# CHAPTER 7: CROP PROTECTION/PROTECT CROP

## 7.1 Introduction

This unit specifies the competencies required to carry out crop protection. It involves; Carrying out disease and pest surveillance, identifying method of pest and disease control, procuring transporting and storing farm pesticides, controlling crop pest/diseases. Disposing expired empty containers and preparing crop protection report. The significance of crop protection is to help farmers reduce crop pest damage and increase crop production. It also help to improve the quality and yield of agricultural produce.

The critical aspects of competency of crop protection to be covered include; Carrying out disease and pest surveillance, Identify method of pest and disease control, Managing farm pesticides and Controlling crop pests and diseases. The basic resources to be used include; diseases and pest identification charts, pictograms, mapping tools, chemicals, PPEs, insects traps, spray pumps, first aid kit, manuals and texbooks.

The unit of competency covers six learning outcomes. Each of the learning outcome presents, learning activities that covers performance criteria statements, thus creating trainee's an opportunity to demonstrate knowledge and skills in the occupational standards and content in curriculum. Information sheet provides; definition of key terms, content and illustration to guide in training. The competency may be assessed through written tests, demostrations, practical assignments, interview/oral questioning and case studies. Self assessment is provided at the end of each learning outcome. Holistic assessment with other units relevant to the industry sector workplace and job role is recommended.

## 7.2 Performance Standard

Carry out disease and pest surveillance, identify methods of pest and disease control as per the farm plan and crop scouting manual, manage farm pesticides and control crop/pest diseases as per the OSH standards, dispose expired chemical and empty containers as per the safe use of pesticide manual and also prepare crop protection report as per the SOPs.

## 7.3 Learning Outcomes

### 7.3.1 List of learning outcomes

a) Carry out disease and pest surveillance
b) Identify method of pest and disease control
c) Procure, transport and store farm pesticides
d) Control crop/pest diseases.
e) Dispose expired chemical and empty containers
f) Prepare crop protection report

### 7.3.2 Learning Outcome No 1: Carry out disease and pest surveillance

#### 7.3.2.1 Learning Activities

| Learning Outcome No 1: Carry out disease and pest surveillance | |
|---|---|
| **Learning Activities** | **Special Instructions** |
| 1.1 Scout pest as per scouting manual.<br>1.2 Identify disease control area according to farm plan. | Ask students to develop a counting frequency for the school farm<br>Guide learners in identifying a disease control area. |

#### 7.3.2.2 Information Sheet No7/LO1: Carry out disease and pest surveillance

**Introduction**

This learning outcome covers the types of crop pests and diseases, their surveillance and mapping as well as the documentation process. Crop pests and diseases have evolved over time proving to be a threat to food security. Climate change in this case has been a major driving force to pest relocation and their mutation is raising a major concern



**Definition of key terms**

**Surveillance**: Is the process of monitoring behavior and activities for the purpose of managing or directing

**Mapping**: It involves timely collection of information regarding plant and soil properties and their requirements. It also involves of application and prescription of site-specific treatment.

**Documentation**: The act of keeping records on official data or information for future reference

**Content/procedures/methods/illustrations**

**1.1 Pest scouting is done as per crop scouting manual**

Pest scouting refers to regular visits to the field to quantify pests' levels and any potential damage. It involves working out for physical evidence of pests and targets insects, weeds, pests, and symptoms of diseases. Crop scouting manual is a guide that helps in identifying and diagnosing pest problems. It is essential since scouting is the backbone of all pest management programs. Before appropriate pest control decisions can be made, a detailed assessment of pest population must be obtained.

Efficient pest scouting requires thorough knowledge of pest and crop biology, pest identification and habits, correct sampling methods and economic threshold. The aim of scouting is to give a complete and unbiased assessment of pest population. The information given has to be accurate since the field scout is the link between the consultants and the growers. The scouting report forms must be comprehensively filled with enough information so that control decisions can be made directly from the report form.

**Scouting frequency**

The frequency with which visits must be made depends on the type of crop grown and pest present or expected. Field visits must be scheduled such that increases in pest populations are detected as soon as possible. For example, field corn should be monitored at weekly intervals until pollination is completed, at which time scouting frequency can be can be relaxed to at least once every ten days. All this time there is little danger of pest levels exceeding the economic threshold. The field scout should however be flexible schedules to allow revisiting field problems.

**Scouting patterns**

An M shaped walking pattern is best used on square or rectangular shaped fields. In irregular shaped fields the field scout must keep in mind that they must cover a representative area of the field. Do not sample the edge of a field unless it is specifically recommended.

**Equipment for pest scouting**

- Scout report forms and cupboard pencils
- Magnifying glass or hand lens for accurate pest identification
- Bags, plastic vials and labels for collecting plant and insect specimen
- Measuring tape
- Reference materials incase problems are encountered in the field
- Spade for digging entire plant for pest identification cooler with ice to keep unknown weed, insect and disease samples fresh until accurate identification can be obtained

**Advantages of field scouting**

- Helps in making immediate decisions based on the pest and diseases threshold
- Helps in tracking trends of pest within a season
- It is vital in making decisions based on the comparison of results between seasons
- Prepares the farmer for these threats in the future
- Scouting is environmentally and economically viable
- It allows the farmer to predict future threats and problems saving him/her time and money
- Scouting gives the farmer an overview of where exactly to use the pesticides.

**Scouting information**

Having background information on your crop does not serve as a requirement for scouting but it serves as a great tool for recognizing damage and linking the damage to possible causes

Information can be frequently obtained from personal experience or it can also be obtained from;

- Weather data
- Farm management records
- Other farm managers
- Sail maps

**1.2 Disease control area/plot is identified according to farm plan**

A farm plan is a document assessing the site-specific aspects of a property and outlining best management practices identified as necessary to avoid potential negative environmental impacts

It contains an assessment of the site and gives clear action/steps developed to meet the farmer's goals while protecting water quality and natural resources

Some of the resources considered are;

- Acreage
- Soil types
- Proximity to stream or water bodies
- Types of livestock or crops
- Farmers goals
- Available resources

A disease control area is defined as the area established to prevent the spread of a disease from an infected area to areas free of the disease

A farm plan also is a process for deciding in the present what to do in the future about the best combination of crops and livestock to be raised through rational use of resources.

Disease control area dictate which specific area must be established as a result of the status of infection and the subsequent surveillance actions that must be performed

A disease control zone defines:

- The physical location and boundaries of the control area, surveillance zone and free area
- The permissible activities in each area that will facilitate accomplishing of immediate goals of any surveillance activities being conducted
- The length of time that each area should be maintained

In the surveillance plan the disease control areas defined are the: control areas, free area and surveillance zone. The control area is further divided into an infected zone and a buffer zone. The area zone for highly contagious disease (HCD) can be used for other diseases as starting point. For non HCDs, the area sizes vary to each situation and depend upon input from collaborating parties.

Table 15:Surveillance plan

| Area classification | Premises classification |
|---|---|
| Infected zone | Infected premises<br>Contact premises<br>Suspect premises<br>At risk premises<br>Monitored premises |
| Buffer zone | Contact premises<br>Suspect premises<br>Monitored premises<br>At risk premises |
| Surveillance zone | Suspect premises<br>Free premises |
| Free area | Free premises |
| Containment vaccination zone | Suspect premises<br>Vaccinated premises |
| Protection vaccination zone | Suspect premises<br>Vaccinated premises |

## Conclusion

This learning outcome covered types of crop pest and diseases, surveillance, mapping and documentation process of crop pest and diseases.



### Further Reading

1. www.ophis.usda.gas

### 7.3.2.3 Self-Assessment

**Written assessment**

1. The following are equipment for pest scouting except?
    a) Scout report form
    b) Magnifying glass
    c) Measuring tape
    d) Thermometer
2. A disease control zone defines all of the following except?
    a) The physical location and boundary of the control area
    b) The yield
    c) The permissible activity in each area
    d) The length of time that each area should be maintained

3. Documentation is the process of keeping records on an official data for future need.
    a) True
    b) False
4. The following are premises classification except?
    a) Suspect
    b) Monitored
    c) Scouting
    d) Contact
5. Which of the following is a resource used in disease control area?
    a) Scouting
    b) Surveillance
    c) Suspect
    d) None of the above

**Short answer questions**

1. What is surveillance?
2. What do you understand by the term pest scouting?

**Oral Assessment**

1. Name resources to be considered in a farm plan

**Practical Assessment**

Visit a farm and identify the different pests



**7.3.2.4 Tools, Equipment, Supplies and Materials**

- Mapping tools
- Scouting manual
- Pictograms
- Diseases and pest identification chart

**7.3.2.5 References**

Jemberu.W.T.Mounts.M.C.M &Hogenveen H.(2015) Farmers intentions to implement foot and mouth disease control measures in Ethiopia.

Khan.M & Danquas.C.A(2015) Farmers knowledge about common pest about pests and pesticide safety in convenctional cotton production in Pakistan. Crop protection. 77.

