lack or excess of water or moisture in soil air e.g. drought, water logging
- Injury by physical phenomena, e.g. wind, rain, thunder, etc.
- Soil PH (too acidic or too alkaline) or soil salinity and others

The Most Common Plant Disorders

- Bolting – premature growth
- Chemical Damage – misapplication, salt on pathways, paint fumes, manure, herbicides…
- Drought – vegetable plants are most vulnerable
- Frost – formation of ice crystals in the plant cells
- Nutrient Deficiency – an imbalance of soil and fertilizers
- Pollution – carbon monoxide is a main culprit, harm is dependent on the concentration
- Sun Damage – too much heat and light exposure can, thin barked trees such as cherry and apple are affected, and tomatoes ripen unevenly.
- Water logging – an issue with mainly indoor plants. Too much water eliminates oxygen in plants soil.
- Wind-chill – one particular side of a plant may eventually brown as the wind displaces water and it worsens if that side is water logged or frozen since the roots in malfunction will not be able to replace the moisture.
- Wind rock – young taller plants are affected especially in exposed windy areas with poorly drained soil. The wind causes the motion of the top growth to loosen new roots resulting in saucer shaped depression susceptible to water logging.

1.4.1. Diagnosis and Identification of Plant Disorders

Diagnosis is the process of recognizing a disorder from its symptoms and signs whether the disorder is caused by something in the physical environment, an infectious organism (pathogen). The diagnostic process should include looking at the entire as well as its

separate parts, carefully analyzing the observations, and attempting to understand or explain why a disorder has occurred. Symptoms on plants include leaf spots, blights, wilt, yellows, galls, leaf mines, and skeleton leaves. The same symptoms may be caused by different organisms or abnormalities in the physical environment and thus may require different management practices. A sign of a pathogen might be the white powdery fungus growth that occurs on leaves infected with powdery mildew.

Diagnosis is an often-complicated process that involves broad horticultural knowledge as well as patience and sleuthing. It is usually difficult to explain why one plant in a hedge declines or dies while the others appear healthy. Diagnosis may also be simple, especially if the cause produces indisputable symptoms or has recognizable signs. Finding an Insect (the sign) chewing on a leaf in a characteristic pattern (the symptom) can result in a positive diagnosis.

1. Flattened stem (fasciation) of sweet potato

2. **Symptoms of Potassium (K) deficiency**

Plants which received100%, 14% and 1.7% of k respectively.

Potassium deficiency

Symptoms of phosphorus deficiency

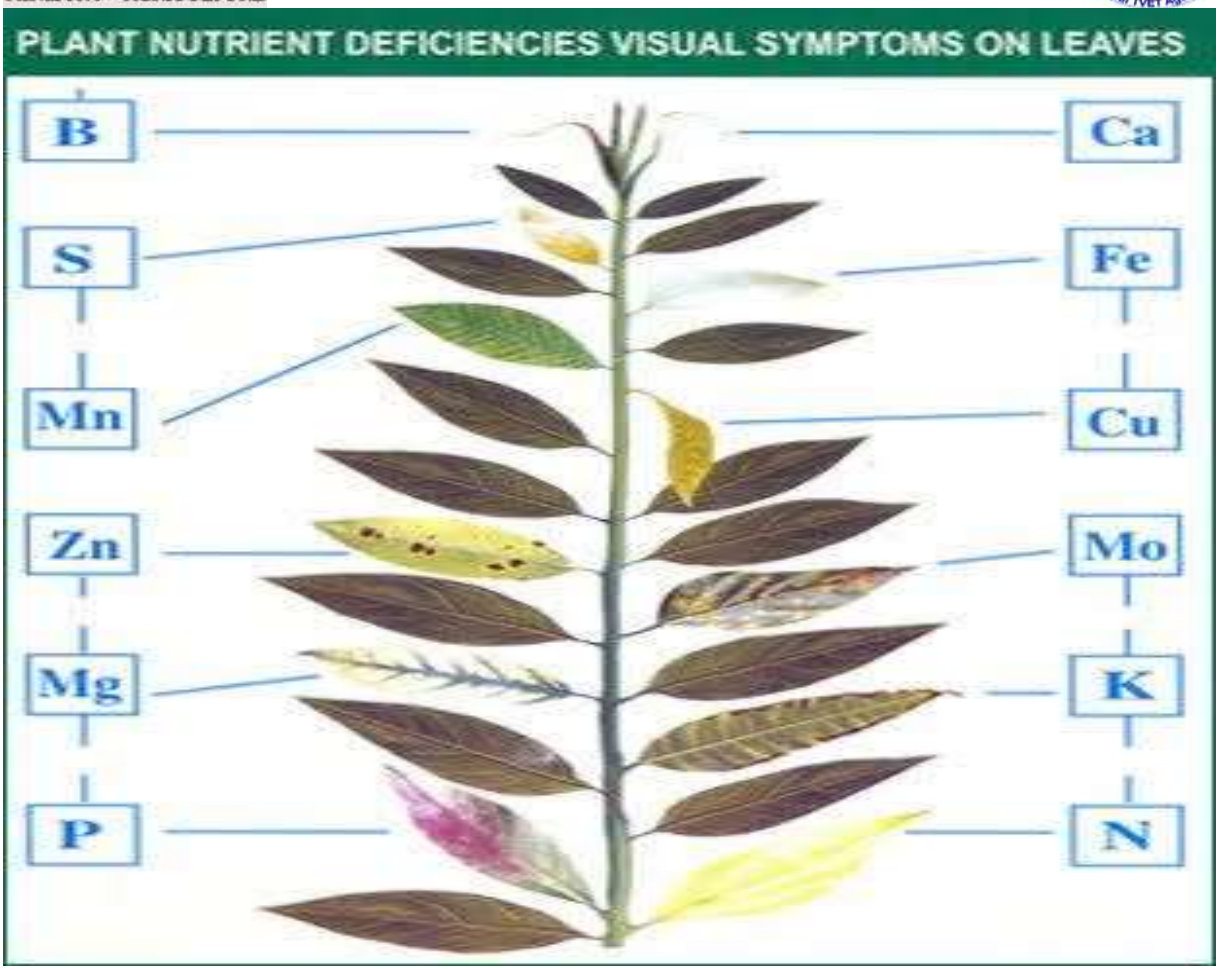

Fig Nutrient deficiency symptoms for nutrients

Fig Wilting of tobacco due to water shortage

Fig 1.4.1 Different types of disorders caused by different factors

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. Define weeds, insects, diseases and disorders (10points).
2. What do mean by infectious and non infectious diseases? (10points).
3. Explain different type of weed classifications (10 points).
4. List at least 10 types of insects (10 points).
5. Explain the direct and indirect harmfulness of weeds on crop plants (10 point).

Note: Satisfactory rating - 50 points and above Unsatisfactory - below 50 points

You can ask your teacher for the copy of the correct answers.

Operation Sheet-1	Identification of the weeds, insects, diseases and disorders for horticultural crops

Objectives:

- To explain how to identify weeds, insects, diseases and disorders.
- To classify each type of weeds, insects, diseases and disorders.
- To identify life cycle of insects and in which stage it may founds.
- To identify parasitic weeds and other introduce weeds.

Materials: - magnifiers (hand lens), microscope, forceps, net, sspecimens, grass shears, buckets, sacks, pots or jars, notebooks and pencils, flip chart; marker pens and tape.

Procedure

1. Identify different horticultural crops and diagnose any insect damage and diseases symptoms.
2. Catch insect pests by using net.
3. Take the sample of diseased plant parts (for disease identification)
4. Observe the main characteristic of the main order insects that damage the crop with magnifiers and microscope.
5. Identify the insect life stage and which stages are more dangerous.
6. Identify each weed species within the farm by name and classify.
7. Observe for disorders like water logging, nutrient deficiency, and climate related factors.

