HORTICULTURAL CROP PRODUCTION

Level -II

Learning Guide -60

Unit of Competence: - Apply Chemicals under Supervision

Module Title: - Applying Chemicals under Supervision

LG Code: AGR HCP2 M15 LO1-LG-60

TTLM Code: AGR HCP2 TTLM 0120v1

LO 1:- Follow instructions to check and maintain application and personal protective equipment

Instruction Sheet	Learning Guide #60

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

- Carrying out checks and maintain of application equipment Pre and post operational
- Preparing and adjusting application and personal protective equipment
- Following instructions to identify and maintain damaged equipment
- Identifying Occupational Health and Safety hazards

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, **you will be able to –**

- Carry out Pre and post operational checks
- Prepare and adjust application and personal protective equipment
- Follow instructions to identify and maintain damaged equipment
- Identify Occupational Health and Safety hazards

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1, 2, 3 and 4” **in page –** 15, 19, 22 and 26.
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

Information Sheet-1	Carrying out checks and maintain of application equipment Pre and post operational

.1. INTRODUCTION

The word ‘pesticides’ is broad term. Literally it refers to killer of pests but it also includes substances used for controlling, preventing, destroying, repelling or mitigating (minimizing) any pest. Applying chemicals on horticultural crops is very crucial tasks that should be carried out safely. When using an approved pesticide the objective is to distribute the correct dose to a defined target with the minimum of wastage due to drift using the most appropriate spraying equipment. Pesticides only give acceptable field results if they are delivered safely and precisely. Unlike other field operations, the results from poor spraying may not become apparent for some time so that it is essential that those involved in pesticide selection and use are fully aware of their responsibilities and obligations, and are trained in pesticide use and application. These learning guide have been prepared to offer practical help and guidance to all those involved in using pesticides for food and fibre production. They cover the main terrestrial spray application equipment such as knapsack sprayers, boom and air assisted sprayers using hydraulic spray nozzles.

1.2. Checking of application equipment Pre and post operational

Operators of spray equipment must receive suitable training before handling and applying pesticides. Training should be provided by a recognized provider and courses are frequently offered by local training groups, agricultural colleges, government extension departments, spray equipment manufacturers and the chemical industry. The satisfactory completion of a course may result in a recognized certificate of competence to cover: safe product handling, Delivery of the product to the target, instruction on using the relevant spray equipment.

It is important that as technology moves forward, field spray operators are be kept up to date with new methodology to help ensuring that pesticides are safely used. In some countries where spray operators are licensed, they can only renew their operator’s license if they attended regular refresher courses. Operator training is best being organized and provided through sustainable permanent national structures.

1.2.1. Spray equipment selection

The selection of appropriate and suitable spray equipment is essential safe and effective pesticide use. The Sprayer is one which atomises the spray fluid (which may be a suspension, an emulsion or a solution) into a small droplets and eject it with little force for distributing it

properly. Ideally, equipment selection should not be based primarily on cost. Safety, design, comfort and ease of use must be major considerations, and ease of maintenance must be a high priority.

Knapsack sprayer maintenance should require only simple tools. The combination of operator training to a recognized standard, combined with the selection of appropriate spray equipment will contribute to improving the accuracy of pesticide delivery as well as protecting the environment. Pesticides should only be used if there is an economically important need and all pesticides must be used strictly in accordance with their label recommendation. Product selection must assess the potential exposure hazard of the selected formulation and determine what control measures and dose rates the label recommendations advocate. Most field sprayers in use today are: Hydraulic:-Maybemounted or self-propelled models,Electrostatic and air-directed sprayers and Boom and bloomless units to match wide range of applications.

⊗ **Types of spraying equipment:**

Depending on the source of power it can be classified as manually operated and power operated dusters.

a) **Hand operated machines** –

E.g. knapsack sprayers, pressurized cans (Aerosols) trigger and Pump sprays.

Push- pull hand pumps sprayer (for small pest control projects), etc.

They are used to apply small quantities of pesticides on small areas.

They are an economical, easy to operate, and easy to clean & store.

b) **Spinning disc sprayers** –

These sprayers use a special type of nozzle which spins at a high speed and breaks the liquid in to uniformly sized droplets by centrifugal force. Power to spin nozzles is provided by small electric or hydraulic motors.

c) **Power operated sprayers** – they may be:-

1. **Low pressure sprayers** – they are designed to distribute diluted liquid pesticides over large areas. These sprayers are usually mounted on tractors, trucks, or boats, but some are self- propelled.
2. **High pressure sprayers** – these sprayers are used to spray through dense foliage, thick animal hair, to the top of all trees. Provide good penetration and coverage of plant surfaces.