Khan.M. & Damalas. C.A.(2015) Factors preventing the adoption of alternatives to chemical paest control. Among Pakistan cotton farmers international journal of pest management 61(1).9-16

### 7.3.3 Learning Outcome No 2: Identify method of pest and disease

#### 7.3.3.1 Learning Activities

| Learning Outcome No 2: Identify method of pest and disease control | |
|---|---|
| **Learning Activities** | **Special Instructions** |
| 2.1 Identify pest and diseases to be controlled as per crop scouting manual.<br>2.2 Map affected areas/plots in accordance with type of pest/disease<br>2.3 Determine pest/disease control method based on type of pest/disease required.<br>2.4 Identify, verify and calibrate material supplies tools and equipment as per method. | Written assessment<br>Oral tests<br>Group Discussion |

#### 4.3.3.2 Information Sheet No7/LO2: Identify method of pest and disease

**Introduction**

The learning outcome covers pest and disease control method are areas affected and material supplies tools, equipment and type of pest diseases.



**Definition of key terms**

**Chemical pest/disease control:** Refers to the regulation or management of a species defined as pest usually because it is perceived to be detrimental to person's health the ecology and economy.

**Cultural pest/disease control:** It is the practice of modifying the growing environment to reduce the prevalence of unwanted pests.

I**ntegrated Pest Management (IPM):** It is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques.

**Content/procedures/methods/illustrations**

**2.1 Pest and diseases to be controlled are identified as per crop scouting manual**

**Pests affecting plants**

- Locusts
- Armyworm
- Fruit Flies
- Aphids
- Spider mites

- Squash Bugs
- Whiteflies
- Tomato hornworms
- Wire worms
- Cucumber Beetles
- Powdery mildew
- Thripid
- Codling Moth
- Gall mites

**Plant diseases**

- Bacterial crackers
- Black knot
- Blossom end rot
- Club root
- Cedar apple rust
- Apple Scab
- Anthracnose
- Brown rots



**2.2 Affected areas/plots are mapped in accordance with type of pest/disease**

Insect pests and fungal diseases can damage shoots, leaves and crowns, which can reduce tree growth and condition. If severe, the damage causes trees to die. Insects and fungi can also reduce woods quality resulting in lower yield and reduced timber prices.

**Common pest and diseases**

**a) Stem borers**

These are caterpillars (moth or beetle) that tunnel through and feed on wood, causing damage to branches, stems and trunks.

**b) Leaf-chewing Insects**

These are beetles and mites. They feed on tree foliage and can cause extensive damage especially to young plants. Symptoms are jagged or rippled leaf edges, reduced leaf area, in distortion and dieback in young leaves and defoliation.

**c) Leaf miners and gallers**

Leaf- miners feed inside the leaf between the top and bottom surfaces. Symptoms include dried, silvery or brown leaf tissues. This can cause leaves to shed early and a severe infection can cause defoliation.

**d) Sap- sucking insects**

These insect affects a plant by removing a large quantity of water and nutrients, causing wilted or shriveled growing tips. Symptoms include leaf discoloration, leaf withering or in severe infestations leaf loss. e.g. Insects like-lerps and psyllids.

**2.3 Pest/disease control method is determined based on type of pest/disease identified**.

**1. Chemical control**

Chemical pesticides are often used to control pests and diseases or weeds. Chemical control is based on substances that are toxic to the pest involved. When chemical pesticides are applied to protect plants from pest, diseases or overgrowth by weeds, we speak of plant protection products.

**Advantages of chemical pesticides**

- The use of chemical pesticides is widespread due to their relatively low costs.
- Chemical pesticides are very effective and easy to be applied on crops.
- Chemical pesticides are available in different areas.
- Chemical pesticides are stable.
- Chemical pesticides are generally fast acting which limits the damage done to crops.

**Disadvantages of pesticides**

- Chemical pesticides they are not only toxic to the organisms for which they are intended, but also to other organisms.
- Chemical pesticides are resistant. They are often effective for only a short period on a particular organism. Organism can become immune to a substance, so they no longer have an effect. They mutate and become resistant.
- Another disadvantage is accumulation. If sprayed, plant are eaten by an organism and that organism is then eaten by another, the chemical can be passed up to the food chain.
- Remains and residuals of pesticides are left behind on crops.

**2. Cultural Pest/Disease control method**

This method is aimed at reducing the sources of inoculum of plants to infection.

**Advantages of cultural pest control**

- Uses of indigenous varieties- Traditional varieties are hardier and relatively more resistant to pests. They can withstand harsh environmental condition better than modern hybrids.
- Pest control through the use of Mesh screen (Nylon sets). Younger plants are usually preferred by insect and they suffer significantly from such attacks when compared to older plants.
- Rogueing or pruning. Removal of diseased plants or plant parts prevents the spread of microorganisms to uninfected areas

- Intercropping with aromatic herbs.
- Encouraging insect predators.
- Crop rotation.
- Multiple cropping.

**Disadvantages of cultural pest control**

- Some are not environmentally benign e.g. conventional tillage.
- May alter crop value or gross income (harvesting, spacing).
- Some are labor energy intensive (pruning, tillage).
- Many conflicts (time, pest).
- Widespread adoption – may be spread.

**3. IPM- Integrated Pest Management**

It is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques.

**How IPM works**

- IPM focuses on long-term prevention of pest or their damage by managing the ecosystem.
- In IPM, monitoring and correct pest identification help you decide whether management is needed.
- IPM programs combine management approaches for greater effectiveness.

**Major components of IPM programs**



- Pest identification.
- Monitoring and assessing pest number and damage.
- Guidelines for when management action is needed.
- Preventing pest problems.
- Using a combination of biological, cultural, physical or mechanical and chemical management tools.
- After action is taken, assessing the effect of pest management.

**ITK- Indigenous Technical Knowledge:** It is a unique traditional local knowledge existing within and developed in a particular geographic area.

**Advantages of IPM**

- IPM increases crop yield and farmers income.
- IPM reduces the risk of farmers and the public.
- It helps farmers to become self-reliant.
- It helps to reduce the national expenditure for pesticide.
- IPM conserves ecosystem and ensures reliability and stability of farm output.

**Disadvantages of IPM**

- More involved planning
- It is a family decision- making
- More demanding lawn and garden care
- Time consuming

**2.4 Material supplies, tools and equipment are identified, verified and calibrated as per method**.

**Material and tools used to control pests**

- Pesticidal dusts
- Dilute sprays
- Concentrated spray
- Aerosols
- Aerial Equipment
- Apron
- Airborne end
- Spray-plane piloting
- Helicopter equipment

**Elements of good equipment**

- Should spray out the pesticides from the plane at a uniform rate.
- Should provide for adjustable rates of discharge so that crops get the right number of gallons of spray per acre.
- Should spread liquid in as wide a swath as possible beneath the plane.
- Should avoid putting down too heavy a deposit in the center or at the edges of the spray swath.



**Conclusion**

This learning outcome covered pest and diseases, the affected plots and areas by pest and diseases, pest and diseases control methods and material supplies tools and equipment used to control pest and diseases.

**Further Reading**

1. POTTs, S.F. Particles size of insecticides and its relation to application distribution and deposit journal. Econ.Ent.39(6).716-720,1946.

**7.3.3.3 Self-Assessment**

**Written assessment**

1. Which of the following is a type of pest?
    a) Locusts
    b) Armyworm
    c) Aphids
    d) All of the above

2. Which of the following is not a pest control method?
    a) ITK
    b) Physical control method
    c) Chemical control method
    d) None of the above
3. Which one of the following is a plant disease?
    a) All of below
    b) Apple scab
    c) Club root
    d) Black Knots
4. Identify from the following tools and materials used to control pests.
    a) Dilute Spray
    b) Aerosol
    c) Pesticides dusts
    d) Water bottles
5. Which one of the following is an equipment for pest control?
    a) Aerial equipment
    b) Spray-plane
    c) Helicopter
    d) All of the above.
6. Identify and explain 6methods of pest control.
7. Highlight different plant pests and diseases
8. What do you understand by the term ITK, chemical control method and pests?
9. Identify ways of knowing the pest affected areas?

**Oral Assessment**

1. What does ITK stand for?
2. What are the plant pests and diseases that affect trees?
3. What does IPM stands for?

**Practical Assessment**

**Plant disease control through ITK**

Prepare a solution from 2kg fresh leaves of papaya in 3-4l of water and keep in overnight. After filtration, this is diluted with 50-60l of water and 250ml soap solution is added to it, it is effective to control brown spot diseases in rice.

### 7.3.3.4 Tools, Equipment, Supplies and Materials

- Mapping tools
- Flip charts
- Felt pen
- White board

### 7.3.3.5 References

Khan, A. S. (1981). Variables affecting spray deposit efficiency of a row crop airblast sprayer (Doctoral dissertation, The Ohio State University).

POTTs.S.F. Particles size of insecticides and Hs relation to application distribution and deposit journal. Econ.Ent.39(6).716-720,1946.

Tirrell, George E.Depositing of spray chemicals,hydraulic method vsair method.14(3)6. OAKLAND.Calif 1954.

Khan, A. S., Carpenter, T. G., & Reichard, D. L. (1981). Variables affecting spray deposit efficiency of a row crop airblast sprayer. Paper-American Society of Agricultural Engineers (Microfiche collection) (USA).