   Note: Mostly disease symptoms are patchy and disorders but not.
8. Record your observations in the following tables and report

A. Weeds

No	Common name of the weeds	Host plants (parasitic or not)	Morphological explanation (Narrow, broad or sedges)	Similarly classify
1				
2				
3				
etc				

B. Diseases

S.No	Common name of the disease	Host plants	Main symptom	Causing agent (pathogens)
1				
2				
3				
etc				

C. Insects

No	Common name of the insect	Host plants	Characteristics of the insect	Growth stage	Damaging stage
1					
2					
3					
etc					

D. Disorders

No	Type of disorder	Crop type	Characteristics of the disorder	Classify	
1					
2					
3					
etc					

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Task 1

Instructions:

You are required to perform any of the following:

- Request your teacher to arrange for you to join a survey team. Make sure you identify different horticultural crops and diagnose any weeds, insect damage diseases and disorder symptoms. Submit your outputs to your teacher for evaluation.
- Perform the following tasks in front of your teacher –
    - Diagnose any insect damage and disease symptoms
    - Diagnose any disorder symptoms
    - Identify weeds and classify
    - Classify the insects in their life cycle
    - Record data you observe on the above table

When you finish request your teacher for evaluation and feedback.

Information Sheet-2	Recording and Reporting Details of the Weeds, Plant Insects, Diseases And Disorders

2.1. Ways of assessing

- **Scouting: -** means observing orchard and plant conditions in order to gain information about the visible signs and symptoms of pests and diseases.
- **Symptoms:** the external and internal reactions or alteration of plant as a result of attack of disease.
- **Sign:** is the pathogen or its part or product seen on diseased plant.
- **Threshold**: A boundary, where something starts or ends.

Purpose of recording and reporting

Survey is a detail collection /listing of pest at a particular time and place. It is important to;

- Assess pest status of particular insect or weeds or others.
- Know the spread of an introduced pest
- Know the spread of mobile endemic pest species
- Identify areas relatively high infestation

Some of the objectives are;

- To know the distribution of plant disease
- To know and control if new noxious weed appear
- To know and estimate the range of disease other than crop
- To plan and make decision about selection of controlling methods

Recording and reporting format:

No	Type of pest	Symptoms	Sign	Status	Remark
1					
2					
3					

2.2. Economic Thresholds and injury levels of pests

Keeping pests (weeds, insects, and diseases) and disorder infestations below significa nt levels through preventative measures is at the core of long term integrated pest management. More immediate control is reactive and is warranted only when the insects begin to affect the producer financially. A common problem for most producers is deciding whether or not to treat a crop for a specific pest.

The question is how many pests are too many pests? The initial response may be to spray as soon as pests are found in the crop. But implementing control measures is costly, sometimes involving large amounts of chemical and fuel. Also, the labor involved in control operations is not insignificant. Many pesticides have broad spectrum activity affecting non-target organisms and therefore, unnecessary applications can have undesirable environmental effects.

So when does an infestation become economically viable to control? Ultimately the decision will have to be made by the producer. **Economic thresholds** attempt to resolve this problem by providing guidance in making the decision as to whether pests control has an economic benefit.

Understanding economic thresholds of pests' infestations is central to sound pest management. Knowing whether or not it is necessary to take action against pest,

especially when pesticides are involved, enables the producer to make financially and ecologically sound decisions.

So where properly used, this knowledge can reduce crop losses, production costs and potential impacts on non-target organisms and the general environment.

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, amount of weeds per unit area etc. 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 with stand a higher pest population with little yield loss, depending on the stage of the plant. Conversely, relatively fewer pests may significantly damage a stressed crop.

The economic thresholds are important for

- 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.

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. What are symptoms and signs (5 points?).
2. Explain way of assessing weeds, insects, diseases and disorders(5 points)
3. Define and explain why economic threshold is needed? (10 points)
4. What are purpose of recording and reporting weeds, insects, diseases and disorders? (10 points).

Note: Satisfactory rating - 40 points and above Unsatisfactory - below 40 points

You can ask your teacher for the copy of the correct answers.

Information Sheet-3	Selecting Treatment Methods

Crop protection is the science of preventing, suppressing or eradicating pests that cause problems to the crops or crop products. A pest 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.

3.1 Groups of pests

Pests can be grouped into the following groups:

- Insect pests e.g. roach, termites, ticks, mosquitoes, aphids, beetles, flies, etc…
- Microbial organisms e.g. bacteria, fungi, nematodes and virus
- Higher plants e.g. weeds and parasitic higher plants
- Diseases (bacterial, viral, fungal…)
- Mollusks e.g. snails, slugs and shipworms; and
- Vertebrates e.g. rodents, birds, higher animals and man.

3.2 Types of pests

According to the damages they cause to crops, pests can be divided into two types

- **Economic pests**: these are pests that cause 5-10 % or even more crop loss in a definite field.
- **Non-economic pests**: these are pests that cause < 5% crop loss in a definite field.

3.3 Principles of pest control

I. Identification of the pest

- Identification of pests is concerned with giving names to individual pest species
- Identification of pests is the first and most important step in pest control.
- Accurate identification of pests can provide correct information about the pest.

Steps in identification of pests:

- Observe the physical features of the pests & the characteristics of the damage they cause.

- Observe their development and biology.
- Refer related books for proper identification

II. Biological studies of pests as basis of control

Studying the pest's living habit, life cycle, occurrence and development cycles etc. are essential in determining whether a significant damage can occur and when pest control measures would be most effective and economical.

III. Rationale for control

- Control only when the pest population has reached economic threshold.
- The economic threshold is the pest population level at which control measures should be initiated to prevent the rising pest population. For example in bean leaf beetles in soybeans, the economic threshold is when defoliation reaches 30% (before blooming) and when there are 5 or more beetles per foot of row.
- Choose the most suitable method
- Cause as little harm as possible to everything except the pest.
- Pesticide is the last choice of pest control methods

IV. When and what to apply

Control a pest only when it is causing more harm than is reasonable to accept, using the most adaptable (suitable) control methods.

V. Integrated approach and pest management

Integrated pest management is the combination of appropriate pest control tactics into a single plan to reduce pests and their damage to an acceptable level.

VI. Supervised and preventive approach

- Supervised approach: monitoring the pests in an area to be protected regularly. i.e.
  a.) to know the kind of pest
  b.) to know if the population of the pest is high enough to warrant control
  c.) to decide the right time to begin control.
- Preventive approach: keeping a pest from becoming a problem through creating an environment not suitable for pest development.

E.g. Cultural practices such as crop rotation, timely tillage, planting of resistant varieties, enforcing quarantine laws etc.

3.4. Methods of pest control

A. Cultural control

This is reducing the number of pests with cultural operations; such as:

- altering the environment (the host plant) to prevent infestation
- disrupting the normal relationship between the host and the pest it includes:

I. **crop rotation:** successive planting of different crops in the same field. Note that each crop must be from a different family.

II. **Delayed or early planting:** planting later or earlier than usual to reduce the population of certain pests. E.g. tomato can be planted later than usual until the weeds have emerged and killed by pre – planting herbicides. Similarly early planting helps to escape some insect pests.

III. **Timely harvesting:** harvesting the crops as soon as they mature or ripen. For example, timely harvesting of mature potatoes avoids the damage caused by wire worms (quality reduction).

IV. **Use of trap crops:** this is planting of trap crops around the main crop to reduce the pest population that would otherwise attack the main crop. Early planting of other crops which are preferred by the pest has also similar effect. For example American bollworm has many hosts such as cereals, cotton and beans, but prefers to feed on beans. Thus planting beans around the maize field to trap American bollworm reduces its population substantially. Sometimes pesticides can also be applied to the trap crops.

V. **Proper disposal of plant residues:** this greatly helps in the control of some pests since they harbor the pests. The residues must be destroyed and the stables should be uprooted in order to reduce the pest transfer to the next season.

VI**. Use of resistant varieties:** some species or varieties of a species may have the ability to resist or to reduce the effects of some pests.

Mechanisms of resistance can be:

- **Tolerance:** the plant tolerates the damage caused by the pest by having vigorous growth or by compensating the damage (e.g. sorghum produces fillers to reduce the damage by stalk borers)
- **Antibiosis**: the ability to induce detrimental effect on the pest and thereby reduce damage by the pest. This can be:
  - plants produce toxic sap which resist insect attack
  - Having thick cuticles affecting ovipositor and feeding.
  - Having hairy leaves.
- **None preference:** some plants are less preferred by the pests for ovipositor or feeding due to the plant's odor, taste and color etc.