   Usually mounted on tractors, trucks, boats or are self- propelled.
3. **Air blast sprayers** – they are a combination of air and liquid rather than liquid alone to deliver the pesticide to the surface being treated.

They are used in agricultural, ornamental and turf, biting fly, forestry, livestock, and right-of- away pest control operations. It has a good coverage and penetration, mechanical agitation, can spray high or low volumes, high capacity. But difficult to use in small areas, drift hazards, and high power requirement & fuel use.

d) ***Granule applicators*** – are used mainly in agricultural ornamental, turf, forestry, and aquatic pest control. Possible by d/t methods like broadcast, side dress, in furrow, by drilling (soil incorporation or injection), forced air, spinning discs (fertilizer spreaders).

e) ***Direct contact applicators (dusters)*** – mostly used by home gardeners,

1. **Hand dusters** – may consist of a squeeze bulb, bellows, tube, shaker, sliding tube, shaker, sliding tube, or a fan powered by a hand crank. It has light weight (no water) and good penetration in confined spaces.
2. **Power dusters** – use a powered fan or blower to propel the dust to the target. Even though there exist drift hazard and high cost of pesticides, they are easy to maintain, light in weight, &low in cost.

1.2.1.1. Parts of Knapsack Sprayer:

- Any sprayer which is carried on the back of the operator is called a knapsack sprayer.
- The commonly used manually operated knapsack sprayer will have one hydraulic pump working inside the container.
- The plunger works inside the replacement well attached at the bottom of the container, for easier maintenance.
- The pump can be operated through the appropriate linkages by oscillating the handle, with the sprayer carried on the back.
- An agitator is also provided with the pressure chamber to agitate the fluid so that the particles in suspension will not be allowed to settle down.
- A delivery tube is attached on the other end of the pump which carries the pressurises fluid to the spray lance.
- The flow to the nozzle is controlled by a trigger cut-off valve.
- In the case of compression knapsack sprayer, an air pump is used to build air pressure above the free surface of the spray fluid in the container and normally the pumping of the air will be done by keeping the unit on ground and then sprayed til the air pressure comes down.
- The unit is again brought back to the ground for pumping air and then the spraying is contained as before.

- The spray fluid, which does not enquire any agitation only can be sprayed by using this type of spray.

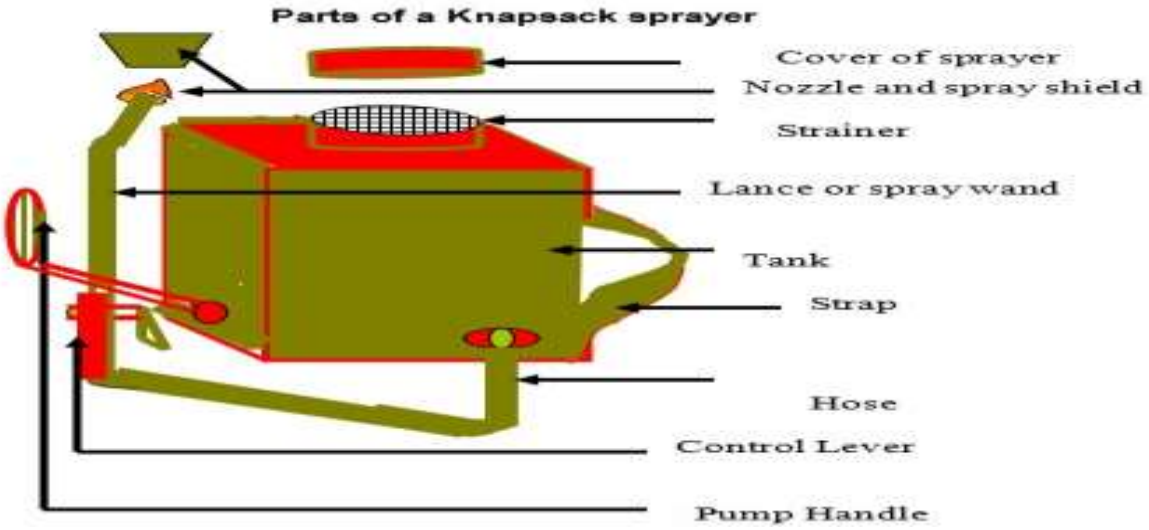


Figure-1 part of knapsack sprayer

1) **Tank** – all sprayer most have tank to contain the spray solution
2) **Filter and/or strainers** –

Fitted to the filler hole of the tank to have an easy pouring of liquid into the tank and for clearing. Filters may also fit in spray lines and nozzles.