### 7.3.4 Learning Outcome No 3: Manage farm pesticides

#### 7.3.4.1 Learning Activities

| Learning Outcome No 3: Manage farm pesticides | |
|---|---|
| **Learning Activities** | **Special Instructions** |
| 0.0. Procure farm pesticides based on type of pest/disease identified, mapped out areas and farm procurement procedures<br>0.1. Transport pesticide in accordance with types of pesticides best practices<br>0.2. Store farm pesticides in accordance with OSH standards, manufacturer's manual and work place policy.<br>0.3. Record farm pests as per SOPs. | Discussion groups of how to store properly |

#### 4.3.4.2 Information Sheet No7/LO3: Manage farm pesticides

**Introduction**

The learning outcome to be covered include; Safe use of pesticides involving handling of pesticides, packaging of pesticides, transportation of pesticides, storage of pesticides and also Occupation safety standards and First Aid skills



**Definition of key terms**

**Pesticide:** This chemical substance used to kill repel or control certain form of plant and animal life consider to be pests

**Safety standards:** They are advisory or compulsory kid down policies to ensuring product activities and processes

**Packaging:** This is the undoing and protection of product for distribution, storage, sale and use

**Content/procedures/methods/illustrations**

**3.1 Farm pesticides are procured based on type of pest/disease identified, mapped out areas and farm procurement procedures**

Provisional guidelines are set for the procurement of hazardous pesticides.

Pesticide formulations fall into; Class 1a or1b of the WHO recommended classification of pesticides by hazard. The guidelines to classification can be grouped under general requirement according to FAO, UN.

**General requirements in procuring pesticides**

- An undertaking that all pertinent obligation arising under the international code of conduct on distribution and that of pesticide will be most and establish dealing with product liability accepted
- Evidence that goods offered will be delivered safely and in a timely manner, adequate technical support will be provided
- A warranty that each product supplied will be of the same quality as that of offered in response to invitations to submit them
- An undertaking accepting the condition of payment for the same quality of products required
- Where technical support from supplies either is required or considered desirable to facilitate effective, safe handling and use of products and where relevant their disposal and technological support
- In need of registration/ approval scheme for pesticide information based on research conducted locally or under similar climate
- A summary of the data relevant to safety and efficiency of the product
- Information on acute oral and ld50 value of formulated product
- In other countries, registration certificate i.e. Kenya drug board
- Where equations with respect to other equivalent product

**Process of Procurement**

- Documentation to inviting tender for necessary supplies of the required pesticide that is the consideration and any information supplied to potential suppliers
- Bids to be carried out with conductions relevant on pesticide, bidder, quality of product, conditions for the packing, conditions for labelling
- Processing the tender documents according to the organizational requirements, and procedural requirements
- Arrangement for supply of pesticide by the winning suppler
- Sampling and analysis of the products received
- Going through control measures and requirement

**Packing of pesticide**

This involves the container size or sizes and the packing specifications conditions for packing

- Bidder must require to demonstrate that package will be in accordance with national requirements, altitude of the international code of conduct on the distribution and pesticide
- Bidder to demonstrate that packing for direct use is in suitable sizes and designs
- The packages should be in a type commonly in use for pesticides
- Inducing closers to be sufficient to produce leakage taking in to account handling during shipment and local transport conditions
- Taking into account possibility of prolonged storage under adverse weather conditions. Storage life is to maximized
- The need that they will satisfy laid down requirements by the relevant international concerned with transport illustration of packing

**3.2 Pesticide is transported in accordance with types of pesticides best practices**

This is done in accordance with best types of pesticide practices and the pesticide being transported to be sealed and secure.

**Precautions taken when transporting pesticides**

There are several precautions that should be adhered to when transporting pesticide involving:

- Pesticides should be transported in to back of a truck or pick up and the containers securely tied down. When loading pesticides in cases of leakage and all the containers you should never put pesticide containers in the passage side of the vehicle.
- Wear chemical resistant gloves. This is when loading pesticide in cases of leakage. All the containers should be inspected thoroughly before loading and do not accept containers missing labels. If there are signs of leakage do not accept the container and always be gentle with containers.
- While unloading pesticides do it carefully and never leave them unattended and check vehicle after unloading to make sure there was no leakage or containers damage during transport.
- If transporting hazardous pesticide, always comply with hazardous materials regulation.

**Advantages of the good handling of pesticide on transport**

- Reduces product loss that is the good handling ensures there is no spillage of loss of any pesticide products while on transport.
- Increase the profit margin. With good handling on transportation no losses will incurred or any damages.
- Prevents other product damages and losses and even prevents any occupational hazards that might arise.

## 3.3 Farm pesticides are stored in accordance with OSH standards, manufacturer's manual and work place policy.

Farm pesticide are stored in accordance with OSH standards manufacture's manual and place of work as discussed, storage as per OSH standards.

This rare the occupational safety and guidelines for the storage of pesticide according to the OSHs directorate of occupational health service. Whereby the OSH pesticide laws are well written out and drafted out as per constitution guidelines. The OSH division undertakes occupational health surveillance throughout the country

**Requirements for storage of farm pesticide**

- Limit quality and type of pesticide stored
- Storage of pesticide should not be in areas prone to flooding or in basements and should be accessible in the event of emergency
- Storage cabinets should be kept locked and the door to the storage area should be properly identified with a sign
- Mixing pesticides should be avoided in areas where a spill a leak or over flow could allow pesticides to get into water systems
- Absorbent materials to activate charcoal should be available to quickly contain and clean up any spills
- Washing of pesticide should be done separately
- Materials and safety data sheets for each pesticide should be posted on good accessible and visible location
- An emergency response plan should be developed to detail on action to take and personnel to contact in an event of an accident or spillage at the store
- Stores should have a smoke detection system that is, automatic
- PPEC (Person Protection Equipment) that is, respirator chemical resistant gloves, gumboots, coverall eye wares goggle and first aid kit.

### 3.4 Farm pests are recorded as per SOPs.

The pesticides in the store should have a proper system of stocking and the reward of stock of pesticides received held and issued

**What involves farm pesticides recording?**

- No more pesticide should be ordered than the number required that is not excess
- The pesticides received should be well labelled the trade name and manufacturer labeled. The store manager should note that down in the store records
- All movements of the chemical in to out of the store be recorded

**Advantages of recording farm pesticides**

- Reduction of problems of having excess unused pesticides. This is in cases whereby the storekeeper for instance had not been trained in or failed to use the existing systems.
- During a way of odd out of date expired pesticides. The pesticide has limited shelf-life so if the dates of manufacture and the expiry was entered in to the storekeeper's record then he/she can be able to dispose off any pesticide that have been out of date.
- Increases financial productivity. This is by reducing losses due to the stock that must have been ordered and there are plenty.
- Reduces Hazards. This is both environment hazards when exposed to the environment and also occupational hazards that might have arose due to usage of instant out of date pesticide
- Relevant in times of emerge genies. This is the times whereby in an event of such disasters the volume as pesticide used in farm can be assess and the necessary steps taken to evade any side problems

**Types of records systems in farms**

The recording systems adopted by farms depend on the side and function of the store. Usually records should be kept separate from the pesticide store

**i. Small stores**

In these there are practices that should allow:

- Date of purchase or Val should be written on each container before being stored
- All the containers received should be checked and ensured that they are proper labelled and that the labels remain attached to the container
- Also, the labels should be readable and clean and the labels in poor conditions should be replaced

- Small scale farmers should also keep invoice, delivery notes and receipts obtained in connection with pesticide purchases away from store
- The farmers should have the material with safety data sheets from the suppliers and manufacturers

**Large stores**

These are stores above the size of small-scale farmers and require a formal record system and the practices involved here are;

- The records to be kept separate from pesticide stock so that they are not destroyed in the event of a major disaster lifers
- Records may be kept as sheets in a ledger or card index form. Public records adjacent to the stock itself may also be required.
- Records should be accurate and sufficiently detailed to enable replacement. When the storekeeper goes another takes over without need refer to the old one.
- Allowing each consignment. A completely separate record because pesticide have a limited shelf-life so the stock batches brought at different times may vary in functional
- A possible sample position store records sheet should have the following:
    - Reference no
    - Identification of pesticide
    - Source of pesticide
    - Packing and issuing units
    - Date received
    - Notes
    - Stock operation and management
    - Disposal

**First aid skills in farm pesticides**

Always follow the instruction on safety use of pesticides but in case of spills or accident.

- Splash a lot of water to arouse the chemical
- In case of poisoning learn uncial, toxicology skill or seek immediate medical response

- If you can endure vomiting you also may use it as a first measure
- For flammable chemicals always store them away from fire and in case they catch fire try to identify if the chemical is reactive with water. If not then you can pour water

## Conclusion

This learning outcome covered procurement, and transportation of pesticides in accordance with types of pesticides best practices. It has also covered storage and records of farm pest as per SOPs.