B. Mechanical control: physically excluding pests from areas where they are not wanted. E.g. hand pulling, mowing and burning weeds in fields or traps, screens, barriers, fences.

C. Biological control: control of pests by natural enemies such as parasites, predators and pathogens and typically involving an active human role.

Groups of natural enemies

a. **Predators**: organisms that live by preying on animals (prey) e.g. lady bird beetle and lace wings feed on aphids, birds feed on insects.
b. **Parasites**: these are species whose immature stage develops on or within a single insect host, ultimately killing the host. E.g. many species of wasps & some flies are parasitoids.
c. **Pathogens:** disease causing organisms including bacteria, fungi and viruses. E.g. *Bacillus thuringensis* cause milky disease in many insets such as Lepidoptera and coleopteran and others.

Types of biological control

a. **Conservation**: preserving and /or enhancing natural enemies that are already present in nature in the environment.
b. **Introduction**: involves importing and releasing exotic (non-indigenous) natural enemies against foreign or native pests.

c. **Augmentation**: involves mass-rearing natural enemies in the laboratory and releasing them in to the environment.

Fig 3.3.1 Biological controlling method by wasp.

D. Chemical control: this is controlling pests by using chemical pesticides. It destroys pests, controls their activities and prevents them from causing damage. It is the fastest way to control pests.

The disadvantages of chemical control include residual effects in the plant, hazard to the environment and damage to non target organisms. As a precaution in the use of chemicals, the chemicals must be specific to the target group and the dosage must be appropriate.

E. Regulatory control: this is the use of legislative laws to prevent or control pests. It is preventing immigration of foreign pests and prevention of dispersal of established pests.

Regulatory control has three aspects.

a. Establishing plant quarantine stations at major ports (air ports, sea ports and boarders) of entry into an area. Quarantines are stations where plant materials are checked by the use of regulatory laws to prevent plant material from moving in an unrestricted fashion into or out of a specific area.
b. Setting up monitoring systems for pests in a given area. This allows dealing with an outbreak before it has a chance to spread.
c. Setting up regulations regarding pesticide use.

Fig 3.3.2: Regulatory control

F. Integrated pest management (IPM): IPM is the combination of appropriate pest control tactics in to a single plan to reduce pests & their damage to an acceptable level. It is based on both ecological and economic considerations. It aims at achieving optimal pest management by using a combination of techniques. The techniques should be integrated so their effects complement each other. It uses control measures only when pest populations are large enough to justify their control. IPM takes social and environmental costs into consideration.

Self-Check 3	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. What are cultural controlling methods (5 points?).
2. Explain some of cultural controlling mechanisms (5 points)
3. Define and explain biological controlling methods? (10 points)
4. List and explain principles of pest control? (10 points).
5. Define following terms(10 points)
    a. Integrated pest management (IPM)
    b. Regulatory control
    c. Chemical control

Note: Satisfactory rating - 50 points and above Unsatisfactory - below 50 points

You can ask your teacher for the copy of the correct answers.

Information Sheet-4	Selecting and Preparing Equipment

4.1 Selecting equipment

1. **Sprayer**: (manual knap sack sprayer, motorized sprayers, etc.) to spray pesticides as well as liquid foliar fertilizer application.

- **Knapsack** sprayers consist of :
  - a tank,
  - a pump, and
  - a spray wand with one or more nozzles.
- Some sprayers have a pressure-regulating valve or a pressure gauge to help the user maintain desired pressure.
- Small size, portability, and ease of use make the backpack sprayer a valuable tool for many users.
- Backpack sprayers are best suited for:
  - small acreage,
  - spot spraying,
  - hard-to-reach areas, and
  - other areas where a larger sprayer is impractical.
- Most knapsack sprayers use hand pumps.
- Hand-operated sprayers should have a comfortably located, reversible handle (to allow for left- or right-hand use.
- The sprayer should also have removable screens to protect the pump and nozzles.
- Sprayer should be cleaned regularly.
- Finally, the sprayer should have a stable base to hold it upright for filling and mixing.

Fig 4.1 Knapsack sprayers

3. **Wick Applicators**
    - It is convenient method to apply contact herbicide
    - Herbicide is applied to the plant by brushing against the plant.
    - The application rate is controlled by adjusting the chemical solution,
    - It reduced chemical usage compared to broadcast spraying is possible.
4. Buckets for carrying infested crops;
5. Sacks; for carrying infested crops part (leaf or whole plants)
6. Transparent collecting pots or jars with lids with a few small holes in them;
7. Magnifying lenses;

Fig 4.2 maginifying lens

8. Notebooks and pencils; flip chart and stand; marker pens; tape.
9. Insect net: for collection insects.

Fig 4.3. Insect net

10. Broadcast spreaders

- They are widely used to apply fertilizer, lime, or amendments on lawns, gardens, or fields.
- These machines may be small handheld or cart-mounted units for home or garden use,
- They may be three-point hitch, trailer-mounted, or truck-mounted units for field use.
- Spreaders for home or garden use can be simple drop spreaders with a series of holes along the underside of the hopper to meter and spread the material
- Larger field spreaders can be single spinner, twin spinner, or air boom designs.
- A large spinner spreader typically consists of a hopper, a drag chain or belt, a discharge gate, a chute, and one or two spinners.

11. Grass shears: for cutting grass in lawns & soft & succulent twigs.
12. Sickle: for clearing the land and harvesting.
13. Machete: similar purpose to bill hook & also for clearing purpose.
14. Wheelbarrow: to transport materials like farm yard manure, compost, seed, etc. from one area to another area in the farm.
15. forceps

Fig 4.4 Wheelbarrow

16. **Basket :**container of products during harvesting
17. **Boxes** (wooden, plastic): for packing and safe transporting of products.
18. **Ladder:** used for climbing of tall trees during harvesting
19. **Hose:** a plastic tube used for conveyance of water from water source to the required area i.e. farm area or temporary reservoir
20. **Axe:** clearing the lands and sharpening of the wooden tools for handle and other purpose

4.2. Preparing Equipment

- After selecting materials checking functionality and numbers are very essential to complete activities at allocated time.
- if materials are damaged, it should be maintained or repaired
- Smooth delivery of material is important.
- Check the discharge material to check the air chamber and tubes for blockages and leaks.
- Refer to your operator's manual for correct settings and adjustments on all machines so as to operate properly.

Self-Check 4	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. Discuss the components of knapsack sprayers (3 points)
2. Wick applicators are convenient to apply contact herbicides. Why? (5 points)
3. Differentiate between bbroadcast spreaders versus wick applicators(4 points)
4. List and explain equipments required for pest treatments (4 points)

Note: Satisfactory rating - 16 points and above Unsatisfactory - below 16 points

You can ask your teacher for the copy of the correct answers.

Information Sheet-5	Identifying OHS Hazard

I. Noise

- Noise limits for different working environments are provided.
- The use of hearing protection must be actively enforced

II. **Vibration**

- Exposure to hand-arm vibration from equipment hand and power tools or whole-body vibrations from surfaces.
- The limits for vibration and action values, i.e. the level of exposure at which remediation should be initiated,
- Exposure levels should be checked on the basis of daily exposure time and data provided by equipment manufacturers

III. **Illumination, Light Radiation And Reflections**

- Work area light intensity must be adequate for :
  - The location and type of activity and
  - Must be supplemented with dedicated work station illumination as needed.
  - All light sources should be energy efficient with minimum heat emission.
  - The employer shall take measures to eliminate reflections and flickering of lights.

IV. **Temperature**

- The employer shall maintain indoor temperatures that are reasonable and appropriate for the type of work.
- Risks of heat or cold related stress must be adequately addressed and
- Feasible control measures implemented for work in adverse environments.

V. **Biological Agents**

- The employer shall avoid the use of any harmful biological agent
- under its normal conditions of use is not dangerous or less dangerous to the workers,
- Precautions must be taken to keep the risk of exposure as low as possible.

