CROP PRODUCTION

LEVEL – I

Based on Dec 2022 Version-4 Occupational Standard

Module Title: Applying Chemicals and Safety Rules

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Table of Contents

Introduction to the Module

This module covers the competence covers the knowledge, skills and attitude required to Prepare tools and equipment for field crop production, under take field crop agronomic practices, clean up, store materials, equipment, record and document

LG #31	LO #1- Follow Requirements and Instructions

Instruction sheet

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

- Identifying individuals roles and responsibilities
- Recognizing and following chemical handling and use
- Recognizing pesticides meaning and their Functions
- Identifying Chemical labels and hazards
- Identifying risks associated with chemicals
- Checking and maintaining pre and post operation
- Preparing and adjusting personal protective equipment's

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

- Identify individuals Roles and responsibilities
- Recognize and follow Safety procedures involved in chemical handling and use
- Recognize pesticides meaning and their functions.
- Identify chemical labels and hazards
- Identifyrisks associated with chemicals
- Carry out Pre and post operational checks and maintenance on application equipment according to manufacturer's specifications
- Prepare and adjust application and personal protective equipment's

Learning Instructions:

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

Information sheet 1

Introduction

Definition of chemical: Chemical is any substance that has a defined composition. Chemicals are a part of everyone's life. There are five to seven million different chemicals known in the world. At least 400 million tonnes of chemicals are produced worldwide each year including agricultural chemicals, food additives, pharmaceuticals, fuels for power production, chemical consumer products, etc.

The frightening reality is that, for the vast majority of the chemicals used and being developed, little or nothing is known about their possible immediate or long-term effects on the health of the workers who produce them or use them at work. Yet workers continue to be required to work with potentially **toxic** (poisonous or harmful to the worker) substances. In some countries, workers are required to work.

- With little or no protection
- With chemicals that are **known** to be hazardous to human health.

Workers in some developing countries are often required to work with toxic chemicals that have been banned in developed countries because of their hazardous effects. Similarly, agriculture workers in developing countries (and in non-union agriculture jobs in some developed countries) often spray herbicides and pesticides without any form of protection. In most developed countries, workers using those same chemicals dress up almost like spacemen in protective clothing to avoid contamination from the chemicals, and are provided with washing facilities and regular medical check-ups.

In many countries chemicals are literally dumped into the environment, often with serious human and environmental consequences. Depending on the chemicals dumped, the results can be serious health problems for the workers (who usually do not know about the dangers from the

chemicals) and the community, and permanent damage to the environment. In other countries the laws about chemical disposal are strict in order to protect people and the environment.

1.1. Identifying Individuals Roles and Responsibilities

In order to effectively manage your staff, it is important to provide them with a clear definition and understanding of their role, function, and responsibilities in the workplace. This will provide them with a good understanding of the job and tasks. They are to perform as an individual and within any teams they are a part of. It also provides information on where they fit within the organization and who they report to, helping to avoid disputes and misunderstandings over authority.

When defining roles and responsibilities in the workplace, you may need to create a list of all of your staff and a list of all of the tasks and roles within your business. You can then assign the roles to each staff member or group of staff. It is important to remain flexible and be prepared to modify your plan in consultation with your employees.

Once you have defined each person's roles and responsibilities, you can record this in a "job description". This can be as formal or informal as you prefer, however it is important to record the key information. Job descriptions provide the opportunity to clearly communicate each individual's roles and responsibilities and also serve as a way to measure performance by setting KPI's (Key Performance Indicators) against the tasks or requirements.

With the role of each individual in the organization defined, you can also create an organization chart. This chart is a tool that helps to define the inter-relationships between all departments, divisions, teams and people. It defines reporting structures and lines of authority and responsibility, providing a picture of how the organization functions.

Failing to define workplace roles and responsibilities can create tension, miscommunication and inefficiency within your business. People may be unsure as to what jobs are their own and who they are required to report to. Mistakes and omissions can also occur where people are unsure of what is required of them, therefore creating inefficiencies which cost time and money.

Employers and employees have responsibilities to each other and they should also expect their rights to be upheld. These rights and responsibilities relate to areas such as Health and Safety, the provision of Terms and Conditions of Employment, Equal Opportunities and the right to be paid a Minimum Wage. The Health and Safety at Work Acts set out responsibilities and rights for both employees and employers. Employees are expected to carry out their work in a way that has regard to the safety of others. Employers are expected to abide by a range of requirements governing such aspects as providing safe machinery and equipment, carrying out regular health and safety checks, ensuring the training of employees in health and safety issues, and carrying out a risk assessment to assess the dangers of particular work activities. There are also specific regulations about the way in which potentially harmful substances should be used and stored.

Employees are expected to receive the terms and conditions of their work setting out when their work commences, what their main duties are, who they are accountable to, rates of pay, and other entitlements.

Equal Opportunities legislation sets out that all employees should receive the same pay and conditions for carrying out the same or broadly similar work. There are also laws against sexual, racial and disability discrimination.

Employers and employees are expected to meet minimum legal requirements for such areas as Health and Safety at Work, and minimum standards and conditions related to hours, and the treatment of people in the workplace. Along with rights for employees there are corresponding responsibilities such as the expectation to work in a safe way and to have regard for the safety of work colleagues.

1.2. Recognizing and Following Chemical Handling and Use

1.2.1 General Chemical Safety Practices

It is impossible to design a set of rules that will cover all possible chemical or laboratory hazards and consequences. The general prudent practice guidelines described below have been shown

through experience to be useful for avoiding accidents or reducing injuries associated with the laboratory use of hazardous chemicals.

I. **Planning Chemical Use**: Before beginning an operation or performing an experiment, and be prepared to prevent such an occurrence or to take proper emergency actions. Answers to this question will require an understanding of the hazards associated with the chemicals and equipment involved.

A. Research Hazards: All chemicals and the manner in which they are intended to be used must be scrutinized by the user to identify potential hazards before acquiring the material or conducting a procedure - if the material is already in.

B. Post Laboratory: An appropriate sign must be posted on the outside of the main door to the laboratory

II. Assure Adequate Hazard Controls and Emergency Equipment: Once the hazards have been identified, commensurate hazard controls and emergency equipment must be planned and acquired or developed to adequately control the hazards to a negligible risk level and to respond to any emergencies which may arise for general guidance.

A. An approved safety shower and eyewash must be provided within the work area for immediate use

B. A fire alarm and telephone for emergency use must also be nearby (within 50 feet).

C. Chemical storage space adequate to the lab's needs and responsive to the requirements outlined in Chemical Management Best Practices, must be provided for activities involving chemicals.

D. A hazard assessment survey must be conducted and documented to assess the need for personal protective

III. Chemical Acquisition: Hazardous chemical must be acquired according the guidelines described in Chemical Management Best Practices.

IV. Labeling/Identification: All hazardous chemicals must be properly labeled at all times, from the time they are brought in to the time they are removed for disposal per Chemical Management Best Practices.

V. Chemical Inventory: Laboratories must at all times maintain an adequate inventory of the hazardous chemicals in the laboratory according to Chemical Management Best Practices -

VI. Storage: The storage of hazardous chemicals must be accomplished in a manner that minimizes safety and health hazards to personnel, equipment, buildings, and the environment per Chemical Management Best Practices.

VII. Distribution: The method of transportation of hazardous chemicals must reflect the potential danger posed by the specific chemical and shall be done in accordance with Chemical Management Best Practices

VIII. General Hazardous Chemical Use: Each Lab Worker with the training and information provided by his/her supervisor, must develop and implement work habits to minimize chemical exposures to his/her selves, others and the environment. Based on the realization that all chemicals inherently present hazards in certain conditions, exposures to all hazardous chemicals must be minimized.

IX. Flammable chemicals must be handled only in areas free of ignition sources (e.g. open flames, static electricity, burning tobacco, hot surfaces). Flammable chemicals must never be heated by using an open flame. Preferred heat sources include steam baths, water baths, oil baths, heating mantles, and hot air baths.

X. Hazardous Chemical Disposal: Laboratory Supervisors are responsible for ensuring that all used and/or unneeded hazardous or articles irreversibly contaminated with these hazardous chemicals, are disposed of according to requirements described in Chemical Management Best Practices

XI. Hazardous Waste Minimization/Pollution Prevention: The cost of disposing of excess and waste chemicals has become extremely expensive, and frequently exceeds the original cost

of purchasing the chemical. Every reasonable effort must be made to reduce the generation of hazardous waste.

1.3.2. Safe Handling of Agrichemicals

There are many chemicals on the farm and some of them can be dangerous. Common agricultural chemicals include fuels, pesticides, herbicides, fungicides and veterinary chemicals. Exposure to chemicals can lead to health effects including headache, poisoning, respiratory illness, burns, cancers and birth defects. Always follow the manufacturers' instructions for storage, transport, use and disposal of chemicals. Keep all chemicals locked away and out of reach of children and wear appropriate protective gear.

Any chemical should be treated with extreme caution and only ever used according to the instructions. Vapours or direct exposure can lead to a variety of health effects, including headache, poisoning, burns, cancers and birth defects.

Hazardous materials are required by law to include a Material Safety Data Sheet (MSDS) and label. The MSDS gives valuable information on how to safely handle the chemical. Before using any farm chemical, you should read the label, understand the MSDS and follow usage instructions.

To further reduce the risks, it is worth remembering that hazardous chemicals can occasionally be replaced with less toxic options. Sometimes, a safer form of the product is available. For example, pellets may be used instead of powder.

Side effects of exposure

The effects of chemical exposure depend on the type of chemical and the degree of exposure. If chemicals are swallowed, absorbed through the skin or inhaled as a mist, vapour or dust, some of the immediate and long-term effects can include:

- Poisoning

- Headache
- Skin rashes and irritation
- Chemical burns
- Cancer
- Birth defects
- Diseases of the lungs, liver or kidneys
- Nervous system disorders.

Material Safety Data Sheet (MSDS) Information

Manufacturers and importers are required to supply a Material Safety Data Sheet (MSDS) that details information on the chemical, including:

- The registered use of the chemical
- Precautions for use
- Possible health effects
- Safety measures for handling
- Contact numbers for further information
- Withholding periods – It is the responsibility of the farmers to ensure correct usage and slaughter or production-withholding periods are observed.