3) **Control valves** –

It must be possible to shut the pray system on and off to regulate the pressure in the system.

4) **Boom and Nozzles** –

The system must be capable of delivering the spray solution to the individual nozzles assemblies. As pressurized spray solution is forced through the orifice in the nozzle tip, it is reduce to spray of fine droplets.

5) **Hoses** - plastic rubber through which the liquid pass to the lance. It is in between lance and sprayer tank.
6) **Pressure gauges**- control the pressure.
7) **Pressure regulators**- regulate the pressure.
8) **Agitators-** used for mixing chemicals to maintain uniform dispersion.
9) **Lance** – a brass tube found between nozzle and hose (sometimes metal).
10) **Pump** – all sprayer systems must have a pump to pressurize the spray solution.

- **Calibration** – is the measurement of dispersal or output and adjustments made to control the rate of pesticide dispersal.
- **Calibration methods*:***
  - Adjusting nozzles (adjust size and distance from each other, distance from ground), pump pressure, spray width, walking speed.

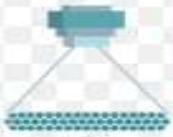
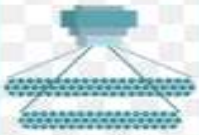
Nozzle Guide for Band and Directed Spraying					
	 Even Flat Fan	 Twin Even Flat Fan	 Hollow Cone	 Full Cone	 Disc and Core Cone
Herbicides					
Pre-emerge	Very Good	Good		Good	
Post-emerge Contact	Good	Very Good	Very Good		
Post-emerge Systemic	Very Good	Good			
Fungicides					
Contact	Good		Good		Very Good
Systemic	Very Good				Good
Insecticides					
Contact		Very Good	Very Good		Very Good
Systemic	Very Good				Good
Growth Regulators	Good			Very Good	

Figure .2 Nozzle Spray Patterns

- Determining and calculating output in nozzle/ha.
- Determining the amount of water needed for different sized area.
- Determining the walking speed.

Meteorological factors affecting spraying of pesticides*:*

1. Gravity
2. Wind velocity
3. Wind direction
4. Relative humidity
5. Air turbulence

Calibration of Boom Sprayers*:*

Three factors govern the amount of spray liquid applied through a boom sprayer.

1. Swath width (W)
2. Nozzle discharge rate (NDR)
3. Ground speed (S)

Safe Use and Handling of Chemicals

In any pest management program pesticide should be considered as the last option however for the management of some pest pesticide remain the only immediate weapons for controlling of pests since pesticide is toxic to humans plant, animals and to the environment, appropriate safety is required in handling and using them.

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.

1.2.2. General instruction before chemicals application:

- ☞ Know the pest and how much damage is really being done.
- ☞ Use pesticide only when needed
- ☞ Seek advice on the proper method of control.
- ☞ Use only the recommended pesticide for the problem. If several pesticides are recommended choose the least toxic to mammal and if possible the least persistent.
- ☞ Read the label, including the small print.
- ☞ Make sure the appropriate protective device is available and is used and that all concerned with application also understand the recommendations and are fully trained in how to apply pesticide.
- ☞ Check that pesticide is in a dry and safe place. Avoid in haling pesticide dust or mist.
- ☞ Check application equipment for leaks, calibrate with water and ensure that it is in proper working conditions.

➪ **Generally, manually operated dusters are:**

(i) package duster
(ii) plunger duster
(iii) bellow duster and
(iv) Rotary duster.

☸ **Uses of spraying and dusting equipments**

- The spraying and dusting equipments are used for the following purposes
- For the insecticides application to control insect pests on crops and in stores
- For the acarices application to control phytophagous mites.
- For the fungicides and bactericides application to control the plant diseases.
- For the herbicides application, to kill the weeds.

- For the harmone sprays application to increase the fruit set or to prevent the premature dropping of fruits.
- For the application of plant nutrients as foliar spray.
- For applying the powdery formulation of poisonous chemicals on the crops and for any other purposes.

1.3. Checking Pre and post operational Checks and Maintenance

The reason for conducting pre-operational and regular checks is to reduce the potential for time out of the paddock due to maintenance issues, and to ensure the spray system is working correctly and efficiently. Good maintenance and regular checks can help to resolve minor problems before they lead to the need for major repairs. Unexpected downtime at critical periods in the season can be especially frustrating when conditions are good for spraying. There are many things the operator should check on a regular basis. Some of these will be quick checks while spraying, others may be at the end of the tank or the end of a day's spraying. The most important of all checks the operator can do is when the sprayer is first delivered. Never assume that a new sprayer is ready to spray when it arrives on-farm. This module refers specifically to checks of the spraying system itself. Spray operators should always perform checks on other mechanical components of the sprayer, as and when recommended by the manufacturer.