### 7.3.4.3 Self-assessment

**Written assessment**

1. A pesticide is a chemical compound used to kill certain form of plants or animal called pests
    a) True
    b) False
2. ---------- advisory policies laid to ensure safety of products
    a) Pesticide
    b) Packing
    c) Safety standard
    d) Storage
3. Which one of the following is not involved in pesticide procurement?
    a) Warranty of the product
    b) Documentation of tender
    c) Carrying out bids
    d) Sampling and analyzing of product
4. The following are requirement of storage of farm pesticide except
    a) Limit quality and type of pesticide store
    b) Lock the storage cabinet
    c) Finessed final productivity
    d) Have material data sheet
5. Which of the following is a precaution in transportation of pesticide?
    a) Process tender
    b) Bidder to demonstrate packing
    c) Provide technical support
    d) Transport in the back of track

6. Records in the farm as per stranded operations procedure should be?
    a) Well stocked
    b) Not recorded
    c) Kept in the same tool
    d) Never updated
7. Store record should contain all the following except?
    a) Reference no
    b) Date received
    c) Stamp
    d) Disposal method
8. List 10 requirements of storage of pesticide
9. Give process of procurement
10. State the necessary precautions to be taken when transporting pesticides
11. Highlight other advantages of recording farm pesticides
12. Give advantage of good handling practices



**Oral Assessment**

1. List the precautions taken when transporting pesticide
2. What is the importance of stored pesticide?

**Case Study Assessment**

Visit the farms that carry out pest control activity and check their activities on management of pesticide starting with:

- Procuring the pesticides
- Transportation
- Storage and record of farm pesticides

**7.3.4.4 Tools, Equipment, Supplies and Materials**

- Chemicals
- Storage facilities
- Record book
- First Aid kit

### 7.3.4.5 References

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### 7.3.5 Learning Outcome No 4: Control crop/pest equipment

#### 7.3.5.1 Learning Activities

| Learning Outcome No 4: Control crop/pest disease | |
|---|---|
| **Learning Activities** | **Special Instructions** |
| 4.1 Adhere to PPEs requirements as per OSH standards<br>4.2 Identify materials, tools and equipment to be used as per the chosen methods<br>4.3 Use material tools and equipment as per the instruction's manual.<br>4.4 Control pest /diseases as per pest/disease identified in a mapped area. | Preparation of required materials and tools to be used. |

#### 7.3.5.2 Information Sheet No7/LO4: Control crop/pest equipment

**Introduction**

The learning outcomes to be covered include; Types of spraying equipment, calibration of control equipment, spray chemical formulation, spraying techniques, use of ppe, occupational safety standards and first aid skills

The student/ trainee should be keen during practical demonstrations as they are the basis of this learning outcome.



**Definition of key terms**

**Calibration:** This means to determine, rectify, or mark/graduate an instrument to perform as per expectations of the user.

**Equipment:** This means anything kept or used for a specific purpose. This can be advanced device or a simple tool used to enable the implementation of a certain activity/role.

**Chemical formulation:** This is a combination/mixture of chemicals that do not chemically react to create a desirable final product/chemical.

**Content/procedures/methods/illustrations**

**4.1 PPEs requirements are adhered to as per OSH standards**

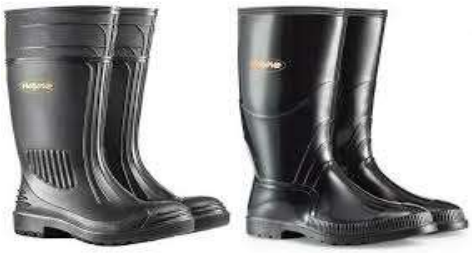
Personal protective equipment is the last line of defense against exposure chemicals/pesticides used in crop pest control. Most of the chemicals are of toxic nature and have adverse effect on human health thus should not be handled without any form of protection.

The PPE include:

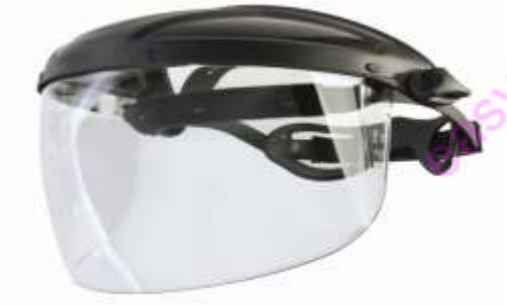
Figure 36: Personal protective equipment

- Respirators

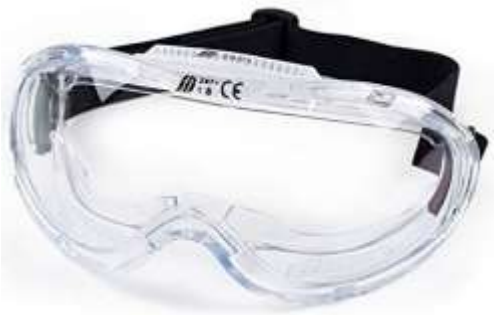
- Chemically impervious footwear (gumboots



- Hats and face shields



- Goggles



- Gloves

- Body wear/ Apron

**PPE Requirements as per OSHA**

Each of the PPE equipment should have a specific set of criteria that should be considered when choosing all the above PPE equipment. These are important factors to be adhered to prevent exposure to toxic material.

**Gloves requirements**

These should be outlined and should cover one's arms to the elbow length. They should be made of chemical resistant material to avoid corrosion. The glove materials of choice include:

- Polyethylene &Neoprene. Good protection from liquid and dry pesticides but is not recommended when using fumigants.
- Butyl. This is good for protection from both dry and liquid pesticides
- Nitrile. This is good for protection from both dry and liquid pesticides but moderately permeable.
- Latex. This material is only effective for dry chemical formulations as it is relatively permeable.

**NB:** Always check the quality of material of any glove because we use gloves with our fingers. Gloves used should be moderate thickness to increase the durability of the glove.

While the material of choice is in discussion, leather and cotton gloves should not be used. It is also important to check for holes in gloves before using them. Torn gloves should be disposed. Once done with the handling of pesticides, one should wash the

gloves with detergents before removing them. After removal, one should wash their hands with detergent or soap and water.

Figure 37: Gloves

**Body covering requirements**

When considering work attire (body covering), long pants, and long-sleeved shirt can be used with mild chemicals. An overall/Apron is however recommended for use. These should offer protection from splash, spills of liquid solutions and also when handling dry formulations. A good apron should extend from the neck to the knees. These should be made of nitrite, butyl and neoprene for maximum protection. PVC and rubber made aprons can be used as intermediates when the former is not available.



Figure 38:Apron

**Boots requirements/ Footwear requirements**

It is required that one wears unlined chemical resistant boots that covers your ankles when handling or applying toxic pesticides. Boots with thick soles are recommended. Nitrite and butyl boots offer best protection. The PVC and rubber boots are also available.

**NB:** Leather boots should not be used. It is also important to wash boots after use.

**Respirators**

These protect one from inhaling toxic chemicals. They are extremely important in protecting one from fumigation fumes or inhalation of toxic chemicals applied to crops. These include the: Air purifiers and the air supplying respirators. Air purifying respirators protect one from inhaling toxic chemicals by purifying the air one is breathing. They are used in areas where the supply of oxygen is inadequate.

Air supplying respirators are used in situations where the other types of respirators will not provide enough protection. These have an air supply provided directly through a hose directly to the face mask.

Figure 39:Air supplying respirators

**Requirements of respirators**

- The respirator should fit properly on your face. It should be worn tightly enough to form a seal all around the face. The respirator should fit ones face properly thus avoid using oversize or undersize respirators.
- The respirator should not be over tightened to prevent suffocation.
- The respirator should not be broken or have holes within the filtration system to prevent inhalation of toxic substances.
- Air purifying respirators should always have adequate oxygen supply before use.
- It is important to clean the respirators after intense chemical exposure if they are to be re-used. This helps prevent the inhaling of the previously accumulated chemical fume.
- Store respirators away from chemical solutions to prevent contamination before use as it could lead to suffocation or exposure to toxins.

**Face shields**

This are used to prevent one's face from contact with toxic pest control chemicals. These could be attached to the respirators in some cases.

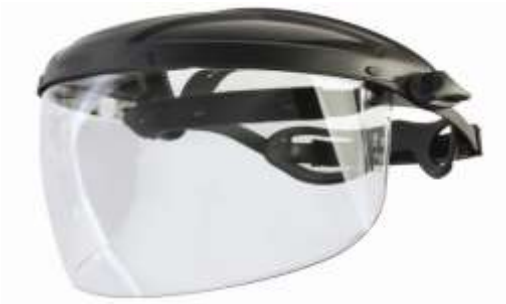


Figure 40:Face shields

**Requirements for face shield**

- Should be able to cover the face even in the presence of a half face respirator.
- Should be made of material that does not react with chemicals being used
- Should be made of material that is easy to manipulate in order to fit the face if glass has not been used.
- The face masks/shields should be transparent in the case where it covers the whole face to facilitate viewing.
- In the case where it leaves space for goggles fitting, it should cover most of the parts and fit perfectly with the goggles leaving no areas unprotected.
- A face shield especially the full-face shield should not be prone to fogging.

**Goggles Requirements**

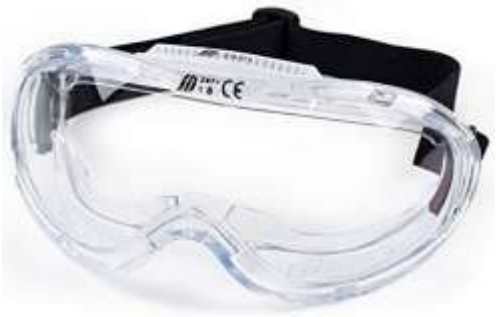


Figure 41:Goggles

These are intended for eye protection. They should:

- Fit and form proper seal with the face.
- Protect the eye from any toxic substance
- Offer brow, temple and front eye protection
- Should have a band to hold it to the body
- Goggles should not be prone to fogging to facilitate viewing
- Should be transparent to avoid straining
- Should be made from material that is non-corrosive

**4.2 Materials, tools and equipment to be used are identified as per the chosen methods**

**Methods of pest control**

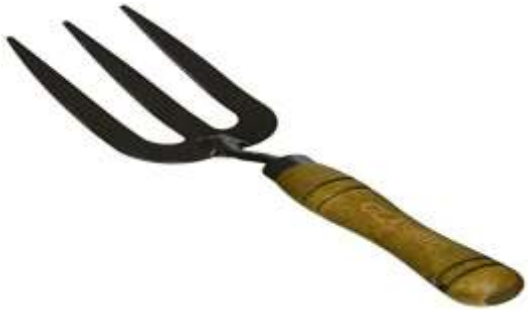
There are different methods of pest control. These are dependent on one's preference. Each of the pest control methods has specific tools and equipment necessary for crop pest/disease control. These include: Organic pest/disease control, chemical control, biological control, mechanical and electronic pest control.