It is important that you research chemicals prior to purchase to ensure that you buy the most suitable and least dangerous chemical available to do the job you require. MSDSs can be found online to assist in safe and effective chemical choices and should be thoroughly read before use and kept in an accessible place for reference.

1.3.3. Safe Storage of Chemicals

Suggestions for the safe storage of chemicals include:

- Always follow the manufacturers' instructions for proper storage.
- Keep chemicals in their original containers and don't pour into smaller bottles.

- Don’t remove labels from containers.
- Store chemicals in a locked, well-ventilated shed with floors that will contain spills.
- Store chemicals and personal protective equipment (PPE) in different locations.
- Separate different classes of chemicals to prevent reactions. .

1.3.3. Safe Transport of Chemicals

Suggestions for the safe transporting of chemicals include:

- Transport chemicals separately from food, water, animal feeds, seeds and fertilizers. This applies to transport of household and home garden quantities of the chemical, as well as bulk transport.
- Secure your load.
- Carry a written record of the chemicals you are transporting.
- Take all appropriate protective gear along with you.

1.3.3. Safe Use of Chemicals

Suggestions for the safe use of chemicals include:

- Ensure anyone using agricultural chemicals is suitably trained to use both the chemical and any equipment required for application.
- Only mix the quantity of chemical required for the task at hand.
- Make sure the decanting and mixing area is well ventilated. If this is not possible, ensure that appropriate personal protective equipment (PPE) is worn for enclosed environments.
- Follow the manufacturers’ instructions on the label.
- Always wear protective clothing such as chemical-resistant gloves, face shields or masks, overalls and goggles.
- Avoid exposing non-target animals or plants.

1.3.5. Safe disposal procedures

Suggestions for the safe disposal of chemicals include:

- Always follow the manufacturers' instructions for proper disposal of both chemicals and rinsate from equipment.
- Return empty containers to the manufacturer or check with your local council on proper disposal methods.
- Audit your chemical store on a regular basis and dispose of any excess or outdated chemicals in the appropriate manner.

1.3.6. Seek medical help

- If you think you are suffering any ill effects from chemical exposure, see your doctor immediately, contact Poisons information or go to a hospital with an emergency department. Be sure to inform them what chemicals you may have been exposed to (take your MSDS).
- Try to avoid using the chemical in the future, select the safest possible chemical to use and follow MSDS.

Things to remember

- Exposure to chemicals can lead to a variety of immediate or long-term health effects including headache, poisoning, respiratory illness, burns and birth defects.
- Manufacturers and importers are required to supply a Material Safety Data Sheet (MSDS) that explains how to handle the chemical safely.
- Always follow the manufacturers' instructions on storage, use and disposal of chemicals.
- Organizations such as Work Safe Victoria can offer valuable advice on improving health and safety on your farm.

1.4. Recognizing Pesticides Meaning and Their Functions

The purpose of a pesticide is usually to kill or repel some form of life. The US Environmental Protection Agency's definition of a pesticide is as follows: "A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Though often misunderstood to refer only to insecticides, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests."

These are grouped according to the types of pests which they kill:

- Insecticides – chemicals that kill insects
- Herbicides – chemicals that kill plants
- Rodenticides – chemicals that kill rodents (rats & mice)
- Bactericides – chemicals that kill bacteria
- Fungicides – chemicals that kill fungi
- Larvicides – chemicals that kill larvae

Pesticide formulations contain both "active" and "inert" ingredients. Active ingredients are what kill the pest, and inert ingredients help the active ingredients to work more effectively

1.5. Identifying Chemical Labels and Hazards

Labels are the primary, initial source of warning for faculty, staff and students when handling hazardous chemical substances.

1.5.1. Interpreting chemical label

- The product Labels main function is to explain how a product can be used most effectively to remove a pest problem.
- The label also provides enough information to make sure the product is Used and disposed of in a safe and efficient manner

1.5.2. Labeling and relabeling

i. Labeling

The purpose of a label is to convey a message about what the product is, who makes it and how it may be used safely and effectively.

- There should be a leaflet securely attached to, or tagged on to, the container.
- Users should always ensure that a leaflet is presented with small containers.
- Information might also include any literature provided separately in a package

Before using any agrochemical the user should read the label and discover the information. The following should be indicated:

- Hazard symbol
- Trade name of the product
- Name and quantity of active ingredient
- Purpose for which it is to be used
- Registration number when required by legislation
- Name and address of the manufacturer, distributor or agent
- Directions for use
- Safety precautions
- Warnings and statements of good practice
- First-aid instructions and advice to health personnel
- Name and quantity of any solvent or similar material classified as hazardous
- Amount by weight or volume in the container
- Identification number of the batch or consignment
- Interval between agrochemical application and harvesting
- Any matter required by national legislation such as a reference to the requirements of specific regulations

ii. Relabelingmust ensure that the contents are identified in a manner which will make known to the users:

- The hazards associated with their use
- The methods of using them safely and

- Emergency procedures

Chemical Labeling

Faculty members and/or
Laboratory supervisors MUST
ensure that all incoming
containers of hazardous materials
bear a label specifying the
following:

- Appropriate hazard
  warnings.
- Identification of the chemical in the container and identification of the hazardous component(s).
- Name, address and telephone number of the chemical manufacturer, importer or responsible party (e.g. principal investigator/faculty member).
- Date of receipt or generation of the chemical.

Chemical Labeling -- Hazard Information

Hazard warnings found on the labels of hazardous chemical containers may be composed of **pictures**, **symbols**, and **words** or any combination thereof which convey the hazard(s) of the chemical.

A. Picture Hazard Warnings

Picture hazard warnings help to identify the following properties and classes of hazardous compounds.

There are a few examples....

B. Symbol Hazard Warnings

Symbol hazard warnings provide basic information in determining what precautionary measures to use when handling hazardous chemical substances and/or dealing with a fire.

The National Fire Protection Association (NFPA) uses a symbol system designed as a diamond-shaped label containing four differently colored squares. A

BLUE DIAMOND, HEALTHHAZARD

4 - Deadly

number (0 - 4) is added to each square indicating the order of hazard severity.

3 - Extreme Danger

2 - Hazardous

1 - Slightly Hazardous

0 - Normal Material

RED DIAMOND, FIRE (FLAMMABILITY)

4 - Flash Point Below 73 ºF

3 - Flash Point Below 100 ºF

2 - Flash Point Above 100 ºF, not exceeding 200 ºF

1 - Above 200 ºF

0 - Will Not Burn

YELLOW DIAMOND, REACTIVITY

4 - May detonate

3 - Shock and heat may detonate

2 - Violent chemical change

1 - Unstable if heated

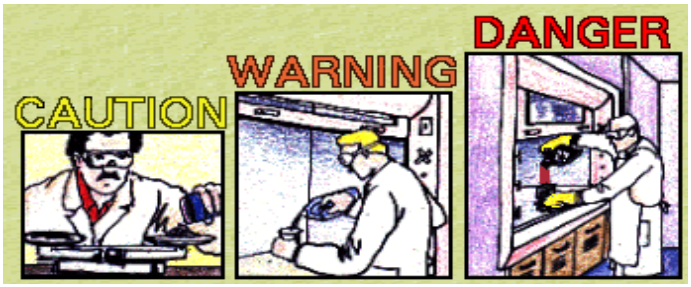
0 - Stable

WHITE DIAMOND

SPECIAL HAZARDS

C. Word Hazard Warnings

Word hazard warnings contain a word or words intended to capture the worker's immediate attention (e.g. flammable, poison and fatal if swallowed). These word labels should be in English, but other languages may be used where needed.



Signal words - are warnings used to designate the degree of hazard.

Signal Word	Degree of Hazard
DANGER	Highest degree of hazard (Red Text)
WARNING	Intermediate degree of hazard (Orange Text)
CAUTION	Lowest degree of hazard (Yellow Text)

1.6. Identifying Risks Associated With Chemicals

1.6.1. Chemical Exposure

- **A workplace should be safe for all workers**

Any union strategy to protect workers against chemical hazards should try to create a working environment where it is safe for **all** workers — the average worker (male or female) and even vulnerable workers — to work without the job affecting their health. Regular medical examinations must never be used by the employer to eliminate "vulnerable" workers, such as women of child bearing age.

- **Exposure to toxic chemicals can lead to accidents**

Exposure to toxic chemicals can also lead to higher rates of accidents at work. Unfortunately, when accidents occur in the workplace, management often blames the worker, claiming he or she was careless. This tendency to "blame the victim" is yet another reason to learn about the substances you work with, to make sure the proper control measures are in place, and to know your rights!

There are many ways in which you may be exposed to chemicals in the laboratory or in your work area. Here are the primary routes of chemical exposure...

1.6.2. Routes of Chemical Exposure

- **Inhalation** - Gases, vapors of volatile liquids, mist and sprays from liquids, particles from solid chemicals, fibers and dusts are all materials that may enter the body via inhalation. The inhaled material can act locally to damage the mucous membranes of the mouth, throat and lungs. The inhaled material may be directly absorbed through the mucous membranes and into the body or can pass into the capillaries of the lungs and be carried into the circulatory system.
- **Ingestion** - Many chemicals can be harmful, even fatal, if they enter the mouth and are swallowed. After ingestion, a chemical may act locally to cause irritation and burns to the mouth throat and stomach or the chemical may be absorbed into the blood and cause systemic injury.
- **Contact with the Skin** - Chemical contact with the skin can be a frequent mode of injury in the laboratory. Contact with the skin by certain chemicals can produce irritation and allergic reactions. Corrosive chemicals can cause minor to very serious burns to the skin, while other chemicals may be directly absorbed through the skin in sufficient quantities to produce systemic toxicity.
- **Contact with the Eyes** - The eyes is so sensitive that very few substances **don't** cause irritation when they come into contact with the eyes. The eyes contain a large number of blood vessels which can be a route for direct chemical absorption into the body.
- **Cuts/Punctures/Injections** - Always take care when using sharp instruments (needles, scalpels, etc...). Cutting yourself or puncturing your skin with a needle may result in you being exposed to a chemical; this is one of the most dangerous routes of exposure since a chemical may be directly injected into the bloodstream thus bypassing the process of absorption. The following figures help to explain how chemicals can enter the body and the effects they can have once they are in the body.