1.3.1. Pre and post-operative checks include:

- ✓ Check equipment's function (e.g. sprayer) before use
- ✓ Do ensure any damaged equipment repaired before use
- ✓ Check the nozzle is working correctly and do replace if necessary
- ✓ Check the direction of wind before starting spraying
- ✓ Clean equipment after use
- ✓ Store spraying equipment securely away children and animals
- ✓ Always store equipments separately from other
- ✓ Wash gloves , aprons, boots, and face shields after use
- ✓ Change respiratory filter following manufactures' guide line

Drift control

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

- ✓ Wind at or nearthe 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.

1.4. Protective Clothing and Equipment

- ✓ **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.

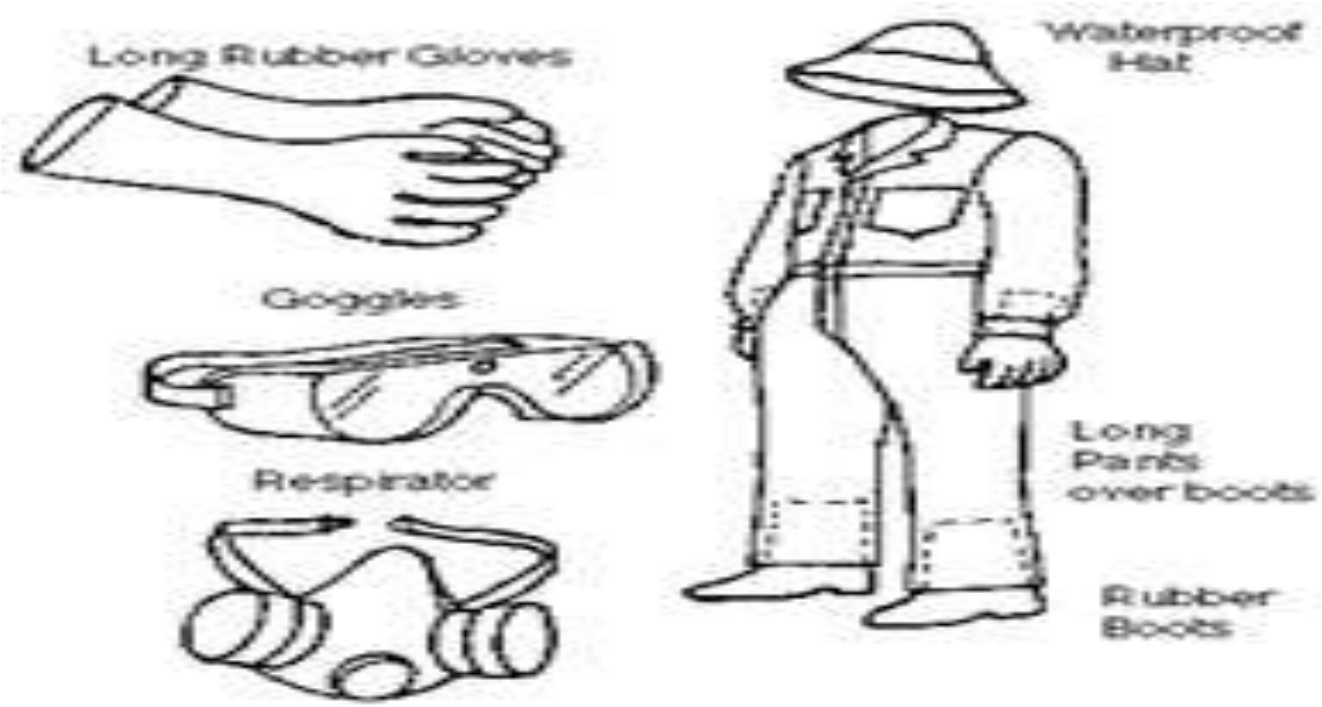


Figure-2 PPE equipment elements

- ✓ **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.

- ✓ **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.

- ✓ **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.