- **Mechanical pest/disease control**

This involves use of physical and mechanical methods to control pests. Tools and equipment used include most of the gardening tools.

a. Machete

b. Gardening fork



c. Jembe



Figure 42: Mechanical pest/disease control

Also, one can use their hands to pick the insects. Fencing and barrier creation are also employed.

- **Organic pest/disease control**

This is the use of organic agents to control pests. Organic control agents can be sprayed using knapsack sprayer for liquid agents or applied physically for dry agents. In dry agents, a spade can be used.

- **Chemical pest/disease control**

These methods are used to control pests when organic/natural solutions are not effective against the disease in question. The tools to be used include: Chemical solutions, PPE Kits, first aid kits, mixing buckets and stirring rods. There are different types of sprayers.

- **Electronic pest control**

This entails the use of electronically powered device that are designed to repel pests. Most of these are used against rodents and insects. These use ultrasonic radio waves and they vary from ultrasonic pest repeller, electronic mouse bugs, mosquito/ insects rejector killer to electronic guns.

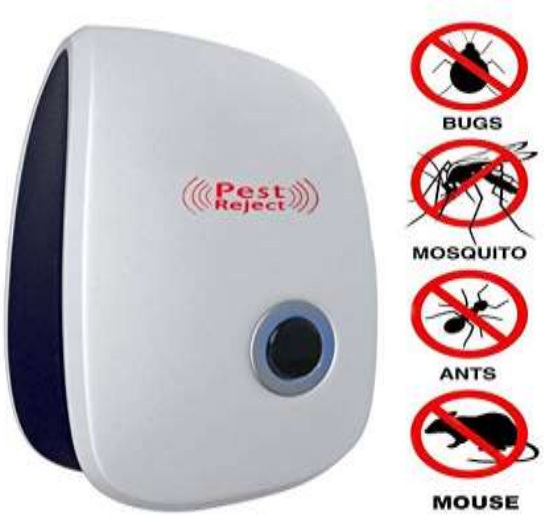



Figure 43:Electronic pest control

**NB:** Although tools have been discussed under chosen method of pest control, it is important to note that some tools/equipment e.g. Aprons cut across all the chosen methods.

There are different types of sprayers, they include: hand pump sprayers, tractor-based sprayers, automated sprayers and the commonly used is determined by the amount of chemical solution that is being used, the spraying technique, recommended pressure, nozzle delivery and the cost of the inputs. Most of these can be categorized into two broad categories either as hydraulic or low volume.



### 4.3 Material tools and equipment are used as per the instruction's manual.

1. **PPE Kit (Personal protective equipment)**

The personal protective kit comprises of the goggles, facemask, Apron, respirators and foot wear. It is advised that all should be used correctly as per the instruction's manual.

**Procedure for using PPE kits**

- Inspect all components of the PPE kit and make sure they are working correctly. That is in the case of respirators.
- Check for broken tools/equipment and those with holes and eliminate them.
- Try the apron or overall first and make sure that it fits, it has a zipper or button and that it covers you up to the neck.
- Wear the boots/gumboots made of bulfyl, nitrile, rubber or PVC as they are chemically non-reactive or offer the best protection.
- Tuck in the overall and make sure it makes a tight seal over the boots preventing chemical entry to the boots.
- Check the respirators especially in the case of filter respirator.

**NB:** Respirators with oxygen tanks are worn last just before the face mask or they come combined with the face mask.

- Wear the goggles and ensure that the band forms a good seal preventing eye exposure.
- Wear the face mask and cover areas not covered by the goggles.
- Wear the hat/head gear in the case it is not integrated to the face mask or apron.
- Wear the gloves last to prevent dexterity when wearing the other PPE components. These should be worn up to elbow height.
- In case of situations dealing with highly toxic chemical solutions, test that your gear is working correctly and does not have leakage points using water. (You can instruct someone to pour/spray water on you with your kit on).
- Clean all PPE kit components after use and store them in a clean dry place once they are dry.

**NB:** Do not use leather equipment as PPE kits as they get eroded quickly.

**2. Spraying equipment**

These form the largest composition of tools that facilitate pest control. They come in different designs, shapes and sizes. The spraying equipment could be hydraulic or low volume and the choice of the item to be used will be determined by:

- The amount of chemical being used
- Nozzle delivery type
- Size of the fields
- Cost of inputs
- Availability of equipment
- Recommended pressure



**Procedure when using spraying equipment**

i) Inspect all the spraying equipment for correct functionality.
ii) Check to confirm that all sprayers to be used were cleaned after use and in the case, they were not, clean them before use and rinse those that were previously cleaned.
iii) Check if the nozzles are of desired type and then calibrate them for desired delivery style.
iv) Calibrate all the sprayers considering the recommendations from the instruction manuals.
v) For hydraulic based sprayers, ensure the hydraulic system is working correctly and not interfering with desired collaborations.
vi) Use sprayers that are not leaking to avoid chemical loss.
vii) Ensure that the calibrations on the sprayer containers are accurate to prevent over spraying or under spraying.
viii) Determine the spraying technique to be used before closing spraying equipment and consider which sprayer can best achieve the desired outcome.
ix) Uniform spraying is recommended to increase efficiency and accuracy.
x) Clean the spraying gear after use and store in a clean dry environment.

### 3. Chemical formulations and mixing equipment

Chemicals to be used in pest control vary from time to time in respect to the intended use. There are many chemical formulations but handling of these chemicals is done in a systematic manner to ensure maximum efficiency and reduce probability of an accident occurring.

**Procedure when handling chemical formulations and chemical mixing equipment**

i) Always wear protective clothing when handling chemical formulations.
ii) Read instructions manual before mixing the chemical formulations for spraying.
iii) Ensure that the mixing bucket/jars and stirring rods are clean before using them.
iv) Measure the correct chemical amount to be used in the case of hand pumps and knapsack sprayer, calibrate correctly and put right amount of chemical in hydraulic sprayers.
v) Ensure that the chemicals being used are recommended and correct in respect to pest/disease detected and human health.
vi) Use mixing equipment that does not corrode with the chemical being used.
vii) Before fully committing on the chemical to use, check for expiry dates and do not use expired chemicals as they could have side effects to the consumers.
viii) Dispose empty chemical containers in a pit and keep chemicals safe in a locked place away from young children.
ix) Do not mix chemicals you are not sure that they should be mixed as it could be dangerous.
x) Chemical formulations should not be exposed to the sun or fire.
xi) Wash the PPE equipment after handling chemical formulations.

**NB:** should be washed after washing the chemical mixing equipment

### 4. Electronic equipment

These could include electronic pest control equipment, electric pumps or other forms of tools/equipment that require electricity to run.

**Procedure when using electronic equipment**

Ensure electricity is off when inspecting the equipment for correct functionality or non-conducting gloves (thick).

Calibrate the equipment to desired level before powering the equipment on.

Check for wholeness and avoid using faulty equipment.

Do not use electric equipment around water or rainfall. It is recommended to use electricity around dry areas.

One should use insulated garments to prevent one from possible electric shock that could be lethal.

Read instruction manuals before operating any electronic device/equipment or tool.

Use the correct tool for the correct purpose for maximum benefit.

Always power off your device after use to save electricity and avoid accidents.

Never handle an electric device bare handed especially if it is not insulated and the power is on.

5. **First aid equipment**

These should always be available for basic first aid after injury or accidents. These tend to save lives. They contain pills, bandages and other drugs that help reverse effects of injury/accidents.

**Procedure when handling first aid equipment**

i) Ensure one's hands are clean when handling a first aid kit.
ii) Open the first aid kit safely to prevent damage of drugs inside or other tools like a thermometer.
iii) Read the instructions manual and use the recommended drugs and dosages where no medical experience has been earned.
iv) Always put first aid kits where they can be openly seen.
v) Do not mix the contents that is, drugs in the first aid kit, remove labels or exchange them.
vi) Ensure to replenish the contents of the first aid kit after the existing ones have been used or have expired.
vii) Ensure that the symptom being treated has been described in the first aid instruction manual.
viii) Do not return contaminated material into the first aid kit as it could harbor disease causing organisms that could affect first aid kit users later.
ix) Clean first aid kit tools and dry them before returning them into the kit.
x) Store the kit away from children
xi) Make sure inventory of first aid kit after use before returning it.

**4.4 Pest /diseases is controlled as per pest/disease identified in a mapped area**

Different pests have different control methods which also is the case with disease as they are different and control methods can be different. This can be attempted through exclusion, physical removal, chemical control, repulsion and biological means. If identified in an area, below are control methods.