Routes of entry of chemicals into the human body

Organs and tissues that may be affected by particular toxic industrial chemicals

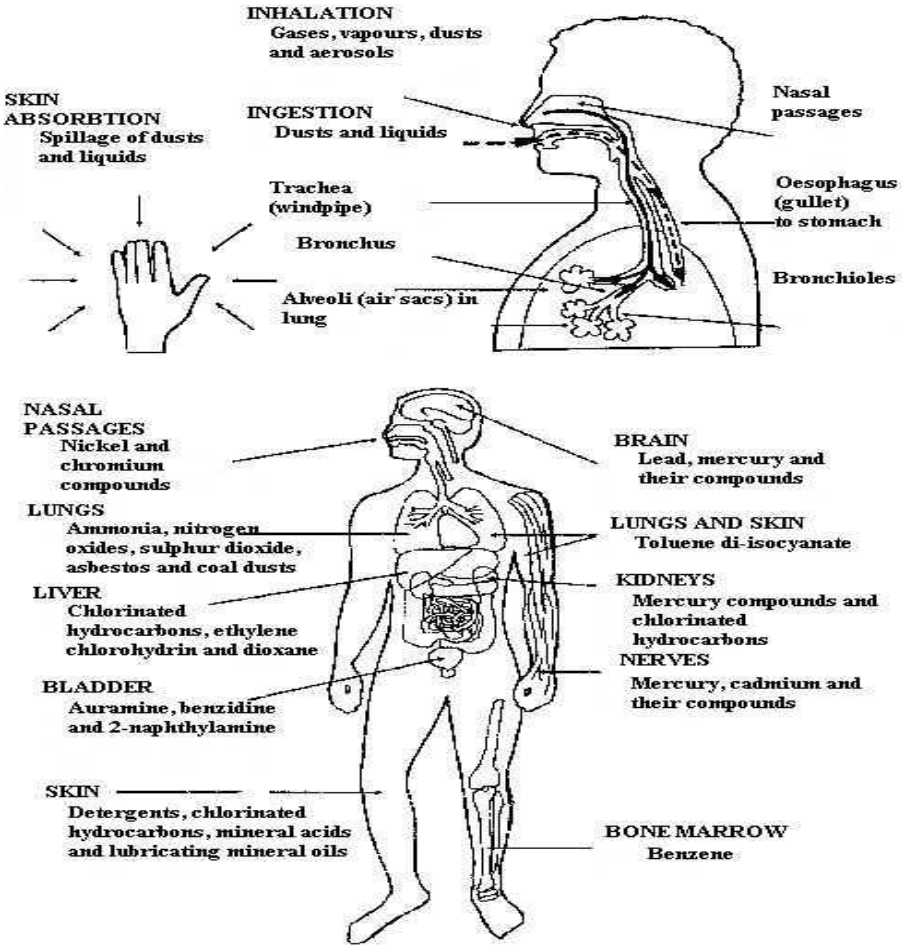


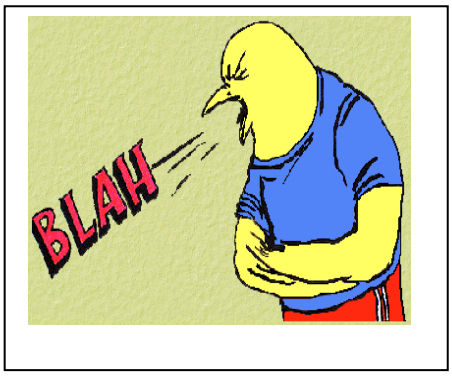
Fig. 1.1. Shows how chemical enter the body

It is important to understand that workers may show different physiological responses to industrial chemicals, just as people may show varied responses to different medicines, foods, etc. Some employers may try to select workers who are more "resistant to hazards" (so-called "super workers") and remove workers who show any signs of poor health. It is also common for employers to refuse to employ women of childbearing age on work processes that are known to affect the development of the fetus in the womb (such as work involving lead).

1.6.3 Toxic Effects of Chemicals

There are a number of factors that determine the type of toxic effect a chemical can have on you. These factors include:

- The chemical composition of the hazardous substance (certain substances are more harmful than others because of their chemical structure);
- The physical form of the chemical (dust, vapour, liquid, etc.);
- The route of entry by which the chemical gets into the body
- The particular tissues and organs in which the chemical collects or localizes;
- The frequency, concentration, and length of exposure; and
- The worker's individual response to the chemical, which can vary a great deal from person to person.



The toxic effects of a chemical may occur in one of three ways:

- **Acute** - Single Exposure
- **Intermittent** - Repeated Exposure
- **Chronic** - Long-Term Repeated Exposure

Some signs of potential chemical exposure (acute, intermittent or chronic) include:

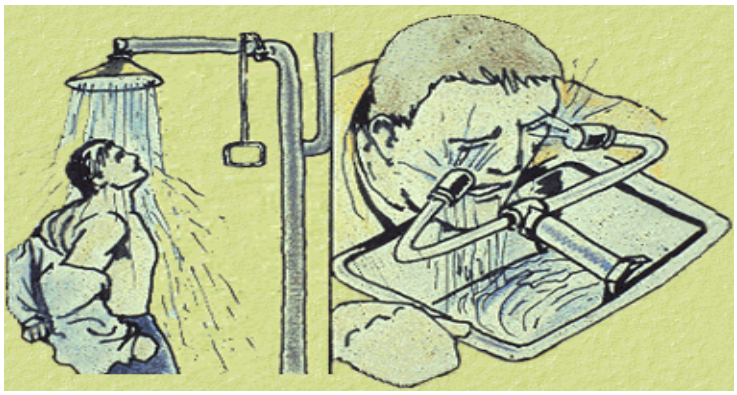
- Do you smell something? An odor in the air.
- Coughing
- Headache
- Fatigue
- Blotches on skin
- Burning sensations in the eyes, nose, mouth and/or throat.
- Nausea
- Dizziness

Toxicity

The concept of toxicity is unique because it can be applicable to all chemical substances used in the laboratory. The terminology explained below can not only assist laboratory workers in assessing the degree of hazard, but it can also provide guidance in the selection of appropriate personal protective equipment.

As defined, **toxicity** is the ability of a substance to cause damage to living tissue, impairment of the central nervous system, severe illness or in extreme cases, death when ingested, inhaled or absorbed through the skin.

Chemical Exposure to the Skin and Eyes



Eyes

If you get a chemical in your eye(s) get to an eye-wash, shower or sink. Flush your eyeball and inner surface of eyelid with water continuously for 15 minutes. When you get something in your eye it will most certainly be painful and irritating, you will not want to open your eye to flush it out.

Skin

If you spill a chemical on your person get to a shower or a sink. Don't be modest, remove any contaminated clothing immediately and flush the affected area with plenty of water for at least 5 minutes. Make sure chemical has not accumulated in shoes. If necessary seek medical attention.

	Points to remember **about routes of entry/health effects**

- Chemicals can enter the body by inhalation, ingestion, or skin absorption.
- Toxic chemicals can cause a variety of harmful effects on different parts of the body, including acute, local, chronic and systemic effects.
- There are a number of factors that determine the type of toxic effect a chemical can have on you, including the form of the chemical, route of entry, and individual response to the chemical.
- Exposure to toxic substances in the workplace can also lead to higher accident rates.
- It is important to learn about the substances you work with, make sure the proper control measures are in place, and to know your rights.

1.7. Checking and maintaining pre and post operation

Pre and post operational checks

- 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.

Sprayers

Most field sprayers in use today are

- Hydraulic:-May be mounted or self-propelled models.
- Electrostatic and air-directed sprayers.
- Boom and bloomless units to match wide range of applications.
- knapsack

The basic components are the

- Tank

- Pump
- Agitator
- Hoses
- Valves and fittings
- And nozzles.

Hoses should be oil resistant and durable.

The hoses should be large enough for proper flow

Nozzles vary according to

- Capacity
- Spray pattern angle
- And shape of spray pattern

Drift control is an important consideration for any type of sprayer. Drift can be caused by

- Wind at or near the ground or by high nozzle pressures
- Evaporation of the liquid on hot days.
- Combination of the three is present.

Drift contaminates other crops or the surrounding woods and streams.

Backpack Sprayers

Backpack sprayers consist of

- A tank
- A pump
- A spray wand
- One or more nozzles.
- Most backpack sprayers use hand pumps; however, some units have a small battery or engine-powered pumping system.

Hand-operated sprayers should have

- A comfortably located
- Reversible handle (to allow for left- or right-hand use).
- The shoulder straps should distribute the load evenly across the shoulders.

- Consider a hip belt to help carry the weight of the larger units.
- The wand should be comfortable and allow for easy use of the trigger.
- The sprayer should also have removable screens to protect the pump and nozzles.
- Should be cleaned regularly.
- The sprayer should have a stable base to hold it upright for filling and mixing.

1.8. Preparing and Adjusting Personal Protective Equipment's

Some agrochemicals such as pesticides are extremely hazardous to

- The health of workers
- The general public
- To the environment.

Therefore there should be strict regulations with regard to the production, sale and use of agrochemicals.

Wear protective clothing and equipment to **minimize exposure** to **pesticid**es during;-

- Mixing
- Loading
- Application and
- Clean-up

The most vital information when we use chemicals:-

- Read the Pesticide Label
- Use Personal Protective Equipment
- Protective Clothing and Equipment
- Protect your Lungs -Respirators
- Protective Equipment for Fumigants, Smoke Bombs and Foggers

- Wash Up & Clean Protective Equipment
- Laundering Protective Clothing
- Additional Resources

Protective Clothing and Equipment

I. Coveralls

Wear long sleeved coveralls over full length pants and long-sleeved shirts. Make sure the coveralls are closed at the neckline and wrists. Remove your coveralls as soon as you have finished your pesticide activities. Remove them immediately if they become wet through with pesticide. Wear waterproof clothing if you might get wet during pesticide application.

II. Waterproof Spray Suits

It should be made of a material that will resist penetration of the solvents in the pesticide. Rubber, neoprene, and polyvinyl chloride are usually suitable.

III. Gloves

- Always wear gloves when handling pesticides.
- Use unlined nit rile gloves unless the pesticide label recommends a different material.
- Do not use gloves made of leather, cloth, or natural rubber or gloves with cloth linings as these will absorb chemicals..

IV. Boots

Wear waterproof, unlined knee-high boots of rubber or neoprene when you load, mixes or applies pesticides. Wear your pant legs outside of your boots so the pesticide doesn't

run into your boots. Do not wear boots made of leather or fabric. Wash the outside of your boots after each use.