✓ **Goggles and Face Shields**

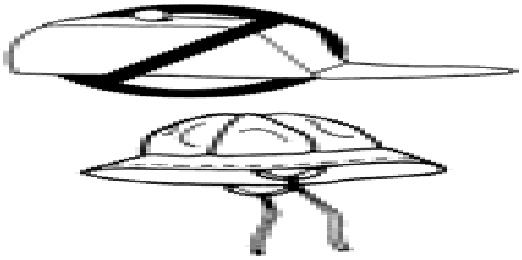
- ⇨ Pesticides are readily ***absorbed*** through the eyes and can cause ***eye injury.***
- ⇨ Wear goggles if there is a chance of getting pesticide spray or dust in your eyes.
- ⇨ Do not use goggles with cloth or foam headbands.
- ⇨ Do not wear contact lenses when handling pesticides as they are permeable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

✓ **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.



✓ **Aprons**

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

➪ Some ***agrochemicals*** such as ***pesticides are extremely hazardou***s 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.

1.4.1. Occupational Health and Safety

- ➢ **OHS requirements**

OHS are to be in accordance with Federal and Regional Legislation and regulations, and organizational safety Policies and procedures.

Requirements may include:

- ❖ The use of personal protective equipment and clothing
- ❖ Safety equipment
- ❖ First aid equipment
- ❖ Firefighting equipment
- ❖ Hazard and risk control
- ❖ Elimination of hazardous materials and substances
- ❖ Safe forest practices including required actions relating to forest fire
- ❖ Manual handling including shifting, lifting and carrying

⊗ **Hazards arise from:**

- The work environment
- The use of machinery and substances
- Poor work design
- Inappropriate systems and procedures

1.5. Maintenance of application and personal protective equipment

Good and constant performance from machines can be obtained only when they are used and serviced periodically. The purpose of maintaining a machine is for increasing the useful life of the machine and to be available in working order whenever put to use. The maintenance of a machine involves proper care, operation, servicing, repair and keeping it in good working order. Normal maintenance jobs include cleaning the equipment and applying necessary lubricating oils and greases to the rubbing and moving parts. If this normal maintenance is neglected the

machine gets rusted and moving parts wear out quickly resulting in loss of efficiency, frequent replacement of spare parts and finally uneconomical working.

Besides the normal maintenance as above, special care has to be taken for maintaining the plant protection equipment. The pesticide formulations are chemically aggressive on metals, etc. The cleaning and washing of the chemical tank, discharge lines, nozzles, etc., are to be done regularly after the day's spraying work is completed otherwise the residues of chemicals used for spraying acts on the parts and causes corrosion and deterioration of materials. If this aspect of thorough cleaning is not done on the plant protection machine, even though it is made of with high standard materials,it will not serve its normal life and would lead to premature condemnation.

1.5.1. Maintenance job for hand operated equipment:

1. Cleaning the chemical tanks, hoses, valves and nozzles etc. and flushing sufficiently to avoid pesticide residue which is corrosive.
2. Cleaning the machine equally well from outside also as it is contaminated due to leakage, spilling of pesticide.
3. Lubricating suitably the pump parts like piston, cylinder, valves and other rotating, sliding, moving parts.
4. Store the machine in dry place duly protected from sun and rain.

1.5.2. Maintenance and safety

1. Wash the inside of the spray tank with clean water after each use.
2. Lubricate the felt sealing washer at the top of the air chamber with light oil at regular intervals. This ensures smooth operation of the air pump and prevents leakage of spray liquid.
3. To replace the cup washer on the piston of the air pump:
    - ⌘ Remove the lid of the air chamber.
    - ⌘ Withdraw the air chamber and remove the valve seal.
    - ⌘ Replace the cup washer.
    - ⌘ Re-assemble all components, ensuring that all threaded fittings are securely tightened.
4. Always wear appropriate personal protective equipment whilst using, cleaning and servicing the sprayer.
5. Do not smoke whilst using the sprayer.
6. Always direct the spray downwind of the operator. Spraying into the wind will result in operator Contamination.
7. Store the sprayer in a well-ventilated area out of reach of children and away from Livestock.
8. Do not expose the sprayer to strong sunlight during storage to prevent deterioration of the

tank.

9. The sprayer is designed for the application of agricultural chemicals, disinfectants, Cleaning agents etc. Do not use to spray caustic or corrosive solutions.

1.5.3. **Maintenance job for power operated equipment**:

All the above maintenance jobs apply to power equipment also. But the engines have to be taken care of specially. The life and efficiency of the engine mostly depends upon

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. What is the importance of pre and post check and maintainance of application equipment?(5)
2. List some type of sprayer and their main components(5)

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Preparing and adjusting application and personal protective equipment

2.1. Identifying the availability of application and PPE

The aim of using personal protective equipment (PPE) is to protect against health or safety risks at work.