**Rodents**

There are several ways to control rodents. These include:

1. **Culture/physical and mechanical control**

These entails several aspects for both mechanical and cultural methods. These are:

- Trapping. Make use of rodent trap to capture rodents in the premises.
- Exclusion. This entails making sure that the rodents are not enticed to come to the premises by removal of potential food and water sources and elimination of rodent shelter and harborage.
- Physical termination of rodents where detected can be employed.
- Repulsion through creation of barriers that prevent rodent entry.

2. **Chemical control**

In this method, chemicals are used to poison rodent food or are sprayed in detected harbors/nests to kill them.

3. **Biological control**

The use of naturally sworn enemies to rodents (cats) in premises where rodents have been detected can be employed especially after harvest when food is in storage.

**Human pest and animals**

The best control method for this class of pests is the creation of a barrier or monitoring where barrier creation is not possible as chemical control would lead to death which is not desirable.

**Control methods**

- **Fencing**

This is the best form of control against animals and humans. Types of fences will vary depending on the pest. For humans, it is recommended to use mesh wires, electric fences or live thorn fences while in animals barbed and smooth wires can be used alongside live, mashed and electric fences. It is important to note that those group of pests are intelligent and need higher level control methods.

- **Monitoring**

Where fencing is not possible, one can monitor the premises/land from intruders as the humans cannot invade a monitored area. Animals will be scared away when monitoring is done.

**Insects**

These include flying insects such as aphids, those that live on plants and soil born insects. All of these include: army worms, corn ear worms, two spotted mite, vegetable bugs and thripeworms. Insects can be controlled by employing these methods if mapped in an area.



**Physical/ mechanical control**

This entails physically identifying and removing the pests by hand. Knowledge on the specific pest is required for the purpose of identification and whether it is harmful so that one should be prepared with gloves and other PPE kits when handling them.

- **Biological control**

This method entails use of biological means to eliminate insects. In this method, one could introduce plants that repel the identified insects together with his/her plants to help repel insects. One could also use other harmless insects that feed on harmful insects alongside making use of other animals. E.g. one could introduce flies to feed on aphids or chicken on established young maize fields to feed on soil insects. Spraying of natural substances e.g. dung on maize could be done to repel worms. Crop rotation could also be employed.

- **Chemical control**

Chemical control is formed around the use of chemical formulations to control pests. The application of chemicals is widely done by spraying liquid mixture all through. Dry and dust formulations are also used in lesser frequency.

The chemical to be used is dependent on the type of insect identified as each insect might have a specifically designed chemical formulation. Where many insects have been identified, broad spectrum insecticides are recommended for best results. Chemical use could turn out to be dangerous and thus it is recommended that one reads

the instructions manual before using chemicals. Long terms chemical control is not recommended.

**Disease control**

There are many diseases in respect to the plants under cultivation. These include: blight, downy mildew, maize steak, carrot nematodes, anthracnose, and powdery mildew among others. These can be controlled using the methods discussed below:

**Chemical control**

This is the most common method under use worldwide. Although it has side effects, it is preferred because of its efficiency. When a certain disease e.g. downy mildew has been mapped in an area, the chemical formulations necessary for disease eliminations are identified and used as per recommendations. Chemicals are applied in respect to size of affected area as the measurement of chemicals is done per Ha. The dry and dust formulations are also applied in respect to the recommendations. Choice of spraying equipment can be determined by size of area of the disease and availability of inputs.

As chemicals are formulated to deal with specific disease, the correct formulation is used in respect to the disease in question.

- **Biological control**

This method of disease employs the use of natural biological agents to eliminate a disease or control it. The biological agents could be sprayed or planted that is other plants. In the case of the former, spraying with agents or other application methods e.g. smearing is done using components that guard the uninfected plants or cure the disease. Planting of plants e.g. trees around the farm crops also helps control some diseases e.g. blought.

- **Physical control/mechanical**

This method involves destruction of already infected plants in the case of contagious disease. This can be done by: uprooting, chopping of the plant, burning the plants or even crushing the plants before disposing their remains away from the uninfected plants. This method is labor intensive as one has to check all plants to identify those infected and those not infected. It also only focuses on control and not prevention.



## Conclusion

This learning outcome covered materials, tools and equipment to be used as per the chosen methods. It has also covered types of spraying equipment, calibration of equipment and various spraying techniques. Therefore, the learner should be conversant with the above topics by now and should show competence in crop pest/disease control equipment.

## Further Reading

1. www.ag.ndsu.edu/publication/crops/spray equipment and calibration
2. www.pesticide.montana.edu/reference/ppe

### 7.3.5.3 Self-Assessment

**Written assessment**

1. Which of the following footwear is recommended when handling chemical formulations?
    a) Sandals
    b) None
    c) Open shoes
    d) Boots
2. A chemical formulation is a mixture of chemicals that are chemically unstable but form a desired effect
    a) True
    b) False
3. Leather can be used as a material for creating a PPE kit
    a) True
    b) False
4. Electronic pest control equipment can use radio waves to control pests
    a) True
    b) False
5. Which of the following materials should not be used in the creation of PPE equipment?
    a) Nitrile
    b) Butyl
    c) Rubber
    d) Cotton
6. Which is the most used pest/disease control method?
    a) Biological
    b) Mechanical
    c) Chemical
    d) Cultural
7. Explain chemical disease control method.
8. Identify best materials in order of preference for creation of PPE equipment.
9. Identify FIVE equipment used in pest/disease control.
10. Outline requirements for gloves and respirators as part of PPE kit.



**Oral Assessment**

11. Explain how to control crop disease biologically
12. Outline material used in PPE kit creation
13. How do you calibrate a knapsack sprayer?

**Case Study Assessment**

Identify a farm/area with an identified disease/pest and employ crop pest/disease control using the correct PPE equipment and other tools necessary for disease/pest control.

### 1.3.5.4 Tools, Equipment, Supplies and Material

- PPEs
- Manuals
- Textbook
- Spray pumps
- Computers
- Projectors

### 7.3.5.5 References

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### 7.3.6 Learning Outcome No 5: Dispose expired chemical and empty containers.

#### 7.3.6.1 Learning Activities

| Learning Outcome No 5: Dispose expired chemical and empty container | |
|---|---|
|  **Learning Activities** | **Special Instructions** |
| 5.1 Collect waste and recyclable materials and stored according to OSH standards and workplace policy<br>5.2 Dispose expired chemicals in accordance with workplace policy, manufacturer's instructions and OSH standards.<br>5.3 Clean tools and equipment and store as per manufacturers manual<br>5.4 Demonstrate first aids skills in accordance with safe use of pesticide manual. | Observe and participate in environmental conservation methods |

#### 7.3.6.2 Information Sheet No7/LO5: Dispose expired chemical and empty containers.

**Introduction**

The learning outcome to be covered includes; Types of chemical packaging material disposal methods, environmental management and regulations occupational safety standards and first aid skills.

**Definition of key term**

**Disposal methods**: This is the process/act of getting rid of something that is unwanted. It can be solid waste effluent or any other form of unwanted end product that is no more significant in its use

**Environmental management**: This is a well-organized program that combines/integrates all possible methods/procedures and processes that involve capacity building monitoring and initiatives that aim to promote ecological conservation and reducing disasters that negatively affect our surrounding

**Safety standards**: These are minimum/baseline measures designed to ensure safety of products, activities, and processes in relation to human usage interaction.

**Content/procedures/methods/illustrations**

**5.1Waste and recyclable materials are collected and stored according to OSH standards and workplace policy**

A waste is an unwanted substance or by product discarded as not useful therefore it needs a way of safe disposal

Recyclable materials are the ones that can be reused; they are used to do the same task or a different task.

Recyclable materials include glass cardboards metals plastic tires textile batteries and electronics

Agricultural recyclable materials include plastic bags for packaging

**Sources of waste and recyclable materials**

Waste and recyclable materials have a range of sources that can be classified into:

- **Organic sources:** e.g. manure and agricultural effluent
- **Heavy metal sources:** This include lead, mercury, aluminum
- **Industrial sources:** These are mainly by products waste resulting from processing that is taking place in industries
- **Agricultural input waste:** e.g. uses of fertilizer rich in nitrogen and phosphorous in excess which finally has a scotching effect on both plants and animals' skin
- **Manufacturing sources**: This include factories dealing in plastic textile woodwork glasswork and metal work.

**Types of chemical packaging material**

Packaging services for chemical industry include

- Soups packaging materials
- Sprays and general agro-chemicals packaging
- Lubricants and oil packaging
- Bottle cans and jars as packaging materials for various products

**Occupational health and safety standards for employees and employers guiding use of chemicals**

- **Obligation of employers**

i. Provide and maintain plants and systems and procedures of work that are safe and without risk to health
ii. Proper handling, storage, and transport of chemicals
iii. Provide information, instructions, training and supervision to ensure safety of workers
iv. Provide and maintain safe working environment for workers
v. Inform employees of risks from new technology and imminent danger.
vi. Carrying out regular risk assessment

**Employees obligation**

- Ensure their own safety and health and that of others who may be affected at work place
- At all times wear protective clothing/equipment for the purpose of preventing risk

- Comply with safety and health procedures requirements and instructions given by a person having power over you
- Report to supervisor any accident incident or any injury
- With regard to any duty or requirement imposed on their employer and cooperative with employer or other relevant person to enable that duty or requirement to be performed
- Administrative control –this controls involvement of management in ensuring management of work. It involves taking personal effort and responsibility to ensure safety in the work place

**5.2 Expired chemicals are disposed in accordance with workplace policy, manufacturer's instructions and OSH standards.**

Expired chemicals are substance whose date of usage has elapsed and therefore they need safe disposal to avoid affecting health factor.