V. Goggles and Face Shields

- Pesticides are readily absorbed through the eyes and can cause eye injury.
- Wear goggles if there is a chance of getting pesticide spray or dust in your eyes.
- Do not use goggles with cloth or foam headbands.
- Do not wear contact lenses when handling pesticides as they are permeable to vapors and gases.

Safety goggles have three types of venting:

- open vents for impact protection only, not recommended for use with pesticides;
- indirect vents for protection from pesticide and other chemical splash;
- Non-vented for protection from gases, mists and fumes.

VI. Hats

- Protect your head and neck area.
- Do not wear baseball caps, fabric hats, straw hats or hats with leather or cloth inner bands as these will absorb and retain pesticides.
- Wash waterproof hat in warm, soapy water immediately after use and store in a clean, dry place.

VII. Aprons

Wear a waterproof apron when you pour and mix concentrated pesticides to protect yourself from splashes.

Protect your Lungs - Respirators

Types of Respirators

Four types of respirators are discussed below:

I. **Chemical Cartridge Respirators** are available in different sizes in half face and full face models. The half face piece respirator is the most common respirator worn for pesticide use. Filters are attached to the face piece. There is a dust pre-filter and a cartridge filter. The cartridge filter contains absorbents such as activated charcoal to remove pesticides.

II. **Canister Respirators**are similar to cartridge respirators but generally have a full face piece and a larger canister of absorbent material. They should not be used to work in a greenhouse after release of a fumigant.

III. **Powered Air Purifiers** use an electric pump to draw air through a filter. Breathing is easy because no effort is required to draw air through the filter.

IV. **Supplied-Air Respirators** come with their own air supply, either a cylinder worn on the back, or a line to a distant tank. They are designed for use in emergencies such as re-entries to fumigated areas or fighting fires in a pesticide storage area.

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Illustrations may be necessary to aid some explanations/answers.

Test I: Choose the best answer and encircle on it (2 marks each)

- Which one is not true about safely used of chemicals?

  A. Follow the manufacturers' instructions on the label.
  B. Avoid exposing non-target animals or plants.
  C. Always use any agricultural chemicals
  D. Always wear protective clothing

- When labeling containers one should:

  A. Not worry about labeling containers since you know what they contain
  B. Only label containers that contain hazardous chemicals
  C. Label all containers since an unlabeled container may result in a citation for violating state and federal hazardous waste regulations
  D. Only label containers that contain bio-hazardous agents

Test II: Answer the following questions briefly and accordingly (4 marks each)

1. List and describe routes of chemical exposure in to the body?
2. Mention the symptoms/signs of chemical exposure?
3. List the specified information's on properly labeled chemical containers?
4. Differentiate the following signal words regarding to the degree of hazard?

Note: Satisfactory rating -20 marks Unsatisfactory rates- below 20 marks

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

Operation Sheet -1

1.1 Techniques of Selecting personal protective equipments and personal hygiene

A. Tools and equipment's

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

B. Procedures/Steps/Techniques

- Identify chemical which needs protective equipment and which does not needs
- Identify different types of protective equipment
- carry out how to wear protective equipments and clothing, never wear leather products which absorbs chemicals
- mix one of the chemical and apply
- In case of a pesticides spill or splash at work site, wash your body immediately after contact.
- Clean protective equipments and clothing after application
- Wash your hands or take shower at the end of the application.

LAP TEST-1	Performance Test

Name _____ Date: _____

Time started: _____ Time finished: _____

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

1. Perform Selecting personal protective equipments and personal hygiene

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LG #31	LO #2- Follow Chemical Handling and Storage Rules

Instruction sheet

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

- Following chemical handling and storage instructions
- Identifying chemical storage locations
- Following instructions and safety rules
- Following procedures of chemical accident

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

- Follow chemical handling and storage instructions on labels
- Identify chemical storage locations
- Follow instructions and Safety rules for transport, handling and storage of chemicals
- Follow procedures in the event of chemical accident and/or spillage

Learning Instructions:

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

Information sheet- 2

2.1.Following chemical handling and storage instructions

2.1.1. Safe handling of agrichemicals

There are many chemicals on the farm and some of them can be dangerous. Common agricultural chemicals include fuels, pesticides, herbicides, fungicides and veterinary chemicals. Exposure to chemicals can lead to health effects including headache, poisoning, respiratory illness, burns, cancers and birth defects. Always follow the manufacturers' instructions for storage, transport, use and disposal of chemicals. Keep all chemicals locked away and out of reach of children and wear appropriate protective gear.

Any chemical should be treated with extreme caution and only ever used according to the instructions. Vapours or direct exposure can lead to a variety of health effects, including headache, poisoning, burns, cancers and birth defects.

Hazardous materials are required by law to include a Material Safety Data Sheet (MSDS) and label. The MSDS gives valuable information on how to safely handle the chemical. Before using any farm chemical, you should read the label, understand the MSDS and follow usage instructions.

To further reduce the risks, it is worth remembering that hazardous chemicals can occasionally be replaced with less toxic options. Sometimes, a safer form of the product is available. For example, pellets may be used instead of powder.

Side effects of exposure

The effects of chemical exposure depend on the type of chemical and the degree of exposure. If chemicals are swallowed, absorbed through the skin or inhaled as a mist, vapour or dust, some of the immediate and long-term effects can include:

- Poisoning
- Headache
- Skin rashes and irritation
- Chemical burns
- Cancer
- Birth defects
- Diseases of the lungs, liver or kidneys
- Nervous system disorders.

Generally, Suggestions for the safe storage of chemicals include:

- Always follow the manufacturers' instructions for proper storage.
- Keep chemicals in their original containers and **don't pour** into smaller bottles.
- Don't remove labels from containers.
- Store chemicals in a locked, well-ventilated shed with floors that will contain spills.
- Store chemicals and personal protective equipment (PPE) in different locations.
- Separate different classes of chemicals to prevent reactions.

2.2. Identifying Chemical Storage Locations

The chemical storage should be identify properly and deposits of spillage clean-ups, discarded items grossly contaminated with agrochemicals, contaminated aqueous waste such as animal dips, and empty containers must be disposed of safely.

The following general steps should be observed during disposal of waste:

- Agrochemical waste should never be dumped indiscriminately
- Agrochemicals should never be disposed of so as to cause any risk to people, animals, crops, water supplies or the environment.
- Advice should be sought from the supplier, local authority or community leader.
- Accumulation of waste should be avoided.

- Waste should be disposed of as soon as possible.
- The user should read the label on the package or container for any specific advice on waste disposal.
- Empty agrochemical containers should never be reused except possibly, if in good condition, to contain an identical product transferred from a deteriorated or leaking container.
- All other containers should always be cleaned thoroughly before disposal.
- Care should be taken to ensure that the water used for rinsing does not contaminate the environment; particularly drinking-water, for example.
- Liquid containers should be drained out before cleaning.
- After cleaning, the containers should be punctured in several places or crushed to make them unusable, and stored in a secure compound until their disposal is arranged.
- Packages of dry powders and granules must be shaken out thoroughly into a mixing vessel or the applicator tank.
- Containers may be buried on premises owned or occupied by the agrochemical user.

Store Now that the sprayer has been thoroughly cleaned, you may want to remove parts of it that may be damaged during storage.

• Remove strainers (filters) and wash them by hand with soapy water (remember to wear chemical-resistant gloves), rinse them and either store them or place them back in the sprayer.

• Pay special attention to nozzles, nozzle bodies and check valves. Chemical residue can build up in these areas and harden over winter, dramatically reducing the sprayer's performance next season.

• Remove nozzle tips, screens, check valves, caps and nozzle bodies from the nozzle body assemblies. Correctly plug the assemblies.

• Clean and rinse out the nozzle tips, nozzle bodies and check valves. And then store in a marked container properly. Store check valves at room temperature over the winter to avoid damage that can be caused by freezing temperatures.

- Remove all pressure gauges and cap the openings on the sprayer. Store the gauges where they are not subjected to freezing or damage. Finally, circulate antifreeze through the sprayer and all plumbing, including booms, valves, manifolds, flow meters and agitation/return lines. Allow the antifreeze to circulate through the boom's hoses.

Fig.2.1. Storage Cabinets and Shelves

2.3. Following Instructions and Safety Rules

2.3.1. Material Safety Data Sheet (MSDS) Information

Manufacturers and importers are required to supply a Material Safety Data Sheet (MSDS) that details information on the chemical, including:

- The registered use of the chemical
- Precautions for use
- Possible health effects
- Safety measures for handling
- Contact numbers for further information

Withholding periods – It is the responsibility of the farmers to ensure correct usage and slaughter or production-withholding periods are observed.

It is important that you research chemicals prior to purchase to ensure that you buy the most suitable and least dangerous chemical available to do the job you require. MSDSs can be found

online to assist in safe and effective chemical choices and should be thoroughly read before use and kept in an accessible place for reference.

Things to remember

Exposure to chemicals can lead to a variety of immediate or long-term health effects including headache, poisoning, respiratory illness, burns and birth defects.

Manufacturers and importers are required to supply a Material Safety Data Sheet (MSDS) that explains how to handle the chemical safely. Always follow the manufacturers' instructions on storage, use and disposal of chemicals. Organizations such as Work Safe Victoria can offer valuable advice on improving health and safety on your farm.

Suggestions for the safe use of chemicals include:

- Ensure anyone using agricultural chemicals is suitably trained to use both the chemical and any equipment required for application.
- Only mix the quantity of chemical required for the task at hand.
- Make sure the decanting and mixing area is well ventilated. If this is not possible, ensure that appropriate personal protective equipment (PPE) is worn for enclosed environments.
- Follow the manufacturers' instructions on the label.
- Always wear protective clothing such as chemical-resistant gloves, face shields or masks, overalls and goggles.
- Avoid exposing non-target animals or plants.

2.3.2. Safe Disposal Procedures

Suggestions for the safe disposal of chemicals include:

- Always follow the manufacturers' instructions for proper disposal of both chemicals and rinsate from equipment.
- Return empty containers to the manufacturer or check with your local council on proper disposal methods.

- Audit your chemical store on a regular basis and dispose of any excess or outdated chemicals in the appropriate manner.