Figure-1 requirement of PPE

OSHA requires that employers protect their employees from workplace hazards that can cause injury. When engineering controls and safe work practices are not feasible or do not provide sufficient protection, employers must provide PPE to their employees and ensure it is used.

✡ RESPONSIBILITIES

Supervisors:

- Conduct a job safety analysis (JSA)
- Ensure PPE is provided to employees and used properly

Employees:

- ✓ Must utilize the provided PPE in accordance with the instructions and training provided.
- ✓ Must inspect their PPE,
- ✓ Properly care for and store their PPE, and
- ✓ Attend training on the PPE.

Commonly required ppe

- **Safety Glasses, Goggles, and/or Face Shield**: Required when eye hazards or flying particles are present

- **Gloves**: Required when cuts, lacerations, electrical, or chemical hazards are present
- **Hard Hats**: Required when overhead and electrical hazards exist
- **Safety Shoes**: Required when feet are exposed to crushing, slip, or electrical hazards are present
- **Work Pants & Shirts**: Long pants and work shirt (minimum short sleeve) should be utilized on all work sites.

✡ **Other PPE examples include:**

Respiratory, hearing, electrical, and fall protection. Hi-Visibility clothing. When selecting PPE, fit and comfort should be taken into consideration. If it fits and it is comfortable they will wear it. Employees who are required to use PPE must be trained in its use.

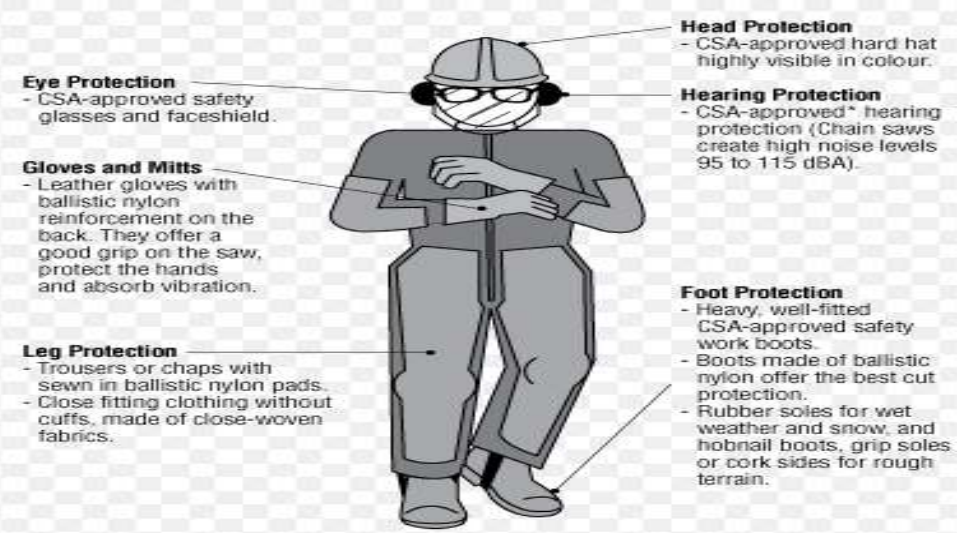


Figure-2 using ways of PPE

Pesticide application plays an important role in pest management. Proper technique of application of pesticide and the equipment used for applying pesticide are vital to the success Of pest control operations. Proper selection of application equipment, knowledge of pest behaviour and skillful dispersal methods are vital. Many pesticides used to control weeds, insects, and disease in field crops, ornamentals, turf, fruits, vegetables, and rights-of-way are applied with hydraulic sprayers. Tractor- mounted, pull-type, pickup-mounted and self-propelled sprayers are available from numerous manufacturers to do all types of spraying.

The sprayer will not function properly without proper hoses and controls to connect the tank, pump and nozzles as they are the key components of the spraying system. Select hoses and fittings to handle the chemicals at the selected operating pressure and quantity. Peak pressures higher than average operating pressures are often encountered. These peak pressures usually

occur as the spray boom is shut off. Choose components on the basis of composition, construction, and size. Hose must be flexible, durable, and resistant to sunlight, oil, chemicals, and general abuse such as twisting and vibration. Two widely used materials that are chemically resistant are ethylene vinyl acetate (EVA) and ethylene propylene dione monomer (EPDM).

Suction hoses should be air-tight, non-collapsible, as short as possible, and as large as the pump intake. A collapsed suction hose can restrict flow and “starve” a pump, causing decreased flow and damage to the pump. If you cannot maintain spray pressure, check the suction line to be sure that it is not restricting flow. Other lines, especially those between the pressure gauge and the nozzles, should be as straight as possible, with a minimum of restrictions and fittings. The proper size of these varies with the size and capacity of the sprayer. A high but not excessive fluid velocity should be maintained throughout the system.