VI. **Accidents And Diseases**

- The employer shall establish procedures and systems for reporting and recording:
    i) occupational accidents and diseases; and
    ii) Dangerous occurrences and incidents.
- The systems and the employer shall further enable and encourage workers to report all:
    i) occupational injuries and near misses;
    ii) suspected cases of occupational disease; and dangerous occurrences a nd incidents

At work place always obey OHS provisions; listen to superiors or senior workers about safe instructions. However, the following principles relevant to personal devices or clothing must be obeyed.

- Wear uniform while working.
- Wear a straw hat while working under sun.
- Wear a mask in dusty conditions, for example, while spraying.
- Wear boots while working on muddy fields;
- Wear rainproof while working in rain.
- Wear hand protective while spraying.
- When you are applying chemicals read instructions.

Self-Check 5	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. What are types of hazards occur in pests treatment area?(5pts)
2. How you can control hazards occur in pests treatment area?(5pts)

Note: Satisfactory rating - 10 points and above Unsatisfactory - below 10 points

You can ask your teacher for the copy of the correct answers.

Operation Sheet-5	Identification of OHS Hazard

Objective

- To identify OHS Hazard
- How to control this OHS Hazard

Procedures

1. Identify OHS Hazard that will occur in treatment area.
2. Classify OHS Hazard
3. Discuss and set controlling mechanisms of each OHS Hazard
4. Finally report to your supervisors about type and controlling methods of OHS Hazard.

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Task 1

Instructions:

You are required to perform any of the following:

- Request your teacher to arrange for you to join a team. Make sure you that Identify OHS Hazard. Submit your outputs to your teacher for evaluation.
- Perform the following tasks in front of your teacher –
  - Identify type of OHS Hazard
  - Record data and report.

When you finish request your teacher for evaluation and feedback.

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HORTICULTURAL CROPS PRODUCTION

Level-II

Learning Guide-67

Unit of Competence: Treat Weeds, Plant Insects, Diseases and Disorders

Module Title: Treating Weeds, Plant Insects, Diseases and Disorders

LG Code: AGR HCP2 M16 LO2-LG-67

TTLM Code: AGR HCP2 TTLM 0120v1

LO2. Apply treatments weeds, insects, diseases and disorders

Instruction Sheet	Learning Guide 67

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

- Selecting suitable personal protective equipment
- Preparing and applying treatments

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

- Select suitable personal protective equipment
- Prepare and apply treatments

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, and 2”.
4. Accomplish the “Self-check 1, and 2.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 and 2.
6. Do the “LAP test” for each operation sheet.

Instruction Sheet1	Selecting suitable personal protective equipment

1. 1. Selecting and checking personal protective equipment (PPE)

Availability and the normal functioning of personal protective equipment are very crucial to run the working conditions. this is because, workers doing their own work with cut PPE are facing injury like physical, chemical, biological and radiation hazards. This is the case that up to 20% of agricultural laborer even the developed countries exposed on agricultural operation hazards due to misuse of operations. As a result of these, depending on the working criteria, personal protective equipment's are prepared for safe operation in the field as well as in the laboratories. These are Goggles, gloves, face mask, respiratory device, helmet, sun hat, and sunlight lotion, apron (overall), safety shoe, which should be clearly prepared and ready to use.

Personal protective equipment may include

a) **Head protective** equipment

Hard hat, helmet, sun hat, and sunlight lotion

b) **Respiratory protective equipment**

Respiratory device/face mask

c) **Footwear**

Boots or shoes

d) **Working clothes**

Overall/aprons

e) Gloves

f) Sunscreen lotion

g) Goggles

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. What is the importance of using proper personal protective equipment?(5pts)
2. Describe different types of PPE?(5Pts)

Note: Satisfactory rating - 10 points and above Unsatisfactory - below 10 points

You can ask your teacher for the copy of the correct answers.

Operation Sheet-1	Identification of Personal protective equipments

Objective

- To identify personal protective equipments
- To check functionality and sufficiency of personal protective equipments

Procedures

1. Identify all the personal protective equipments physically one by one
2. Describe the use or purpose of personal protective equipments.
3. Check whether personal protective equipments are functional/non- functional.
4. Count the number of faulty and functional personal protective equipments.
6. Finally report to your supervisors about personal protective equipments.

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Task 1

Instructions:

You are required to perform any of the following:

- Request your teacher to arrange for you to join a team. Make sure you Identify type of personal protective equipments. Submit your outputs to your teacher for evaluation.
- Perform the following tasks in front of your teacher –
  - Identify type of personal protective equipments.
  - Record data and report.

When you finish request your teacher for evaluation and feedback.

Instruction Sheet 2	Preparing and applying treatments

2.1 Approaches to weed treatments

A. Prevention

It comprises all measures taken to hinder the introduction and spread of weeds includes clean cultivation, use of clean seeds, keeping irrigation channels free from weeds, for weeds' seeds will get to the field by irrigation.

B. Eradication

It means eliminating weeds totally from a specific area it may be very costly and difficult conditions justified for eradication.

- Newly introduced weed with limited distribution
- Existing weeds with limited distribution
- If the weeds are very noxious

1. Cultural Control

Several kinds of practices can be used in cultivated plants to make it more difficult for weed to survive by disrupting the normal relationship between the weed and the crop.

a) Tillage

Advantages

- Remove weeds from the soil;
- Effective control practice in row crop, nurseries and forest planting
- Stimulating the weeds to germinate by breaking their dormancy;
- Carbohydrate depletion by removing the above ground parts of the weeds repeatedly to deplete the stored food in underground part.
- Destruction of underground part directly, e.g. Rhizomes, tubers, bulbs and roots.
- Exposure of underground parts to sunshine to kill weeds.

b) Time of planting

Planting crops are delayed until weeds have emerged and could be removed by cultivation or by herbicides.

c) Mulching

- serving as a physical barrier and by keeping light from reaching weed seeds;
- Mulching prevents weed growth between rows, around trees and others

d). Mowing (removing the top port of the weeds)

- Reduce competition between weeds and crops;
- Prevent flowering and seeding of annual, biennial and perennial weeds
- Mowing is often used in orchards to control weeds and prevent soil erosion

2. Biological control

Involves the use of insects and diseases causing organisms (agents) against weeds

E.g. Seed fly (*Ophimoyia lantana*) to control *Lantana camera*,

Puccinia caualiculata to control cyperus esculentus

3. **Chemical methods to weed control** (use of herbicides)

A. Classification of herbicides

Herbicides are classification into the following based on time method of application, mode of action, chemical nature and selectivity.

1. Based on time of application

A. Pre-planting herbicides

- Applied before the cultivation of crop plants.
- Because of their greater toxicity on the emerging seedling they are applied before sowing or planting.

  E.g. glyphosate or paraquat is applied

B. Pre-emergence herbicides

- Applied before the emergence of crop or weed

- The aim is to kill germinating weed seeds.
- Crops are below the applied site of the herbicides;
- For shallow germinating weeds

  E.g. Butachlot, laoproturon, Atrazin.

C. Port- emergence

- Applied after the emergence of crops or weeds;
- post emergence herbicides are selective on crops and weeds; need two or more application kill remaining weeds

  E.g. 2.4 – D to wheat against broad leave weeds

2. Based on method of application

a. Soil herbicide

- Applied on the soil.
- Pre planting or pre emergences are generally applied to the soil.

b. Foliage herbicide

- Applied on the foliage of crops.
- post emergence herbicides are sprayed on the plant parts
- Foliage is the main source of entrance and the herbicide molecules are absorbed by the foliage.

3. Based on mode of action

A. Contact herbicides

- Contact herbicides kills only the plant that the chemical touches
- usually are used to control annuals and biennials weeds characterized by the quick dieback

B. Tran located herbicides

- Absorbed by the roots or leaves and carried throughout the plant.
- Effective against perennial weeds, because they reach all plant parts including deep roots and woody stem.

4. Based on selectivity

a.) **Selective herbicides**: kill weeds without causing significant damage to desirable plants nearby.

b.) **Non-selective herbicides:** toxic to all plants including non-target plants.

Factors affecting foliar applied herbicides

a. **Leaf shape:** herbicides tend to bounce or run off narrow, upright leaves. Broad, flat leaves tend to hold the herbicide longer.
b. **Waxy cuticle**: sprays applied to leaves may be prevented from entering by a thick waxy cuticle. They waxy surface also may cause a spray solution to form droplets and run off the leaves.
c. **Leaf hairs**: a dense layer of leaf hairs holds the herbicide droplets away from the leaf surface and less herbicide are absorbed by the plant. A thin layer of leaf hairs causes the chemical to stay on the leaf surface and more chemical to be absorbed.