Health care employees is vulnerable to chemicals especially at work place and therefore the following healthcare procedures are applied by pharmaceutical industries or other users in disposing expired chemicals

**Procedure/method of disposing expired chemicals based on OSH**

i. **Dilution and pour method**

Involves addition of water into corrosive chemicals such as bleaching agents and hydrogen peroxide to reduce corrosive effect to the body and then you pour to a designated place that is less frequently visited by people

ii. **Proper safety precaution while disposing**

A person should first adhere to personal protection guidelines while handling expired chemicals while ready to dispose them. This reduces risk of harm. This can be use of gloves masks overalls etc.

iii. **Storage solution of specialized collection**

Some chemicals need the advisory measures from certified firms that are best known in dealing with the chemicals and therefore they are able to handle even their disposal based on the chemical risk or regulatory measures about management of the waste

iv. **Recycling automotive fluids**

This is a form of disposing chemicals that can no longer be used by the first beneficiary but can be helpful to the next client

v. **Drain all canisters**

This can be done in control fume chambers to avoid spread to work place where air contamination can occur causing respiratory problems

vi. **Use of expired chemical movable pit**

This can be metallic box like container tightly sealed with a thick dropping of chemicals that are closing it until further transportation to the designated site that has been certified for disposal of the waste

vii. **Thorough cleaning of reusable containers**

Reusable containers having expired chemicals should be thoroughly cleaned with disinfectant and rinsed to wash the expired chemical away. Protective clothing must be worn

**Note: Never reuse pesticide containers for any purpose**

viii. **Proper labelling and observing dates**

This ensures note of expiry date to avoid using already expired drugs. Some transportation should be done while in transit into disposal site. They should not be carried in passenger vehicles

ix. **Keep chemicals away from grocery**. This avoids food poisoning for home and animals.

**5.3 Tools and equipment are cleaned and stored as per manufacturers manual**

**General procedures for cleaning agricultural tools and equipment**

- Physical removal of soils clods in farming tools such as jembes
- Apply foam forming alkaline detergent to the tool's equipment
- Rinse with water with high pressure, this helps to break remains of soil clods
- Buck on the sun to dry to minimize chances of rusting
- For reusable containers, thoroughly cleaning and use of sanitary detergent is used for maximum safety of the product you will store in the container.

**Storage and maintenance of tools and equipment**

- Grease metal parts
- Tightening weak handles
- Hanging tools in a tool rack and in a tool shade
- Store tools in their original casing
- Dry tools after use and before storage
- Do periodic sharpening



**Waste collection method**

**i. Curbside collection method**

This is provision of waste bins especially in sub urban and urban areas as a method of enhancing cleanliness of the environment to avoid negative impact on agricultural potential land and around homestead

**ii. Drop off centres**

This is a site where individuals can bring their waste as long as they adhere to the regulations. They comply with submission and sorting procedures to enhance proper management especially recycling or incarceration of solid waste.

**iii. Buy back centres**

These are depots where individual waste collectors, reclaimers and street waste collectors can sell their recyclable waste. These include metal artisan who buy metals for refurbishment

**iv. Deposit/refund programmes**

This is a program where goods that fail to be processed are returned to the original producer with the hope that he/she can handle best because disposal procedures are only known by the producer.

**Waste disposal and management methods as per OSH**

- **Opening burning:** This is setting fire on non-degradable waste to minimize them filling up the productive land for agriculture.
- **Sanitary land fills**

These are sites where waste is isolated from environment until it is safe. It is until its degraded biologically, chemically and physically.

- **Fascination**

This is collecting solid into a burning structured incinerator and setting it on fire especially waste that cannot undergo decomposition

- **Composting**

This method is useful for disposal of biological waste

- **Land filling**

This involves a low-lying open area of the city where garbage is collected and dumped

**Waste management measures in work place based on occupational safety standards of health**

Waste risks can be managed in is work places to avoid harming workers. The following methods can be applied in work places to avoid occupational hazards

- **Elimination of hazard services**

Based on the impact analysis of the waste to human health, elimination can be recommended if the waste has more harm than good

- **Substitution**

If the product that gives out the danger waste has a substitute, then the decision of replacing it can be made to avert more harm

- **Wearing protective**

Every person who works in places exposed to hazards must wear protective gear which mostly comprises of head veil, masks, and ear protective equipment overalls and gloves for personal safety

- **Engineering control**

This involves redesigning the product that results to the waste to come up with an improved and less hazardous results after processing. This can include thorough and refined processing to eliminate toxic or use of anti-toxic in processing the product as part of value addition.

## 5.4 First aids skills are demonstrated in accordance with safe use of pesticide manual

**Pesticide manual safety standards**

- Follow label directions carefully
- Avoid sparking and spilling of chemicals and leaks
- Do not eat and drink while using chemicals
- Do not smoke as some may be volatile

**Application of first aid skills for safe use of pesticides**

- Learn to always follow instructions
- In case of spillage or splashing, use a lot of water in rinsing the chemical

- For poisoning always try to apply clinical toxicology skills or seek immediate response from suitable personnel. You can induce vomiting as a first aid measure
- For flammable chemicals always to store away from fire and in case they catch fire try to identify if the chemical is not reactive with water. If not, you can put off fire using water.

**Conclusion**

This learning outcome covered collection of recyclable materials, disposal of expired chemicals and cleaning of tools and equipment.

**Further Reading**


1. Clark, E.E.K, Lery, L.S; Spurgeon, A, and Calvet, I.A (1997).The problem associated with pesticides use by mitigation workers in Ghana occupational medicine, 47(5), 301-308
2. Padgitt, S, Wintersteen, W, and Stones (1995). Agricultural Pesticide exposure. Safety precaution and pesticides attributed illnesses among farmers. Agricultural Health and Safety, 2(12(, 189-94
3. www.youtube.com//pesticide/insecticide/sprayingsafetyprecautionandequipment


**7.3.6.3 Self-Assessment**



**Written assessment**

1. The following are sources of waste and recyclable materials except
    a) Heavy metal sources
    b) Organic sources
    c) Industrial sources
    d) Lake nature sources
2. Agricultural pesticide packaging is not part of solid waste
    a) True
    b) False
3. Both employees and employers should adhere to occupational safety standards
    a) True
    b) False
4. Pesticides safety manual is important as a first precautionary procedure in promoting safety in use of pesticides
    a) True
    b) False

5. Gardening tools should not be cleaned and dried after use because of rusting
    a) True
    b) False
6. The following are waste collection methods except?
    a) Curbside collection
    b) Drop of centres method
    c) Bury back centres
    d) Incineration
7. It is advisable to recycle pesticides container
    a) True
    b) False
8. What is the source of waste and recyclable materials?
9. Give three first aid skills applications in pesticides application occupational safety standards
10. State three occupational standards for employees to adhere in work place
11. Give two maintenance of tools for agriculture
12. Name four equipment used for agriculture farming

**Oral Assessment**

1. What is the importance of guide manual provided in pesticide safety standards?
2. Why is environmental management important?



**Case Study Assessment**

Trainees to visit a farm and check out the activities carried out and participate in the collection of waste and recyclable materials and how they are stored then participate in disposing the expired chemicals and even cleaning tools and equipment and finally train in first aid skills

### 7.3.6.4 Tools, Equipment, Supplies and Materials

- PPEs
- Spray pumps
- Chemicals
- Water
- Insect traps

### 7.3.6.5 References

Lee, M. M., Teuscher, J., Miyasaka, T., Murakami, T. N., & Snaith, H. J. (2012). Efficient hybrid solar cells based on meso-superstructured organometal halide perovskites. *Science*, *338*(6107), 643-647.

Li, X., Ominsky, M. S., Warmington, K. S., Morony, S., Gong, J., Cao, J., ... & Chen, Q. (2009). Sclerostin antibody treatment increases bone formation, bone mass, and bone strength in a rat model of postmenopausal osteoporosis. *Journal of Bone and Mineral Research*, *24*(4), 578-588.

Moore, T. A. (2012). Coalbed methane: a review. *International Journal of Coal Geology*, *101*, 36-81.

### 7.3.7 Learning Outcome No 6: Prepare crop protection report

#### 7.3.7.1 Learning Activities

| Learning Outcome No 6: Prepare crop protection report | |
|---|---|
| **Learning Activities** | **Special Instructions** |
| 6.1 Prepare crop pest/disease situation report as per SOPs<br>6.2 Share crop pest/disease as per SOPs<br>6.3 Prepare crop protection schedules/activities prepared and doc6.1Prepare crop pest/disease situation report as per SOPs<br>6.2 Share crop pest/disease as per SOPs<br>6.3 Prepare crop protection schedules/activities prepared and documented in the journal documented in the journal. | Use practical questions to assess understanding<br><br>Apply case study technique to improve on trainee understanding. |

#### 7.3.7.2 Information Sheet No7/LO6: Prepare crop protection report

**Introduction**

The learning outcome to be covered includes data collection, data analysis and report writing. Data is collected for the purpose of analysing a situation. The aim of crop protection report is to provide farm with knowledge or crop protection programs in order to improve crop production. Therefore, these trainees should be equipped with this kind of knowledge.