Agrochemical spillage is both wasteful and hazardous. It should be avoided wherever possible but when it occurs it should be dealt with immediately. Some common causes of spillage are:

- Containers bursting as a result of bad handling;
- Container leaks due to defective packaging that does not withstand heat or humidity; – containers being punctured during transport by sharp edges or metal studs protruding upwards through vehicle floorboards;
- Careless pouring while transferring from container to applicator;
- Equipment failure prior to or during application because of worn pipe couplings or hose lines. Action in the event of spillage should include:
- Taking immediate steps to avoid the spillage spreading and contaminating a wider area; – keeping other people, animals and vehicles away from the site;
- Wearing protective clothing appropriate to the use of the concentrated formulation involved;
- Soaking up the agrochemical with absorbent material such as dry sand, soil or wood shavings in the case of a liquid, and removing the contaminated matter with a brush and shovel and storing securely in a bag to be disposed of safely. Using sand to contain and remove an agrochemical spill
- Removing a dry powder or granule gently with a brush and shovel and storing securely in a bag to be disposed of safely. If there is a risk of the spillage becoming airborne, some damp sand should be scattered before attempting to decontaminate;
- Decontaminating any remaining traces of spillage including that on vehicles or equipment by washing down and draining the contaminated water to a safe place, or soak-up;
- Bathing or thoroughly washing immediately afterwards.

Disposal of containers and waste.

There will be circumstances when agrochemicals in store need to be disposed of safely. They may no longer be required or may be out of date, or the packaging may be broken or the container damaged. Similarly, deposits of spillage clean-ups, discarded items grossly contaminated with agrochemicals, contaminated aqueous waste such as animal dips, and empty containers must be disposed of safely.

The following general steps should be observed during disposal of waste:

- Agrochemical waste should never be dumped indiscriminately.
- Agrochemicals should never be disposed of so as to cause any risk to people, animals, crops, water supplies or the environment.
- First of all, the supplier should be asked if he would accept the waste for disposal. – Whenever possible, waste should be disposed of through a company or persons licensed to handle waste disposal. Advice should be sought from the supplier, local authority or community leader.
- Accumulation of waste should be avoided. Waste should be disposed of as soon as possible.
- The user should read the label on the package or container for any specific advice on waste disposal.
- Empty agrochemical containers should never be reused except possibly, if in good condition, to contain an identical product transferred from a deteriorated or leaking container. All other containers should always be cleaned thoroughly before disposal. They may be cleaned in accordance with the labeled instructions.

In the absence of instructions, rinse the containers in water successively at least three times. Care should be taken to ensure that the water used for rinsing does not contaminate the environment; particularly drinking-water, for example. Liquid containers should be drained out before cleaning. Ideally cleaning should take place when a spray mixture is being prepared so that the drained material and the rinsing liquid can be added to form a part of that mixture.

2.3.3. Seek medical help

- If you think you are suffering any ill effects from chemical exposure, see your doctor immediately, contact Poisons information or go to a hospital with an emergency department. Be sure to inform them what chemicals you may have been exposed to (take your MSDS).
- Try to avoid using the chemical in the future, select the safest possible chemical to use and follow MSDS.

Things to remember

- Exposure to chemicals can lead to a variety of immediate or long-term health effects including headache, poisoning, respiratory illness, burns and birth defects.
- Manufacturers and importers are required to supply a Material Safety Data Sheet (MSDS) that explains how to handle the chemical safely.
- Always follow the manufacturers' instructions on storage, use and disposal of chemicals.
- Organizations such as Work Safe Victoria can offer valuable advice on improving health and safety on your farm.

2.4. Following Procedures of Chemical Accident

Accidents and emergency situations preparation is the best defence against emergencies. Operators should always know in advance what to do in emergency situations. Written emergency procedures should be available to all operators at all times. During poisoning consult the pesticide label and the MSDS for specific information on first aid. Never put yourself at an unreasonable risk to rescue others, as you may become the next victim. If there is any doubt about whether a person has been poisoned or not, seek medical attention.

2.4.1Safe and Effective Pesticide Use: A handbook for commercial spray operators safety first follow first aid steps for anyone who is poisoned or exposed to a pesticide. These could include: removal of affected clothing immediately washing of contaminated skin with soap and water. If chemical is splashed in the eye, wash it immediately in running water for 15 minutes and call a

doctor immediately. Leaks and spills consult the relevant MSDS or manufacturer of the pesticide for specific information on handling leaks and spills. In the event of a chemical spill: ensure it is safe for you to approach the incident area move people to a safe distance from the incident area keep bystanders away from the spill contain the spilled material if possible, using absorbent material use absorbent material to soak up spilled liquid clean up the spill.

MSDS have information on clean-up and decontamination procedures. If in doubt, contact the emergency phone number on the pesticide label for specialist advice. A person licensed as a Pest Controller or Pest Management Technician must report any spillage of pesticide that, due to its magnitude, location or toxicity may require assistance to manage, or may have an immediate impact on the environment or public health and safety. The spillage must be reported. In any fire involving pesticides, the first response is to ensure your own safety, then to raise the alarm Fire and pesticides.

In any fire involving pesticides, the first response is to ensure your own safety, then to raise the alarm, both to people in the vicinity and to the relevant fire authority. Next, evacuate people from downwind of the fire. Do not fight the fire yourself unless you are certain of your own safety. When the fire is extinguished, clean up as for leaks and spills. If there is a risk of contaminating waterway the water and foam used in firefighting should be contained.

2.4.2. Emergency precautions and equipment

Applicators must have easy access to emergency decontamination and first aid kits whenever they are applying herbicides, even if they are out in the field. All applicators should have access to an eyewash kit and at least 2 gallons of clean water. Decontamination kits are available from many suppliers or can be assembled independently. Rubber buckets or tubs with tight sealing lids are convenient for homemade kits and should include:

- Two (or more) 1 gallon containers filled with potable water,
- Eyewash kits or eyewash bottles with buffered isotonic eyewash,
- Hand or body soap (bring enough for all workers to thoroughly wash their hands when in the field),

- Paper or other disposable towels,
- A full tyvek coverall with foot covers,
- A map and directions to the nearest medical facilities

Generally, keep away from clothing and other combustible materials. Take any precaution to avoid mixing with combustibles. Wear protective neoprene gloves, safety goggles and face shield with chin guard. Wear fire/flame resistant clothing. Do not breathe dust or mists. Wash arms, hands and face thoroughly after handling. Store locked up. Dispose of contents and container in accordance with local, state and federal regulations.

First aid:

- **If on skin** (or **hair) or clothing**: rinse immediately contaminated clothing and skin with plenty of water before removing clothes. Wash contaminated clothing before reuse.
- **If in eyes**: rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- **If inhaled**: remove person to fresh air and keep comfortable for breathing. immediately call a doctor
- **If swallowed**: rinse mouth. donot induce vomiting. Immediately call poison center.

Specific Treatment: Treat with doctor-prescribed burn cream. Fire: In case of fire: Use water spray. In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.

Self-check 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer and encircle it. (2 marks each)

1. When storing chemicals one should:
   A. Store all chemicals together in one place and sort alphabetically
   B. Separate chemicals into compatible groups, and within each group store the chemicals alphabetically
   C. Store all chemicals in a laboratory fume hood
   D. Store chemicals in the hallway if your lab has run out of space

2. Which one of the following is true about the side effects of chemical exposures for human beings?

   A. Normal nervous system
   B. Cancer free
   C. Skin rashes and irritation
   D. Free headache

Test II: Answer the following questions briefly and accordingly (3 marks each)

1. Putdown and explain some of the general rules of handling and storing chemicals safely?
2. What are the safe disposal procedures?

Note: Satisfactory rating – 10 marks Unsatisfactory rates- below 10 marks

Operation Sheet -2

2. 1**Techniques of Site selection, handling and storage of chemicals**

A. Tools and equipments

- PPE
- Water
- Soap
- Marker
- Notebook
- Store
- Pesticides/ chemicals

B. Procedures/Steps/Techniques

1. Select the site that separated from other equipments and storage facilities and far from flood plain
2. Select materials for construction
3. Construct a simple storage house
4. Make ventilation, spill and drainage and have sources of heat and water be fireproof
5. Make a secure locking systems
6. Mark the building with placards indicating the presence of pesticide inside the house
7. Store the pesticides
8. Separate each pesticides class for storage on its own shelf
9. Keep the product off the floor
10. Practice a good housekeeping or lock the house

LAP TEST-1	**Performance Test**

Name _____ Date: _____

Time started: _____ Time finished: _____

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

1. Perform proper site selection and store chemical

LG #32	LO #3- Preparing Chemicals and Calibrating Equipment

Instruction sheet

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

- Introduction to the module
- Measuring and decanting of chemicals with directions
- Practicing simple calibration of equipment and chemicals
- Following safe working practices

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

- Measure and decanting of chemicals comply with directions
- Practice simple Calibration of equipment and chemicals based on the procedures and label recommendations.
- Follow safe working practices relevant to the situation.

Learning Instructions:

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

Information Sheet 3

3.1. **Measuring and Decanting of Chemicals with Directions**

Definitionof Decanting

Decanting should be avoided because of the difficulty of maintaining identification of decanted contents in new containers, unless used immediately. An example of immediate use is when measuring out an amount of pesticide and pouring it directly into a spray tank.

A chemical must not be transferred from one container to another (decanted), unless both containers are properly labelled. A chemical should be decanted only into another container designed for the chemical. Some chemicals can react with the container, if the wrong type of container is used. Do not decant a chemical into a food or beverage container.

Where reasonably practicable chemicals should be kept in their original container with the original labelling. Where chemicals are decanted the new containers must be appropriate for the chemical they will hold and be correctly labelled.

Decanting chemicals in explosive atmospheres or chemicals that may produce explosive atmospheres require special arrangements that will not produce static electricity (egearthing equipment, non-synthetic protective garments).

Particular attention must be given to decanting chemicals that have unique hazards such as:

- Solvents which can create explosive atmospheres; a
- Asphyxiates.

Fig 3.1 decanting chemical

3.2. Practicing simple calibration of equipment and chemicals

3.2.1. Calibration

Is the method used to determine the proper amount of chemical is being applied, the operator must measure the output of the application equipment. Calibration is a technique that identify sprayers whether they are functional or not functional. Calibration not only ensures accuracy, a critical factor with regard to many chemicals, but it can also save time and money and benefit the environment.

Why calibrate?