Parasitic weeds

Parasitic weeds depend on other plants to survive. Damages of the parasitic weeds to crops:

- Wilting of crops
- Reducing plant size (stunted growth)
- Reducing crop yield.
- Reducing the quality of the grain

Conditions favorable for parasitic weeds developing (use opposite for controlling)

- Mono-cropping of the same host.
- Low inputs in the fields; e.g. herbicides are not used to control parasitic weeds
- Not used improved crop seeds E.g. resistant seeds
- No fallow period in a field.

2.2 Approaches to insect treatments

A) Cultural treatment methods

The most common cultural controlling methods includes:-

1. **Field sanitation:** destroying weeds and crop residue**.**
2. **Crop Rotation**: - Rotating fields to different crops each year can be overemphasized as one of the most important and easily implemented disease control strategies.
3. **Sowing healthy seed**
4. **Transplanting Healthy Seedlings**: - A basic rule for controlling plant insect is to begin each growing season with healthy seed and transplants. A crop established with infected or infested plant material may contaminate an entire field and remove it from production for many years.
5. **Other Cultural Practices** :- include planting after soils have warmed, selecting well-drained areas, using raised beds, reducing plant densities, scheduling overhead irrigation when foliage will dry soon afterwards, controlling weeds,

B) Physical treatment methods for insect pests:

a) Collecting insects by hand and killing
b) **Insect traps**: moths can be trapped using light traps and pheromone traps. This is generally used for monitoring army worm
c) **Using sticky color board traps**: insects are generally attracted by different types of colors. hence this can be used as a trap by painting a sticky material (petroleum jell/Vaseline) on the colored boards and placing them in the field.
d) **Using repellants**: insects can be repelled or kicked off the field by spreading some undesirable materials in the soil. for example grounded egg shell, coffee residue etc can be spreaded on the soil around seedling to control cut worms.
e) **Washing/ brushing**: small insects such as aphids and scale insects can be removed by washing with water or rubbing with brush. they can also be rubbed off using running water jet
f) **Soil solarization**: this is the practice of covering the field (soil) with a plastic sheet/mulch during dry season for more than three weeks. The plastic absorbs sunlight and increases the temperature of the soil killing the insects in the soil.

Sticky color board trap spreading egg shell for cut worm control

Physical barrier (covering with net) covering fruits Soil Solarizatoin

Fig 2.1 Physical treatment methods

C) Biological control methods

Releasing natural enemies such as parasitic insects, wasps, frogs, birds, chicken and some kinds of bugs feed on African bollworm, army worms, cut worms

Example releasing lady beetle to feed on aphids

Fig 2.2. Rove beetles attacking house fly

D) Chemical control methods

Insecticides: chemicals used to kill insects' pests are called insecticides:

They include: Ethiozinon, Ethiolathion (Malathion), Fenitrothion, Chlorpyrifos ,Trichlorfon.

Fig 2.3 Chemical controlling method

2.3 Approaches to diseases treatments

Diseases are caused by living and non living factors, when a disease is caused by living factors such as fungi, bacteria, virus and nematodes and parasitic weeds etc, it is called infectious or transmissible disease. When a disease is caused by non living or environmental

factors such as nutrient deficiency, chemical toxicity, high soil moisture, high temperature, frost, etc.., the disease is called none infectious or non transmissible disease.

Microorganisms that cause diseases are called pathogens. They infect different parts of the plant. Some infect above ground parts of the plant such as leaves, stems, flowers or fruits, while some infect below ground parts such as roots, tubers etc. When a plant is infected with a pathogen, it shows physical or chemical changes. Any visible abnormal change on an infected plant is called symptom. Symptoms could be color change or malformation of tissues. Every disease has its own symptoms and hence symptoms are used to identify which pathogen has infected the plant.

For a disease to occur at least three conditions have to be fulfilled at the same time. This is commonly called the disease triangle

a. A virulent pathogen should be present
b. A plant should be susceptible
c. The environment should be suitable

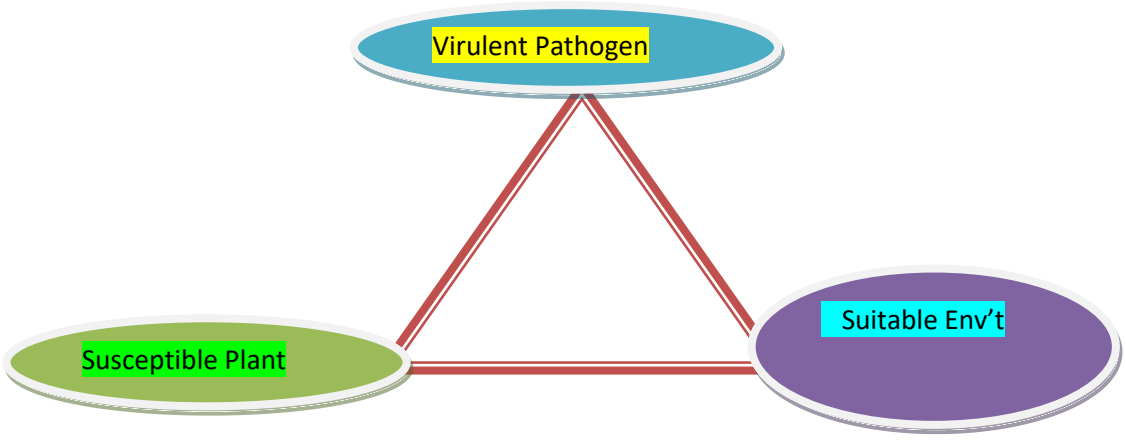

Fig 2.4 Diseases triangle

If one of these 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.

The choice of management method will depend on the nature of the pathogen, the plant and the growing environments. The objective of the methods could be:

i. **Preventive** i.e. protecting the entrance of a pathogen into a plant tissue.

ii. **Inoculums reduction** i.e. reducing the amount or number of a pathogen infesting a plant.

iii. **Host protection**

iv. **Pathogen eradication** i.e. destroying the pathogen or its inoculums.

v. **Adjustment of environments** i.e. makes the environment less suitable for a disease to occur.

vi. **Increasing plant resistance** i.e. breeding resistance/ tolerance.

In general, disease management methods can be grouped as follows:

1. **Regulatory**: quarantine methods
2. **Cultural:** crop rotation, early or late planting, inters cropping, weeding, destruction of alternate hosts, mixed cropping, use of trap crops, proper spacing, using disease free seeds, etc.
3. **Biological**: use of parasites and predators to kill pathogens.
4. **Physical or mechanical**: treating seeds, plant parts, or soils with heat or sun light.

Physical control methods for disease

- Soil solarization
- Sterilizing farm tools: burning farm tools with fire or alcohol.
- Rouging: Removing the infected part of the plant.

5. **Chemical**: use of pesticides for the control of diseases (fungicides). **Fungicides:** chemicals used to kill diseases are called fungicides

Fungicides can be classified as protectants, eradicants and systemic fungicides.

- **Protectant fungicides** they are chemicals applied before the occurrence of the disease. Example Mancozeb, Zineb, maneb.
- **Systemic Fungicides**- Systemic fungicides are the compounds, which are transported over a considerable distance in plant system after-penetration. They are applied after the occurrence of the disease. Examples:, Metalaxyl, Tridemephon, Ridomil.

6. Resistant varieties: use of varieties with good disease resistance.
7. **Integrated method**: using a combination of the above two or more methods to control diseases effectively and efficiently.

2.3.1 Diseases for horticultural crops

Late blight (*Phytophthora infestans*)

- Host: potato and tomato
- Pathogen: fungi
- Infected plant parts: foliage. fruits, tubers on the field and in the store
- Symptoms: irregular or circular water soaked lesions. In cloudy or humid weather, the lesions increase quickly and form dark brown, blighted areas with indefinite borders. Under favorable conditions, all above ground parts of the plant are blighted and rot away rapidly; sometimes bad smell is released.
- Source of inoculums: infected tubers and plant parts left on the field; infected soil.
- Dispersal: wind borne and rain splash.
- **Management options:** field sanitation, fungicidal sprays and resistant varieties.