**Definition of key terms**

**Data collection:** It is the process of gathering and measuring information on variable of interest in an established systematic fashion that enables one to answer stated problem or evaluate outcome.

**Data analysis:** It is the process of systematically applying statistical and/or logical techniques to describe and illustrate, condense and recap, and evaluate data. It is an essential component of ensuring data integrity is accurate and appropriate.

**Content/procedures/methods/illustrations**

**6.1 Crop pest/disease situation report is prepared as per SOPs**

A report is a structured piece of writing designed to present findings or recommendations to a specific audience. A good report has a clear structure and is written in sections with subheadings. The report structure reflects what was intended to be done or the objectives.

**Procedure for preparing a report**

i. **Assess the situation:** Determine what information must be covered and from whom is order. To know the dysfunction or other Agricultural Extensions. Make a list of target contact and set a target to contact and report.
ii. **Collect the data:** visit the targeted group of individuals while collecting appropriate data use appropriate date collection tools that fit the situation in question. record your data appropriately.
iii. **Data analysis and report writing**: Analyze the collected data using appropriate data analysis tool. This may include statistical data analysis tool. Write the report; followed with paragraphs arranged in a coherent manner, detailing each decision event and detail. Provide the report to all relevant staff members.
iv. **Follow-up** on the initial situation report with regular progress report if needed.

**Data Collection**

Data collection is the process of gathering and ensuring information on variable of interest in an established systematic fashion that enables one to analyze a situation in question.

**Importance of ensuring account and appropriate data collection**

Accurate data collection is essential to maintain the integrity of research.

Both selection of appropriate data collection instruments and clearly delineated instruction for correct use reduce the likelihood of error occurring.

**Consequences from improperly collected data**

i) Inability to answer the problem accurately
ii) inability to repeat and validate analysis
iii) Distorted finding resulting in waste of resources
iv) Compromising decisions for public policy
v) Causing harm to human participants and animal subject.

**Data collection methods**

**a) Observation**

Observation is the process in which one or more people observe what is occurring on some real-life situations. A researcher can visit the farm and observe the situation of crop pest and disease protection.

**b) Interview**

Interview as a technique of data collection is very popular and extensively used in every field of social research. It involves oral questionnaire involve face to face conversation with the farm and collecting the required data. Interviewing is a relatively more flexible tool of any written inquiry from explanation, adjustment and variation according to the situations.

### c) Questionnaire

It is the fastest and simple technique of gathering data group of individuals scattered in a wide and extensive field.

In this method, a questionnaire form is sent usually to the person concerned with request to answer the questions and return the questionnaire.

According to Goode and Hatt, it is a devise for securing answers to questions by using a form which the respondents fill in him/herself. Language barrier is the main challenge of collecting data is this manner.

### d) Case Study method

According to Biesanz and Biasenz, case study is a form of qualitative analysis involving a very careful and complete observation of a situation e.g. crop protection.

## Data analysis

Data analysis is a systematic process of statistics and logical techniques to describe and illustrate condense and recap, evaluate data. According to Shamoo and Resnik (2003) various analytic procedures provide a way of drawing inductive inferences from data and distinguishing the signal from the noise present in the data.

## Types of data analysis

### 1. Texts analysis (Date mining)

It is a method to discover a pattern in large data set using database or data mining tool. It is used to transform data into analytical information.



### 2. Statistical analysis

This shows what happens by using past data. It includes analysis, interpretation, presentation and modelling of data. These are two more categories.

a) **Descriptive analysis:** Complete data or a sample of summarized numerical data. It shows mean and deviation to continuous data.

b) **Inferential Analysis:** Analysis sample form complete data. Provides different conclusion from the same data by selecting different samples.

## Data Analysis process

### i. Data collection

Data is collected using appropriate method. Correct record should be made including collection of date and source of data.

### ii. Data cleaning

Data that is irrelevant should be cleaned out. The data which is collected may contain duplicate records, white spaces or errors.

### iii. Data analysis

Data analysis tools and software are used to understand, interpret and derive conclusion based on the requirements.

**iv. Data interpretation**

Data interpretation may appear in simple words, tables or charts. The best course of action is determined.

## 6.2 Crop pest/disease report is shared as per SOPs

Once a report is ready, sharing is very essential. The report should be shared to specific groups of individuals where the report is relevant to them. The group may include Government extension offices and farmers. The report should be compiled in appropriate method of communication.

**Methods of sharing extension crop pest/disease report**

**i. Individual method**

Face to face methods are probably the most universally used. The extension agent meets the farmer at home or on the farm and discusses issues of mutual interest giving farmers both information and advice on crop pest or disease protection. The method is important in developing farmer's individual trust.

Methods of individual's method of sharing report include:

**Farm visit:** It is the most commonly used and it is important to be clear about the purpose of such visits. Take a lot of time from both officers and farmers

**Office calls:** The extension officers call individual farmers to provide the report and appropriate advice

**Letter:** A letter is sent to farm from extension officer giving a detailed report and farmer being advised accordingly.

**ii) Group methods of sharing report**

Extension officers consider use of groups to pass the message from his/her report.

**Advantages**

- It is a less expensive as compared to individual methods.
- Individual methods involve too much emphasis which can lead to undue concentration on progressive farmer to the detriment of the poorer farmer

**Types of group extension methods**

**a) Group meetings**

An extension officer organizes a meeting with the farmer and provides the report and advice to the group of individuals.

**b) Demonstration**

Farmers like to see how new ideas work and also which effects they can have on increasing crop production. Using demonstration will be the best way to share the report to farmers.

### 6.3 Crop protection schedules/activities are prepared and documented in the journal

Plant pests and disease can wipe out farmers hard work and cause significant losses to yield and income, posing a major threat to food security. Pest and disease can easily spread to several countries and reach epidemic proportion, outbreak and upsurge can cause huge losses to crops and pastures, threatening and livelihood of farmers and the food and nutrition security of million at a time.

Crop proportion is therefore necessary in accordance to high crop production. Integrated management should focus on the following points

i) Use resistant repetition varieties, crop sequence, associations and cultural practices that minimize the pressure and maximize biological prevention of pest and disease.
ii) Apply pest and disease forecasting techniques where available.
iii) Maintain accurate record of agro-chemical use.
iv) Assure that agrochemical is only applied by trained personnel
v) Maintain regular and quantitative assessment of the balance status between pest and disease.

**Crop protection schedule/ activities**

**a. Crop rotation: Intergroup**

Each king of plant attracts its own particular pest and diseases which soon become established around the crop. Crop rotation helps to eradicate pest and disease that are specific to plants.

**b. Use of adequate cultivation technique**

Burning plant residues and ploughing the soil is traditionally considered necessary to phytosanitary reason: to control pest, disease and weeds. In system with reduced mechanical tillage used on mulch cover and biological tillage, alternatives have to be developed to control pest and weeds.

**c. Disease control or management**

Management means a complete set of activities that support each other. These activities are carefully planned and are implemented over several seasons not controlled within a single season.

**d. Weed Control**

Weed reduce yield by competing with the product for sunlight, moisture and soil nutrients. Weeds can also host pest and disease introducing this harmful organism to plant.

**Conclusion**

This learning outcome covered preparation and sharing of crop protection report. It also involves preparation of crop protection schedules and activities.

**Further Reading**

1. Strange, R. N, Scott, P. R (2005). Plant disease: A threat to global food security, Enact, Rev phytopatted. 43 (2005): 83-116.

### 7.3.7.3 Self-Assessment

**Written assessment**

1. ..... Is the process of systematically applying statistical techniques to evaluate data?
    a) Collection
    b) Protection
    c) Data analysis
    d) Data collection
2. Assessing the situation is involved in preparing a report. True or False?
    a) True
    b) False
3. The following are procedures in preparing a report except?
    a) Collection of data
    b) Analysis and report writing
    c) Presentation of a thesis
    d) Assessment of situation
4. Which is a consequence of improperly collection of data?
    a) Distorted findings
    b) Good decisions
    c) No harm journals
    d) Solving the problem
5. Data collection method involves the following except?
    a) Observation
    b) Interview
    c) Case study
6. Types of data analysis is statistical analysis and population analysis. True or False
    a) True
    b) False
7. Which is not a method of sharing extension reports
    a) Individual methods
    b) Group methods
    c) Group meeting
    d) Shows

8. Highlight the procedure in preparing a report
9. Give the relevance of appropriate and accurate data collection
10. List the types of data analysis
11. State the methods as sharing extension crops pest disease
12. How is a group sharing schedule prepared?

**Oral Assessment**

1. What are the advantages of appropriate data collection?
2. What methods are used for sharing extension of crop pest or disease?

**Case Study Assessment**

Trainees to visit a farm and assess the crops protection measure, collect data and analyze, and give report on their findings about the measures.

### 7.3.7.4 Tools, Equipment, Supplies and Materials

- Note book and manuals
- Computers
- Textbooks

### 7.3.7.5 References

Gourley, C. J. P & Mahowani,A.A. (1999). Assessing difference in pasture mass with an automated risk plate meter and direct honesty technique 31, 337-339.

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