- Enables the accurate calculation of how much product to add per tank and that product‘s optimal safe use. Under-dosing can lead to product failure, over dosing can lead to un-acceptable crop residues and other risks.
- Both under-dosing and over-dosing lead to wasted product and wasted money.
- To determine the required amount of water and chemicals

- To know materials weather they are functional or not functional.

I. Calibration of chemicals

Careful and accurate control of ground speed is important for any type of chemical application procedure. From large self-propelled sprayers and spreaders to small walk-behind or backpack units, precise ground speed is a key for success. Ground speed can be determined by one of two methods.

The first method requires a test course and stopwatch. For this procedure, measure a suitable test course in the field and record the time it takes to cover the course with the equipment. The course should be between 100 and 300 feet long. Drive or walk the course at least twice, once in each direction, and average the times for greater accuracy.

The second method is to use a true ground speed indicator such as a tractor-mounted radar or similar system. Do not rely on transmission speed charts and engine tachometers. They are not accurate enough for calibration.

Factors affecting application volume -

- Forward speed
- Nozzle size, type and condition
- Sprayer pressure
- Operator accuracy

Calibration process

- Fill the knapsacks spray tank to maximum rated capacity with clean water.
- Set the correct operating pressure.
- Spray holding the nozzle at the required height and measure the swath width.

Using the calibration chart find out how far you must walk to cover $100m^2$

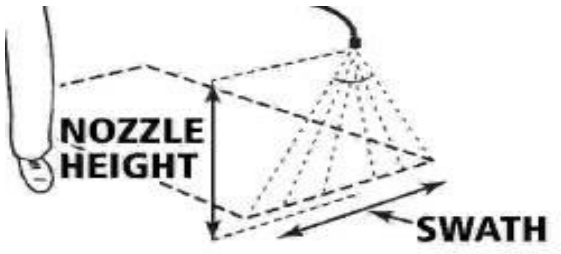


Fig.3.1. Swath width

Most nozzles have an optimum height of 50cms above the first intercepting surface

Procedures of calibration;

- Measure the small area .Final out its area is sqm (L*W)= a sqm
- Pour measured quantity of water in tank of sprayer (water) = V1 liter
- Spray the area uniformly with pump and nozzle tube used for spray
- Measure the left over water in tank (water) = V2 liter

The formula for sprayers' calibration is;

$$\mathbf{Q} = \frac{(\mathbf{V1} - \mathbf{V2}) \times \mathbf{A}}{\mathbf{a}}$$

Where;

Q = Quantity of water required (L/ha)

V1 = volume of water (L) in the sprayer before spray

V2 = Volume of water (L) in the sprayer after spray

A = one hectare (10000m^2)

a = measured area of spray (m^2)

Area covered per unit hour can be calculated using formula given below.

$$\text{Area (ha)} = \frac{\text{Walking speed } \left(\frac{\text{m}}{\text{hr}}\right) \times \text{Spray width (w)}}{10000\text{m2}}$$

Example: Aperson walks with speed of 1km/hr covers swath of 0.5mwide. How much area he will be cover in one hour?

Solution:

$$\text{Area (ha)} = \frac{1000\ (\text{m/hr}) \times\ 0.5\text{m}}{10000\text{m2}} = 0.05\text{ha/h}$$

II. Calibration of sprayer equipment

For calibration to be successful, several items need to be taken care of before going to the field. Calibration will not be worthwhile if the equipment is not properly prepared. Whenever possible, calibration should be performed using water only. If you must calibrate using spray mixture, do so on a site listed on the chemical label and with wind speeds less than 5MPH. Always follow high hygiene standards when working with crop protection products. Spraying equipment must be calibrated at least once in every season of useKeep calibration records. Product labels often contain recommendations on optimum application volumes, timing and the choice of nozzles

Follow the steps outlined below to prepare spraying equipment for calibration.

- Inspect the sprayer.
- Be sure all components are in good working order and undamaged.
- Check the label of the product or products to be applied
- Next, determine some information about the sprayer and how it is to be operated
- Choose an appropriate nozzle or nozzles from the manufacturer's charts and install on the sprayer.
- Fill the tank half full of water and adjust the nozzle pressure to the recommended setting.
  - ✓ Measure the discharge rate for the nozzle.
  - ✓ This can be done by using a flow meter or by using a collection cup and stopwatch.
  - ✓ The flow meter should read in gallons per minute (GPM).
  - ✓ If you are using the collection cup and stopwatch method
- Whenever possible, calibrate with water instead of spray solution.
  - ✓ Do not calibrate with spray solution unless required by the chemical label.
  - ✓ Follow all recommendations on the label.
  - ✓ If the spray solution has a density different than water, the rate can be corrected using the procedure shown in Calibration Variables.

3.3. Following safe working practices

3.3.1 Follow Safe working practices

Safety

- Safety precautions must be taken when spraying pesticides.
- Gloves, boots, eye protection, andcoveralls are needed when spraying,

and a hat should be wear if spraying tall crops.

3.3.2. Safe use of chemicals

Suggestions for the safe use of chemicals include:

- Ensure anyone using agricultural chemicals is suitably trained to use both the chemical and any equipment required for application.
- Use chemical decanting kits to reduce the risk of spills and splashes while mixing chemicals.
- Only mix the quantity of chemical required for the task at hand.
- Make sure the decanting and mixing area is well ventilated. If this is not possible, ensure that appropriate personal protective equipment (PPE) is worn for enclosed environments.
- Follow the manufacturers' instructions on the label.
- Always wear protective clothing such as chemical-resistant gloves, face shields or masks, overalls and goggles.
- Avoid exposing non-target animals or plants.
- Triple rinse equipment after chemical application and dispose of the rinse water (rinsate) appropriately. Rinsate contains low concentrations of the chemical from the cleaning process.

Handling Agricultural Chemicals Safely Eight Points to Remember

I. Read and understand the information contained in the product label and the MSDS, before you begin working with any agricultural chemical product.

II. Always wear the appropriate safety equipment, as required on the label and MSDS.

III. Follow all label directions and legal requirements for mixing, handling and empty package disposal.

IV. Prevent splashes and spills. Recover any spilled chemical product and return it to the mix or to storage.

V. In case of an accident, report it to your supervisor immediately, so that you can proceed with the proper cleanup Report any spill, no matter how small.

VI. Follow established security procedures to ensure only authorized personnel's access to chemicals.

VII. Secure all chemical containers for safe transport.

VIII. Follow all label directions and established practices for field mixing, application and cleanup.

3.3.3. A Workplace should be safe for all workers

Any union strategy to protect workers against chemical hazards should try to create a working environment where it is safe for all workers — the average worker (male or female) and even vulnerable workers — to work without the job affecting their health. Regular medical examinations must never be used by the employer to eliminate “vulnerable” workers, such as women of childbearing age.

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions**:Answer all the questions listed below.**

Test I: Choose the best answer

1. Which one is a method used to determine the proper amount of chemical and water being applied(3marks)

A. Decanting B. Calibration C. Sprayer D. Chemical

2. From the following one is not factors affecting application volume of chemical (3marks)

A. Forward speedB. Nozzle size,

C. Type of nozzleD. Nozzle colour

Test II: Short Answer Questions

1. Define decanting of chemical (3marks)
2. Write importance of calibration(3marks)
3. Write factors affecting application volume (3marks)

Note: **Satisfactory rating - 15 points Unsatisfactory - below 15 points**

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

Operation Sheet -3

Techniques/Procedures/Methods calibrating equipment and Calibration of Chemical

3.1. Calibration of equipment

A. Tools and equipments

- Sprayer(knapsack)
- Water
- Water container
- PPE

B. Procedures/Steps/Techniques

1. Select PPE
2. Fill the sprayer with clean water
3. Apply the water with normal technique
4. Check for leaks if there is leakage, pinpoint where it is and repair or replace the parts.
5. Check for any coarse particle blocking/interfering the flow of water through the pipes to the nozzle.
6. Check your nozzle give a uniform output, if not change it.

3.2.Calibration of Chemical

Techniques ofdetermining volume application rate (VAR)

A. Tools and equipment's Materials

- Knapsack
- Measuring cylinders
- Goggles ,glove .hats , boot, cover all, half face respirators
- Water
- meter

B. Procedures/Steps/Techniques

<u>Method 1</u>

1. Measure and mark out an area of crop 10 m x10m ($100m^{2)}$.
2. Fill the sprayer with clean water
3. Spray the measured area with normal spraying technique.
4. Find out how much you have used by measuring the amount of water needed to refill the sprayer, or checking the liquid level against the markings on the tank.

5. Step 4: Use the following formula to calculate the volume application rate. (VAR in liters/hectare)

Vol. App. Rate (liters/hectare) =$\frac{\text{volume used (litres)x10,000m}^2}{\text{Area Sprayed (m}^2}$

Method 2

1. Step 1: Determine swath width.
   - Partly fill the sprayer with water and attach the appropriate nozzle.
   - Select a dry target area e.g. concrete ground, holding the nozzle at the correct height spray stationary.
   - Measure the wetted area, which area, which shows a uniform dark band, repeat three times.
   - Calculate the average swath in meters (m).
2. Step 2: Determine walking speed.
   - Mark out a line at least 100m long and put a stake at each end.
   - Start spraying and walk at comfortable speed along the line while spraying correctly.
   - Measure the distance walked in exactly one minute.
   - Repeat the operation and calculate the average walking speed in meters per minute (m/min).
3. Step3: Determine sprayer output.
   - Adjust the pressure at the required level and
   - pump the sprayer using steady strokes and
   - Collect the spray in dry bucket, or other container, for exactly one minute, measure the water collected in the bucket.
   - Repeat the operation and
   - Calculate the average output in liters per minute (1/min) using the following formula.

Vol.App. Rate (lit/ha) = spray output (lit/min) =$\frac{\text{spray output (lit /min)x 10,000m}^2}{\text{Walking speed (m/min)x swath width (m)}}$

LAP TEST-3	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary tools and materials you are required to perform the following tasks within 4 hour. The project is expected from each student to do it.