Bacterial wilt (*Psuedomonas solanacearuml Ralstonia solanacearum*)

- Host: potato, tomato, banana, tobacco, and groundnuts
- Pathogen: bacteria
- Infected plant parts: stems, leaves, tubers' eyes, leaves and seeds
- Symptoms: wilting, stunting, and yellowing of the leaves followed by collapse of the entire plant. During long rain, sudden drooping of leaves and rotting of stem from any point occur. If the infected stems or tubers are cut across and squeezed, grayish white bacterial ooze comes out of the vascular ring. Eye buds of infected tubers will be blackened during sever infection.
- Source of inoculums: infected crop debris, infected soil and seed.
- Dispersal: wind borne and rain splash.
- **Management options**: field sanitation, crop rotation, and resistant varieties.

Bacterial canker (*Corynebacterium michiganense/ Clavibacter michiganense*)

- Host: tomato
- Pathogen: bacteria
- Infected plant parts: leaves, stems, fruits and seeds

- Symptoms: leaf veins turn brown, wilt and finally die out. Brown streaks develop on the stems which may crack to reveal brown discoloration of internal tissues. When infected stem is cut creamy white, yellow or grown line is seen under the phloem vessel. Infected fruits become brown and develop lesions. Green fruits develop water soaked spots which are soon surrounded with a white halo.
- Source of inoculums: infected crop debris, infected seeds
- Dispersal: rain splash.
- **Management options**: field sanitation, crop rotation, disease free seeds and transplants and resistant varieties.

Downy mildew (*Peronospora destructor*)

- Host: onions, garlic, leek and shallot
- Pathogen: fungi
- Infected plant parts: leaf and stem
- Symptoms: at first, yellowish spots on the upper half of the leaves appear. When the humidity gets higher, the fungus grows and appears as bluish-gray, hairy mildew. Spots lesions enlarge and merge together. Lesions may consist of alternating chlorotic and green layers of tissue on the leaves and stem. Finally the affected leaves wilt and die.
- Source of inoculums: infected bulbs, soil and seed.
- Dispersal: rain splash.
- **Management options**: clean cultivation, crop rotation, seed dressing, and fungicides.

Onion rust (*Puccinia allil Puccinia porri*)

- Host: onions, garlic, leek and shallot
- Pathogen: fungi
- Infected plant parts: leaf and stem
- Symptoms: longitudinal pustules on the leaves which up on rupturing expose yellowish-brown spores. Black pustules are produced at later stage.
- Source of inoculums volunteer onion crops.
- Dispersal : wind born
- **Management options**: resistant varieties, crop rotation, soil drainage, rouging infected plants and fungicides.

Purples blotch (*Alternaria porri*)

- Host: onions, garlic, tomato, leek and shallot
- Pathogen: fungi
- Infected plant parts: leaf and stem
- Symptoms: first small white lesions with purple center appear on the leaves. Later the lesions enlarge rapidly, girdling leaf and stem which fall down. Bulb rotting will follow in the store.
- Source of inoculums crop debris, infected seeds and soil
- Dispersal : rain splash, wind born
- **Management options**: field sanitation, seed dressing, resistant varieties, increase spacing, and fungicides.

Fig 2.5: Tomato blotch

Late blight of potatoes

- Pathogen: fungi (*Phytophthora infestans*)
- Host: potato, tomato, pepper, carrot etc.
- Affected plant parts: foliages, stems, fruits, tubers

- Damage: causes total destruction of the crops within a short period of time (a week) if weather
- Conditions are favorable and no control measures are taken.
- Symptoms: circular or irregular water soaked spots appear at the tips or edges of the lower.
- Leaves. They later enlarge rapidly and form brown blighted areas with indefinite boarders in moist conditions.
- Source of inoculums: infected tubers used for planting, wild solanaceuos plants, volunteer potato plants.
- Control: planting disease free tubers destroy all volunteer potatoes and other hosts, use of resistant varieties, fungicides.

Fig 2.6: Symptoms of leaf blight on carrot and potato plants at the end of vegetation

Tobacco mosaic virus (TMV)

- Pathogen: virus
- Host: tobacco, tomato, pepper and other dicotyledonous plants.
- Damage: affects the leaves, flowers, and fruits and causes stunting of the plants
- Symptoms: on tobacco; mottled dark- green and light-green areas on leaves developing after inoculation. On tomato; mottling of the older leaves.

- Over wintering: the virus over winters on infected tobacco stalks and leaves in the soil, on the surface of contaminated tobacco seeds.
- Control: use of resistant varieties, sanitation, control of vectors

Fig 2.7 Pepper leaves affected by tobacco mosaic virus

Bacterial spot of tomato and pepper

- Pathogen: bacteria (*Xanthomonas compestris* pv. Vesicatoria)
- Affected plant parts: leaves, stems, seedlings, and fruits.
- Symptoms: small irregular purplish gray spots with black center and a narrow yellow halo appear on the leaves.
- Over wintering: on seeds contaminated during extraction, infected plant debris in soil, on weeds and other hosts.
- **Control**: use of disease free seeds and seedlings, use of resistant varieties, crop rotation, spray copper maneb pre mixed pesticides.

2.4 Approaches to disorder treatments

Plant disorder is the confusion of plant due to problem (toxic) soil, air and toxic water. Some problems render the soil unfit for cultivation. Even if the total element contents in such soil are high, these may not be fertile because of poor soil health. The term soil refers among other things, to the often-encountered soil problems like soil alkalinity/sod city, salinity and

acidity. Salt-affected soil (saline, saline-alkali and alkali) develop in arid and semi arid regions, while acidic soils is found in high rainfall areas where a considerable loss of alkaline earth metal cat ions takes place by way of leaching.

Saline, saline-alkali and alkali soils

P^H refers to hydrogen ion concentration in the soil solution, which is considered neutral when the pH is at 7. Soils with ph below 7 are termed acid and those above it, alkaline. Many plants have definite range of ph within which they are grown successfully. If it is out of range, it may cause disorder or toxic to plants.

Reclamation of Saline, saline-alkali and alkali soils

- Since soil salinity refers to the presence of excess soluble salts, the reclamation of such soil is based on the removal these salts, by leaching with good quality irrigation water having low salinity level.
- Soils with high Ph (greater than 8.5) (alkaline soil) may be reclaimed by treating them with a suitable amendment like gypsum, pyrites, sulphur etc…
- Soil having PH less than 6.0,(acidic soil) nutrient availability is affected adversely by liming, is usually practiced for keeping the soil PH in the optimum range for making nutrient available in appropriate quantities

Water Quality for Irrigation

The quality of irrigation water is a crucial factor for long-term soil productivity. Poor quality water if used for a long time can make the less productive, or even barren depending on the amount and type of constituents present in it and the texture of the soil in question. Low or marginally saline waters sometimes appear to stimulate crop growth because of the higher amount of nutrients ions presents. However, excess of the soluble salts in water leads to their accumulation in the surface layer particularly in fine textured or poorly drained soils. Many areas in the country are facing a serious problem of not only scarcity of water, but also of its extremely poor quality. It is therefore advisable to get the water tested for quality while installing tube instead of repenting later.

2.5. Applying treatments to weeds, insects, diseases and disorders

To apply the above treatment methods for pests select infested area of field from farm and apply the following pest treatment methods.

a) apply field sanitation by doing the following activities

- destroy alternate hosts (weeds)
- destroy infected crop residue

b) collect all insects found in the field on weeds by hand/hand picking and try identify each of them. Collect larva and pupa of moths, beetles, flies

c) rogue diseased plants plant parts (crop or weeds) and destroy them or burry them

d) remove sucking insects (aphids and scale insects) by brushing and washing

e) clean and disinfect farm tools with fire to kill disease pathogens

f) place insect traps /light traps in the field

g) prepare and place sticky color board traps in the field

h) apply plastic mulch

i) select and transplant healthy vegetables seedlings

j) prepare apply home-made sprays /extracts (extracts of neem, ginger, hot pepper, garlic) on insects

k) spread coffee residue, egg shell around plants

l) collect some predators and release them on insects

m) collect ants and release them on caterpillars

n) release chicken to feed on caterpillars

o) apply insecticide on the insects

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. How you can treat disorders like salinity, nutrients deficiency and water logging? (10 pts).
2. Describe major horticultural diseases with causing agent and controlling (10Pts).
3. Explain treatment methods for insects' pests (10 Pts).
4. Explain treatment methods for weeds (10 Pts).
5. How you can apply treatment methods for weeds, diseases, insects and disorders (10 Pts).