Lines that are too large reduce the fluid velocity so much that some pesticides, such as dry flowables or wettable powders, may settle out, clog the system, and reduce the amount of pesticide being applied. If the lines are too small, an excessive pressure drop will occur. A flow velocity of 5 to 6 feet per second is recommended. Check sprayer and chemical manufacturers literature for compatibility.

2.2. Preparing application and personal protective equipment

The most suitable equipment for applying chemicals must be carefully chosen. Always use equipment correctly and take good care of it. Before using any equipment, it should be checked thoroughly to be absolutely sure that everything is working properly. The equipment needs to be calibrated properly so that it applies the exact amount of chemical necessary. Be sure there are no leaks in hoses, pumps, or tanks. Check for loose connections and worn spots in hoses that could leak or burst if belts, pulleys, or drive chains are exposed, put guards around them so that the operator, children, or other people cannot be injured. The spray tank should have a tight lid so that neither the operator nor others will be splashed and spray materials will not leak onto the ground.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define PPE (5)
2. List PPE equipment elements (5)

Note: **Satisfactory rating -10 points** **Unsatisfactory - below 10 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Following instructions to identify and maintain damaged equipment

3.1. Identifying roles and responsibilities of people in the work place

Provide us with technical information that can help form a risk assessment that will then allow us to develop suitable controls and wear protective equipment to protect us against the hazards associated to a machine or equipment. The repair and maintenance of ophthalmic equipment, including surgical of this information is usually the manufacturer's user and/or service manual. Staff should know how to handle and fold them properly in order to prevent damage**.**

3.1.1. Equipment repairs and maintenance

Repairs to spray equipment should be noted, and changes in spray technique during the season, nozzle and or operating pressure change, must be listed for future reference. Equipment repairs must be promptly addressed and replacement parts ordered. Spare nozzles, anti-drip valve diaphragms, pump diaphragms and valves for both tractor and knapsack sprayers should be kept in stock.

- **Care and maintenance of sprayers**

1. Clean sprayers properly and store them in dry place.
2. Drain the tank of sprayer and flush it with clean water, wash the pump nozzle before and after use.
3. Overhaul the machines regularly and replace the worn-out parts. Grease and oil the moving parts.
4. Do not bend hose at acute angles when in use.
5. Filter sprays liquid to avoid clogging of the nozzle.

3.1.2. Personal protective equipment

PPE is only as good as its maintenance and should be provided to individuals. To make sure safety equipment gives maximum protection full operator training is important. Wearing protective clothing on its own does not guarantee total protection if equipment becomes defective through wear or damage so regular visual checking must be carried out. Specialist equipment, such as respirator must be checked in accordance with the manufacturer’s recommendation. The periods between checks will be more frequent when working conditions are more severe. Faults must be recorded and corrected before further use.

N.B. Selecting approved PPE in the first instance will make sure that operators receive the correct protection for the product to be

When using an approved pesticide the objective is to distribute the correct dose to a defined target with the minimum of wastage due to drift using the most appropriate spraying equipment. Pesticides only give acceptable field results if they are delivered safely and precisely. Unlike other field operations, the results from poor spraying may not become apparent for some time so that it is essential that those involved in pesticide selection and use are fully aware of their responsibilities and obligations, and are trained in pesticide use and application.The Worker Protection Standard (WPS), which addresses the protection of agricultural workers from pesticide exposure. The WPS includes requirements designed to reduce the risks of illness or injury to agricultural workers and pesticide handlers from occupational or accidental exposure to pesticides in the production of agricultural plants on farms and in nurseries, greenhouses, and forests. The WPS expands the scope of prior worker protection regulations to identify two types of agricultural employees:

- **pesticide handlers**—those who handle agricultural pesticides (mix, load, apply, clean or repair contaminated equipment, act as flaggers, etc.) and
- **Agricultural workers**—those who perform tasks related to the cultivation and harvesting of plants on farms or in greenhouses, nurseries, or forests where pesticides are used.