Task 1-perform calibration of sprayer (knapsack)

Task2- perform calibration of chemical

LG #33	LO #4- Apply chemical

Instruction sheet

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

- Identifying and assessing OHS hazards and risk
- application of required dose of chemicals
- Applying chemical on the target field
- Observing re-entry, withholding, plant back and restocking periods

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

- Identify hazards and recognize associate risks
- Follow requirements for application equipment to accurately and effectively apply the required dose of the chemical to the target
- Apply chemical on the target field
- Determine and observe re-entry, withholding, plant back and restocking periods by label directions

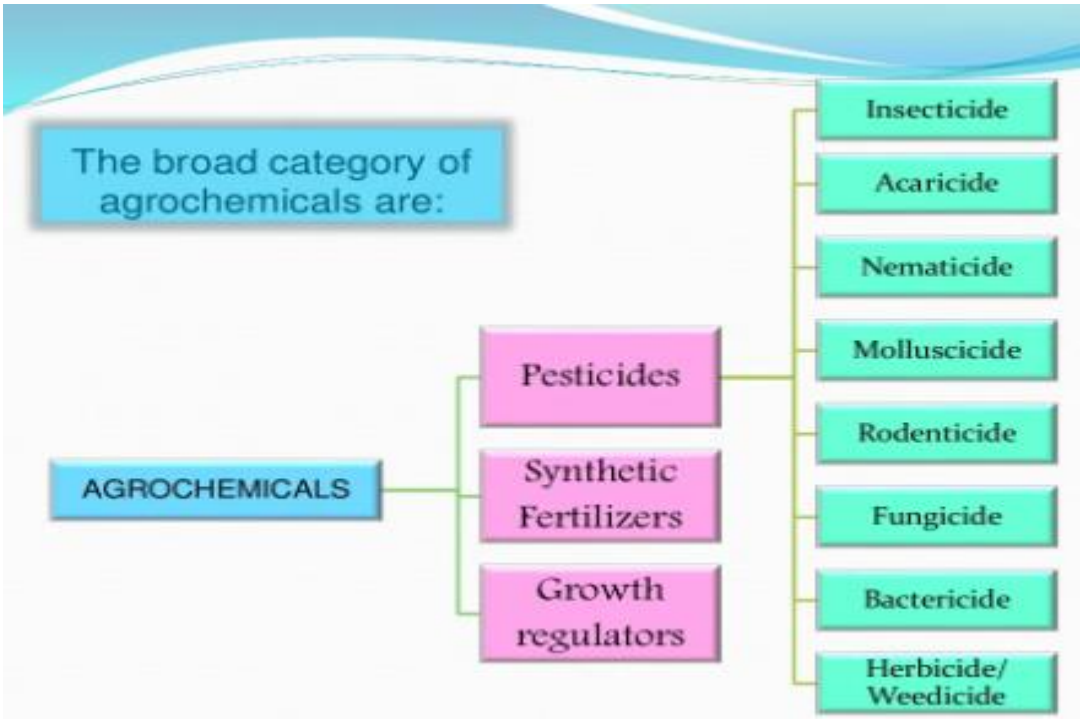
Learning Instructions:

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

Information Sheet4

Definition

Chemical applications means the application of herbicides, pesticides, organic or mineral-derived fertilizers, or other hazardous substances.



4.1. Identifying and Assessing OHS Hazards and Risk

Work place hazards

The various work place environmental factors or stresses that may cause sickness, impaired health, or significant discomfort or inefficiency in works may be classified as

- Chemical
- Physical
- Biological and
- Ergonomic (psychology)

I. Chemical hazards

Chemicals make up the majority of work place hazards. They include many or naturally occurring substances as well as the simple and complex manufactured chemical Products.

Chemical hazards include the followings;-

A. Dusts

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

B. Mist

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

C. Gases

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

D. Fumes

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

E. vapors

Gaseous form of a substance that is normally a liquid, or solid.

E.g. alcohols

Precautions

Pesticides carry one of three precautionary words or phrases.

- **DANGER-POISON**

The products most toxic to humans will be labeled “Danger- poison and display a skull & crossbones. These products are extremely toxic in the form in the container, before they are diluted. Only a few drops could cause severe burns, serious health problems or even death.

- **WARNING**

Products labeled Warning are less toxic to humans, but extreme care must be exercised in their use, particularly before they are diluted.

- **CAUTION**

The word caution will appear on those pesticides that are the least harmful when used as directed. These products, however, can still cause serious injury or health problems, and even death.

II. Physical hazards

All work places encounter some agents of the physical environment which have potential to present health hazards at work.The physical hazards can be:

A. Noise:

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

Typical farm noises that can damage hearing include:

- Tractor
- Chainsaw etc

Some early warning signs of hearing loss include:

- Ringing in the ears after work
- Difficulty understanding a normal conversation
- Turning up the volume on radio or television when others appear to hear adequately
- Failing to hear background noises, such as a ringing telephone or doorbell.

B. Vibration

In fact, high frequency, low amplitude vibration is absorbed and damped by the layers of muscle that envelop the skeleton. A typical example is the vibration of the steering wheel of a tractor or a combine harvester.

Low frequency high amplitude vibration is dangerous for the skeleton and the internal organs such vibration occurs on all vehicles, but chiefly on those without springs (tractors, combine harvesters, and on machines drawn by tractors.

C. Heat

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

III. Biological hazards

Some biological hazards of work place include:

- Bacteria
- Fungal
- Virus etc

IV. Ergonomic hazards

Ergonomic (human engineering) is a way of thinking and planning work so that it is organized to suit the abilities and needs of the people doing it.

- Working positions- standing
- Working positions –sitting
- Visual conditions
- Strenuous work

4.2. Application of required dose of chemicals

Applying the required dose

Agrochemicals should be applied with optimum dose, if it is beyond the required dose it will hamper creatures as well as their living ecosystem. Hence, we have to apply agrochemicals with

the required dose.

To achieve the best result, it is essential that the right amount of pesticides should reach the target. Too much chemicals can damage crops and cause excessive chemical pollution. Too little will not eliminate the pest. Consequently, either to much or to little is very expensive. Lack of precision cost too much in chemicals and wastes manpower as well as damage the environment. Therefore, accurate matching of chemical and spraying technique to crop and environment is very important.

There are a variety of techniques for the application of pesticides depending upon the type of pesticide, formulation, target and its size. Most techniques involve equipment of some sort, which might be simple or complex to save labor and time and to ensure efficient application.

During application:

- Wear the personal protective equipment recommended on the label.
- Use the label rate.
- Use application equipment that is calibrated, properly maintained, and adjusted for the crop being treated. .
- Use separate equipment for applying chemicals
- Shut off the spray nozzles when you turn.
- Wear gloves to replace or clean plugged nozzles.
- Spray when human activity nearby is unlikely
- Do not work alone when handling very toxic chemicals.
- Avoid eating, drinking, smoking, and touching your face during chemical application.
- Wash before eating, drinking, smoking or using the toilet.
- Have fresh water available for emergencies.
- Prevent chemicals from contaminating non target areas
- Spray when the wind is blowing away from sensitive areas

4.3. Applying chemical on the target field

I. Target Area

For the purpose of safeguarding against injury either to yourself, fellow employee or an adjoining neighbour, occupier or passer-by, you should always be familiar with the target area or the area you are expected to spray. A location check may reveal hazards and potential problems that can be minimized or overcome before you arrive on the scene with a tank full of chemicals ready to go.

On your physical inspection of the area look for:

- nature of the terrain and environment;
- slopes;
- surface hard or soft sand;
- how close is the surrounding bush land , crops of neighbors or neighbor's gardens;
- physical hazards – potholes, dips, irrigation valves, risers, overhead sprinklers and drainage sumps;
- water storages and water collection points such as roofs of park buildings;
- Will fellow workers or the public be in the vicinity when you spray?;
- proximity of residential areas; and,
- new seedlings – they are particularly susceptible to herbicide damage

II. Avoid non-target surfaces

When possible, remove from the application site any items that should not be contaminated with pesticides. Cover or protect any items that cannot be removed from the area and that are not involved in the handling activity. Items that should be removed or covered include such things as food and food utensils; bedding; toys; seed; pet or livestock feed, water, or supplies; and other items that could transfer pesticides to people, pets, or livestock

4.4. Observing re-entry, withholding, plant back and restocking periods

4.4.1 Observing Re-entry

The time interval that should elapse between agrochemical application and entering the treated area for safety reasons is known as the re-entry period. It is an interval during which traces of the chemical would have been absorbed by the crop or otherwise removed from plant surfaces. In practice, the timing of the re-entry period is subject to many variables, such as the nature and toxicity of the product, its application rate, weather conditions and the surface area of the crop

treated. If entry is required to a treated area before the re-entry period, then protective clothing appropriate to the pesticide should be worn.

The re-entry period should not be confused with the harvesting interval, which is the time between agrochemical application and the harvesting of a crop for eating.

Minimum re-entry periods

The following re-entry periods could provide the necessary protection under normal conditions of use:

Agrochemical	**Suggested re-entry period**
(a) Any agrochemical with a specific labeled or data-sheet requirement for re-entry	As described on the label or data sheet
(b) Any agrochemical which is classified as either very toxic or toxic and is applied as a spray, dust, granule or in any other form in the open air such as in a field, orchard, vineyard or hop garden	Three days
(c) Any agrochemical which is classified as harmful, irritant or corrosive but is applied.	Two days
(d) Any pesticide which is unclassified but to which the circumstances in (b), above, would otherwise apply	One day
(e) Any pesticide used as a fumigant or gas treatment within a building, greenhouse, mushroom shed or other enclosed space	12 hours, but first ventilate for at least one hour or more to ensure a complete change of air

4.4.2. Withholding period

The minimum recommended interval that must elapse between the last application of a chemical product to a crop or pasture, and the harvesting, grazing, cutting or the collection human consumption orthe collection of fiber (as the case may be). It is part of the directions for use within the concepts of good agricultural practice in the use of agricultural chemicals products. Do not graze or cut for stock food for 7 days after application

Self-Check – 4	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Choose the best answer

1. Which of the following is physical hazardous
   A Working position B. Noise C. Dust D. Bacteria
2. The time interval that should elapse between agrochemical application and entering the treated area is.

A. Re-entry period. B.Target area C.Withholding period D .harvesting

Test II: Short Answer Questions

1. What is ergonomic hazard mean ?
2. Differentiate re-entery period and Withholding period
3. Define target and non-target area?