Note: Satisfactory rating - 50 points and above Unsatisfactory - below 50 points

You can ask your teacher for the copy of the correct answers.

Operation Sheet-1	Applying controlling mechanisms for weeds, insects, diseases and disorders

Objectives:

- To identify controlling methods for weeds, insects, diseases and disorders
- To explain how to apply controlling measures for weeds, insects, diseases and disorders

Materials: - buckets, sacks, canvas, grass mulching materials, knapsack sprayers, chemicals (pesticides), lime, limestone, hoe, notebooks and pencils, flip chart; marker pens and tape.

Procedure

1) Confirm identified weeds, insects, diseases and disorders.
2) Choose best controlling mechanisms based on intensity and amount of weeds, insects, diseases and disorders
3) Apply controlling measures
4) Record each every activities after completion of task

Data recording and reporting format

No	Type of pest	Controlling method used	For which crop	Controlled by	Remark
1					
2					
3					

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Task 1

Instructions:

You are required to perform any of the following:

- Request your teacher to arrange for you to join a survey team. Make sure you apply controlling measures for horticultural crops based on identification of weeds, insect damage diseases and disorder symptoms. Submit your outputs to your teacher for evaluation.
- Perform the following tasks in front of your teacher –
  - Apply controlling measures required for weeds, insect damage diseases and disorder
  - Record data and report.

When you finish this operation request your teacher for evaluation and feedback.

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HORTICULTURAL CROPS PRODUCTION

Level-II

Learning Guide-68

Unit of Competence: Treat Weeds, Plant Insects, Diseases and Disorders

Module Title: Treating Weeds, Plant Insects, Diseases and Disorders

LG Code: AGR HCP2 M16 LO1-LG-68

TTLM Code: AGR HCP2 TTLM 0120v1

LO3. Carry out post treatment operations

Instruction Sheet	Learning Guide 68

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

- Shutting down and cleaning equipment
- Disposing treatment waste

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

- Shut down and clean equipment
- Dispose treatment waste

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, and 2”.
4. Accomplish the “Self-check 1, and 2”.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1 and 2.
6. Do the “LAP test” for each operation sheet.

Information Sheet 1	Shutting down and cleaning equipment

1.1 Cleaning equipment

Cleaning is the removal of dirt and organic substances, such as fat and protein particles from surfaces of walls, floors, tools and equipment. Through the cleaning procedures, high numbers of microorganisms (90% and more) present on the mentioned objects will be removed. However, many microorganisms stick very firmly to surfaces, in particular in tiny almost invisible layers of organic materials, so called *biofilms*, and will not entirely be removed even by profound cleaning but persist and continue multiplying.

Inactivation of those microorganisms requires antimicrobial treatments, carried out through *hot water* or *steam* or through the application of *disinfectants*. **Disinfectants** are chemical substances, which kill microorganisms but should not affect human health through hazardous residues and not cause corrosion of equipment. The application of disinfectants is called disinfection.

The term **Sanitation** refers to the inactivation of microorganisms through disinfectants, but also includes combating pests such as insects and rodents through chemical substances (insecticides and rodenticides). In general, the term “sanitation” usually refers to disinfection and pest control.

Periodic cleaning and sanitation is an integral part of good Hygienic Practice. Cleaning and sanitation can even be considered as one of the most important activities**,** as these measures provide the necessary environment for proper handling and processing.

How to carry out cleaning and sanitation

a) Preconditions for efficient cleaning and sanitation

- Premises and equipment must be “Cleaning -friendly” , which means
    - easy and practicable access to all contaminated areas,
    - Smooth surfaces and adequate materials for building structures and equipment to be cleaned.

- Proven methods for cleaning and sanitation must be available.
- Personnel must be regularly instructed and trained in cleaning and sanitation methods.

Methods of Cleaning

1. **Physical Cleaning** with pressurized water may stir up dirt or produce contaminated water droplets (aerosol), which could contaminate anything present in such rooms.
2. **Chemical Cleaning** /disinfection may produce toxic residues when in contact with remaining meat or meat products. The same applies to insecticides and rodenticides for pest control.

Cleaning and disinfection procedures are complex processes depending on the surfaces to be treated and the kind of contamination to be removed. Selection of suitable chemicals for Cleaning or for disinfection may require special knowledge. All these factors can make correct Cleaning and disinfection a difficult task for the personnel involved. However, staff must be made aware that efficient Cleaning and disinfection is of utmost importance for product quality and safety.

b) Cleaning procedures

The first step in equipment cleaning is to physically remove scrap, i.e. coarse solid particles, with a dry brush or broom and shovel. This is usually referred to as "**dry Cleaning**". Using large amounts of water to remove this material would be extremely wasteful and eventually cause drains to clog and waste water treatment facilities to become overloaded. More profound clean-up procedures require water in sufficient quantities. **Manual Cleaning** using brushes or scrapers is widely applied in small-scale operations although labor and time-intensive.

High pressure water is efficient for surface cleaning after dry cleaning of scrap. It serves for the removal of remaining small solid parts, blood and dirt from the entire floors and walls of processing sections as well as for the removal of meat and fat particles and layers of protein from tools and equipment. As hot water has a much better Cleaning effect than cold water, hot water should be available for this purpose.

Cleaning with equipment producing a pressurized steam/water-mix is even more efficient as impact temperatures of approximately 100°C can be achieved. The disadvantage of this method is the intense fog and aerosol formation, which may not only cause unwanted microbial spreading by water droplets (aerosol) but also affect installations and equipment through high humidity and excessive condensation. For these reasons a steam/water-mix is not suitable for meat processing facilities and cold or hot pressurized water cleaning is preferred.

Application can be by hand using brushes or scrapers for dismantled equipment or in general for smaller surfaces to be cleaned. Mechanical Cleaning with high pressure equipment together with cleaning solutions is used for larger containers and equipments.

Types of cleaning agents

1. Alkaline Cleaning agents:

Generally suitable for removing organic dirt, protein residues and fat.

2. Acid Cleaning agents:

Used particularly for removal of encrusted residues of dirt or protein or of inorganic deposits (“scaling”) such as water stone, milk stone, lime etc.

3. Neutral Cleaning agents:

Have much less effect than alkaline or acid cleaning agents, but have mild impact on skin and materials and are useful for manual cleaning of smooth surfaces without encrusted dirt.

In practice alkaline and acid cleaning substances should be used alternatively. The alkaline agent should be the substance used for routine cleaning, but every few days an acid substance should be employed instead in order to remove encrusted residues, scaling etc.

Cleaning substances together with the suspended dirt particles must be rinsed off using potable water. A relatively new cleaning method in the larger-scale plants is foam cleaning. Water foam containing detergents and other cleaning agents is sprayed on wetted walls,

floors and surfaces of equipment. The foam does not immediately run off but clings to the surfaces. This allows a longer term contact on the surfaces to be cleaned. After a sufficient impact period (min. 15 minutes) the foam is washed down with water (water hose or low-pressure water spray). As no high pressure water spraying is needed for washing off the foam, the spreading of water droplets (aerosol) in the room to be cleaned is minimized.

Disinfection techniques

Cleaning reduces a substantial amount of microorganisms, but it does not have the potential to completely eliminate all surface contamination. Persistent microorganisms will continue to grow in number by using remaining protein as nutrients and pose a further risk to the foods to be processed.

The elimination of microorganisms is achieved through disinfection either by using hot water (or better steam) or chemical disinfectants. Chemical disinfectants are preferred for most applications in the meat industries as they are easy to use and do not involve the risk of accidents or other negative side effects such as damage to equipment by generating high humidity or water condensation, which may occur when using steam.

Best disinfection results are achieved when chemical disinfection is preceded by intensive dry/wet cleaning. Disinfection without pre cleaning is not fully efficient as many microorganisms remain embedded in encrusted dirt, protein and fat, which cannot be properly dissolved by disinfection chemicals. Therefore microorganisms remain protected against the disinfection chemicals. Moreover, remaining protein may inactivate chemical disinfectants.

Adequate rinsing with water after cleaning and prior to disinfection is also indispensable, as chemical disinfectants may be neutralized by remaining cleaning substances. All this has to be taken into account, otherwise the disinfection procedures may be inefficient and a waste of money.

A compromise on this issue is proposed by the chemical industry by offering so called combined disinfection/ cleaning agents. They are made on the basis of *quaternary*

ammonium compounds, which have surfactant and disinfectant properties. The combined method should be considered only in cases of very little dirt contamination.

It is very important that disinfection chemicals are strictly used according to the specifications given by the suppliers. Lower concentrations and shorter impact periods than prescribed will considerably reduce the efficacy of disinfection or make it totally inefficient. Surfaces should be dried after cleaning and rinsing before starting disinfection. This is important, as the concentration of the disinfection solution would be lowered with remaining water on the surfaces and possibly ineffective when becoming too highly diluted.

The application of chemical disinfectants is done with stationary or mobile spraying devices. In medium or small scale meat plants, mobile spraying devices are sufficient. The disinfectant is applied by means of spraying lances and manual or electrical pumps. One important rule is that the disinfectant solution must be applied from top to bottom, i.e., first upper parts of walls, and then lower parts of walls and the floor last. The same applies to equipment.

Self-Check 1	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. Define cleaning? (5 pts).
2. Explain methods of cleaning (5 Pts).
3. Types of cleaning (5 Pts).
4. Procedures for cleaning (5 Pts).

Note: Satisfactory rating - 20 points and above Unsatisfactory - below 20 points

You can ask your teacher for the copy of the correct answers.

Operation Sheet-2	Clean materials at the end of treatment

Objectives:-the learner will able to

- Identify type of cleaning
- Know how we can clean materials
- Prepare and adjust cleaning and sanitation agents

Materials required: Water, brush, cleaning materials (soap and detergent), disinfectants (Lysol, dettol)

Procedures

- Identify all materials after treatments of the infested area.
- Classify materials according to purpose of use and damaged part.
- Clean by water, cleaning detergent or by dry cleaning
- Maintain or repair if there is damaged part
- Sort and store in a suitable place.
- Record and report

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Task 1

Instructions:

You are required to perform any of the following:

- Request your teacher to arrange for you to join a team. Make sure you that you have clean materials at the end of treatment. Submit your outputs to your teacher for evaluation.
- Perform the following tasks in front of your teacher –
  - Clean materials at the end of treatment
  - Record data and report.

When you finish request your teacher for evaluation and feedback

Information Sheet 2	Disposing treatment waste

2.1 Implementing waste disposal operations

After completion of all field establishment activities **all containers, leftover fluids, waste and debris including weeds, insects and disease crops should be disposed safely and appropriately**. Waste materials which may **be toxic** to human beings or **pollutants** environmental conditions should be properly disposed to minimize hazards.

Disposing of treatment wastes

- Empty pesticide and herbicide containers cannot be :
  - refilled,
  - reconditioned,
  - recycled, or
  - sent back to the manufacturer.
- They must be crushed, broken, or punctured so that they cannot be used again.

❖ Hazardous substances have one or more special characteristics which include:

- The potential to cause violent chemical reaction.
- The potential to be dangerously corrosive.
- The potential to ignite.
- The potential to be harm

Pesticides

❖ Pesticides are chemicals that are intended to kill unwanted insects, animals, plants or microorganisms.

❖ These products may also be toxic to humans or pets.

❖ Many pesticides are not biodegradable; they accumulate in the environment and

❖ Could eventually contaminate groundwater and food supplies.

Disposal

- To safely store pesticides,
  - keep them in their original container,
  - wrap them in newspaper and
  - place them inside a double layer of plastic garbage bags.

- Always keep them out of the reach of children and away from heat and pets.

- Empty pesticide containers should be triple rinsed before being thrown away.
- The rinse water should be saved and used as a pesticide.
- The empty container should then be wrapped in newspaper and discarded with household trash.

❖ The primary goal of any solid waste management system is to safeguard the health of the citizens and protect the environment.

❖ This is achieved by:

- ✓ ensuring proper collection,
- ✓ transportation,
- ✓ treatment and, finally, safe disposal of waste.

❖ However, the last step is missing in most solid waste management systems Implemented.

2.2. Completing all work place records

These records must contain the following details relating to each and every ground distribution (pesticides application and other instructions) carried out:

- the name of the licensed operator (licensed commercial operator or licensed pest management technician holding a relevant pest management qualification) carrying out or supervising the ground distribution
- the name and address of the person for whom the ground distribution is being carried out, including postal and physical address of the property
- the diluents used (i.e. water or oil), details of any wetter, spreader, emulsifier or other material added to the spray mixture (i.e. the full registered name on the label of the product used).
- details identifying the exact location of the land treated, including distance and directions from the nearest town site - an example of this would be the real property description number found on the rates notice for the property together with a farm map detailing paddock names or numbers

- the date or dates and start and finish times of the ground distribution carried out
- details of weather conditions such as the wind direction and velocity (strength) at the commencement time and place of the ground distribution
- details of any change in wind velocity or direction occurring once the ground distribution commences and up until it concludes including recording the time when the change occurred
- the quantity, concentration (rate per hectare) and total volume of pesticides mixture applied
- the total area covered
- a description of the type of crop treated or a situation in which the chemical was used (e.g. road sides, fallow etc)
- the purpose for which the pesticides was applied, for example, control of wild oats
- an additional optional record not required to be kept under section but which is useful to make and keep is details of the temperature and humidity that existed at the time and place of the distribution.

You may keep your records in a format that suits you (e.g. hand written, computer generated, using record books or as part of a quality assurance program). The only requirement is that they contain all the required information, are clear, accurate and must be readily available to an authorized officer upon request.

All required work place records should be completed accurately and promptly in accordance with enterprise requirements. Recording and documenting your work activities in an area serves you for several purposes simultaneously.

- ❖ It helps you in evaluating and learning from past field establishment efforts.
- ❖ It helps you to organize your own work for the future and allows you more closely monitor your activities.

Self-Check 2	Written Test

Name: _____ Date: _____

Directions: Answer all the questions listed below.

1. What are waste materials regarding to pest treatments? (4 pts).
2. How and when you can manage waste materials (4 Pts).
3. Why recording is required according to treatments of weeds, diseases, insects and disorders (4 Pts).
4. What should be recorded after pest treatments (4 pts).

Note: Satisfactory rating - 16 points and above Unsatisfactory - below 16 points

You can ask your teacher for the copy of the correct answers.

Operation Sheet-2	Identify type of waste and disposing treatment waste

Objectives:-the learner will able to

- Identify type of treatment waste
- Know how we can dispose treatment waste

Materials required: shovel, spade, measuring tape and rake

Procedures

- Identify all wastes that left after treatments of the infested area.
- Dig a hole that needed to dispose identified waste (left over pesticides).
- You should dispose on prepared place (hole).
- If weeds and infested plant by insects, diseases should be burnt.
- Easily decomposable weeds can be for compost preparations.

LAP Test	Practical demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Task 1

Instructions:

You are required to perform any of the following:

- Request your teacher to arrange for you to join a team. Make sure you Identify type of waste and disposing treatment waste. Submit your outputs to your teacher for evaluation.
- Perform the following tasks in front of your teacher –
  - Identify type of waste and disposing treatment waste
  - Record data and report.

When you finish request your teacher for evaluation and feedback.

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1. Environmental Protection Agency, (2012). Pesticides and food: why children may be especially sensitive to pesticides. http://www.epa.gov/pesticides/food/pest.htm

2. Schafer, K.S., Marquez, E.C., (2012). A generation in jeopardy: how pesticides are undermining our children's health and intelligence. Pesticide Action Network North America. 44pp.

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Profile of trainers participate on special Horticultural Crop Production TTLM development for level I at Adama 2019