Note: **Satisfactory rating - 15 points Unsatisfactory - below 15 points**

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

Operation Sheet -4

4.1.Procedures/Steps/Techniques forChemical application

A.Materials,Tools and equipment

- Knapsack
- Measuring cylinders
- Goggles ,glove .hats , boot, cover all, half face respirators
- Water
- Chemicals

B. Procedures/Steps/Techniques

1. Wear the personal protective equipment recommended on the label.
2. Use the label rate.
3. Use application equipment that is calibrated, properly maintained, and adjusted for the crop being treated. .
4. Use separate equipment for applying chemicals.
5. Shut off the spray nozzles when you turn.
6. Wear gloves to replace or clean plugged nozzles.
7. Spray when human activity nearby is unlikely
8. Do not work alone when handling very toxic chemicals.
9. Avoid eating, drinking, smoking, and touching your face during chemical application.
10. Wash before eating, drinking, smoking or using the toilet.
11. Have fresh water available for emergencies.
12. Prevent pesticides from contaminating non target area
13. Spray when the wind is blowing away from sensitive areas

LAP TEST-4	Performance Test

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour. The project is expected from each student to do it.

Task-1 perform chemical application

LG #34	LO #5- Follow Instructions to Empty and Cleaning Equipment and Containers

Instruction sheet

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

- Following instructions for emptying and clean-up equipment
- disposal of containers and unused chemicals or biological agents
- Identifying and disposing containers and unused chemicals

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

- Follow instructions for Emptying and clean-up
- Recognize instructions for disposal of containers and unused chemicals or biological agents
- Identify and dispose containers and unused chemicals

Learning Instructions:

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

Information Sheet 5

5.1 Following Instructions for Emptying and Clean-up Equipment

5.1.1 IdentifyInstructions for Clean-up

- Spray out any remaining pesticide mixture over crops.
- Take off sprayer lid and place to one side upside down.
- Remove lid filter and tap out any solid deposit in this and then pour some water through the filter. Replace lid filter in tank.
- Shake sprayer vigorously.
- Remove the lid, put it aside upside down and remove the lid filter and place on put turned lid for safety. Swirl remaining water around in tank and tip out on bare ground to remove and solid matter form the tank. Remember safety precautions.
- Replace lid filter and again quarter fill the tank with water and replace lid. Pump out the water through the nozzle to remove any pesticide inside the pump, pressure chamber and house
- At the end of the season, the sprayer must be washed thoroughly, nozzles, filter and hoses removed and the sprayer stored away form direct sunlight. All water must be drained from the sprayer. Damage and broken parts must be replaced.

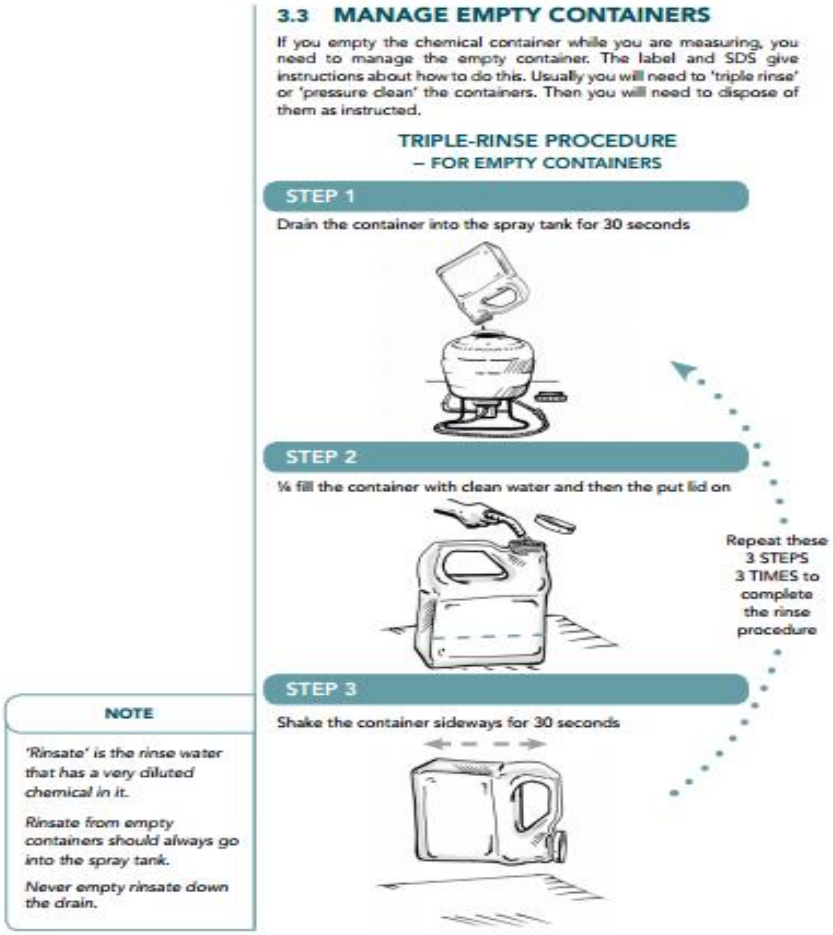


Fig. 5.1 cleaning steps

5.1.2. Instruction for clean-up

- Mixing, loading, and application equipment must be cleaned as soon as they are finished being used.
- Cleaning should be done in a special area that has a wash rack or concrete
- The best way to dispose of wash water containing a registered chemical is to use it as directed on the label.
- Collect the contaminated water and use it to dilute the chemical or a compatible chemical if possible.
- Waste from equipment cleanup must be kept out of water supplies and streams.

- It is extremely important for chemical equipment to be properly cleaned between applications.
- Be sure to clean the inside and outside of the equipment, including the nozzles.
- The outside of the equipment should be washed so that people touching it will not be exposed to chemicals.
- The inside must also be cleaned so that dangerous chemical mixing does not occur.
- At the end of each day the person applying chemicals must take a shower.

5.1.3. Cleaning and Storing the Sprayer

Having completed the spraying in the field, the sprayers should be cleaned and stored in proper condition.

5.2. Disposal of Containers and Unused Chemicals or Biological Agents

Each year thousands of agricultural chemical containers are emptied and become waste items that require disposal. To a lesser extent, unused chemicals or unused materials treated or contaminated with chemical (e.g., seed grain) also require disposal. Mostly, these chemicals are registered pesticides. Other chemical wastes may include fertilizers, organic solvents (from parts cleaning), and caustic cleaning solutions. Dilute solutions of pesticides from barrel rinsing and equipment cleaning also pose potential problems for the farm applicator. Numerous chemical incidents have occurred resulting in livestock losses, contamination of domestic wells, and damage to valuable croplands.

Farmers, more so than other businesses producing potentially hazardous waste materials, are given a great deal of flexibility in how they may dispose of wastes.

With this freedom of choice comes a high degree of responsibility to choose a safe, effective disposal method. Sound management procedures for hazardous wastes are as important on the farm as in the industrial plant.

5.3. Identifying and Disposing Containers and Unused Chemicals

5.3.1. Identify Disposal of Containers and Unused Chemicals

Suggestions for the safe disposal of chemicals include:

- Always follow the manufacturers' instructions for proper disposal of both chemicals and rinse from equipment.
- Thoroughly triple rinse and then puncture empty containers to prevent reuse for other purposes.
- Return empty containers to the manufacturer or check with your local council on proper disposal methods.
- Audit your chemical store on a regular basis and dispose of any excess or outdated chemicals in the appropriate manner.

5.3.2. Disposing of Containers and Unused Chemicals

Deposits of spillage clean-ups, discarded items grossly contaminated with agrochemicals, contaminated aqueous waste such as animal dips, and empty containers must be disposed of safely.

The following should be observed during disposal of waste:

- Agrochemical waste should never be dumped indiscriminately
- Agrochemicals should never be disposed of so as to cause any risk to people, animals, crops, water supplies or the environment.
- Advice should be sought from the supplier, local authority or community leader.
- Accumulation of waste should be avoided.
- Waste should be disposed of as soon as possible.
- The user should read the label on the package or container for any specific advice on waste disposal.
- Empty agrochemical containers should never be reused except possibly, if in good condition, to contain an identical product transferred from a deteriorated or leaking container.
- All other containers should always be cleaned thoroughly before disposal.
- Care should be taken to ensure that the water used for rinsing does not contaminate the environment; particularly drinking-water.
- Liquid containers should be drained out before cleaning.

- After cleaning, the containers should be punctured in several places or crushed to make them unusable, and stored in a secure compound until their disposal is arranged.
- Packages of dry powders and granules must be shaken out thoroughly into a mixing vessel or the applicator tank.
- Containers may be buried on premises owned or occupied by the agrochemical user.
- A record should be kept of the dates and the material buried.

During burial of waste, protective clothing appropriate for the most hazardous product handled should be worn

Self-Check – 5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below.

Test I: Short Answer Questions

1. Write instruction for cleaning (5 points)
2. What mean waste disposal (5 points)
3. Why we dispose chemical container (5 points)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**
You can ask you teacher for the copy of the correct answers.

Reference Materials

Books:

Department of Entomology, Soils, and Plant Sciences, South Carolina May 1992

Revised 2nd edition 2006

Code of practice for the safe use and storage of chemicals (including pesticides and herbicides)

International code of conduct on pesticide management Guidelines for personal protection when handling and applying pesticides; Food and Agriculture Organization of the United Nations World Health Organization Rome, 2020

Standard Operating Procedures for Residential Pesticide Exposure Assessment October 2012 Health Effects Division Office of Pesticide Programs Office of Chemical Safety and Pollution Prevention U.S. Environmental Protection Agency Washington, DC

United Nations Economic Commission for Europe (UNECE). 2017. Globally Harmonized System (GHS) of Classification and Labelling of Chemicals, 7th revised edition. Geneva, Switzerland. (also available at https://www.unece.org/index.php?id=46260&L=0)

WHO. 2010. WHO Recommended Classification of Pesticides by Hazard. Geneva, Switzerland. (also available at http://www.who.int/ipcs/publications/pesticides_hazard/en/)

Guidance Document on Pesticide Analytical Methods for Risk Assessment and Post-approval Control and Monitoring Purposes SANTE/2020/12830, Rev.1 24. February 2021

Website address

OSHA BRIEF: Hazard Communication Standard: Labels and Pictograms https://www.osha.gov/sites/default/files/publications/OSHA3636.pdf (access 2022)

Guidelines for PPE when handling https://www.fao.org/3/ca7430en/CA7430EN.pdf (access, 2022)

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The experts who developed the learning guide

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