Applying chemicals on horticultural crops is very crucial tasks that should be carried out safely. Now a day's crop failure caused by biotic factors(insects, diseases and weeds) which are a potential agent for horticultural crops yield as well as quality redactors. Hence, we have to apply chemicals so as to curve their impact on horticultural crops. A major concern while applying chemicals is preventing the environment from being polluted**.**

Self-Check -3	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List the activities of Care and maintenance of sprayers(5)
2. Write down the importance of maintaining equipment(5)

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Identifying Occupational Health and Safety hazards

4.1. **Identifying hazards and associated risks**

⊗ **Work place hazards**

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

- ⌘ ***Chemical***
- ⌘ ***Physical***
- ⌘ ***Biological and***
- ⌘ ***Ergonomic (psycholog***y)

❖ **Chemical hazards**

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

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.

A. 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.

B. "WARNING"

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

C. "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.

- ❖ **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:-

1. 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.

2. 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.

3. 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.

Biological hazards

Some biological hazards of work place include:

- Bacteria
- Fungal
- Virus etc.
- **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

Self-Check -4	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List type of Chemical hazards(5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Reference

1. http://www.shop.nsw.gov.au/pubdetails.
2. Horticulture Australia Ltd - good information on current projects and general developments in horticulture www.horticulture.com.au
3. Horticulture for tomorrow - interesting national project on quality assurance guidelines www.horticulturefortomorrow.com.au
4. Palis FG, Flor RJ, Warburton H, Hossain M: Our farmers at risk: behavior and belief system in pesticide safety. J Public Health 2006, 28:43–48.

4. Damalas CA, Eleftherohorinos IG: Pesticide exposure, safety issues, and risk assessment indicators. Int J Environ Res Public Health 2011, 8:1402–1419.

5. Recena MCP, Pires DX, Caldas ED: Acute poisoning with pesticides in the state of Mato Grosso do Sul, Brazil. Sci Total Environ 2006, 357:88–95.

HORTICULTURAL CROP PRODUCTION

Level -II

Learning Guide#61

Unit of Competence: - Apply Chemicals under Supervision

Module Title: - Applying Chemicals under Supervision

LG Code: AGR HCP2 M15 LO2-LG-61

TTLM Code: AGR HCP2 TTLM 0120v1

LO 2:- Use application and personal protective equipment

Instruction Sheet	Learning Guide #61

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

- Reading and interpreting chemical label
- Using application and personal protective equipment
- Complying measurement and decanting of substances
- Following safe working practices
- Identifying chemical spill procedures

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

- Read and interpreting chemical label
- Use application and personal protective equipment
- Comply measurement and decanting of substances
- Follow safe working practices
- Identify chemical spill procedures

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 20.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1,2,3,4 and 5” **in page -.33,37,40,45 and 48**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

Information Sheet-1	Reading and interpreting chemical label

1.1. Understanding chemical label

Chemical Labeling is an important component of an effective Hazard ... transferred from primary containers for **use** in production or **chemical application** areas. OSHA has updated the **requirements** for labeling of hazardous **chemicals** under its Hazard Communication Standard (HCS). All **labels** are **required** to have pictograms, a signal word, hazard and precautionary statements, the product identifier, and supplier identification. Product Identifier is how the hazardous **chemical** is identified. ... The same product identifier must be both on the **label** and in section 1 of the SDS. Signal Words are used to indicate the relative level of severity of the hazard and alert the reader to a potential hazard on the **label.** The product identifier and words, pictures, symbols, or a combination that provide at least general information about the hazards of the chemicals. Generally, things that must be labeled include: Storage bottles created for the distribution of small amounts of a material. **Chemical labels** are very **important** because they contain information on them about usage, direction, application and storage amongst other equally **important** information. ... **Chemical labels** should be designed to clearly inform us on how certain **chemicals** must be used or stored, which can save users from potential harm.

1.2. Importance of labeling chemical

Chemical Labeling is an important component of an effective Hazard Communication Program. Clear and consistent labeling throughout your facility will ensure that chemical hazards are easily distinguishable and understood by employees. The label also provides other relevant and useful safety information, which will include the product common name, chemical name, the manufacturers name and a contact in the event of an accident. The label must also be available for medical staff treating anyone who has been accidentally poisoned or contaminated by the pesticide. A good copy of the label must be retained as reference for the emergency services in the event of an accident.

- **There are generally two types of chemical containers that are present in manufacturing facilities:**

  - **Primary Containers** –

Primary chemical containers are the bags, barrels, bottles, boxes, cans, cylinders and drums that you receive from the manufacturer. These containers should be labeled following the GHS mandates per the GHS label example above and include all six labeling elements. When a label is on a container directly from a supplier, this label cannot be removed, altered or defaced. If it needs to be replaced, the new label must contain the same information as the original. Containers in which bulk chemicals are typically received and contain larger volumes of chemicals (i.e. chemical drums).

Figure-1 primary containary of chemical container

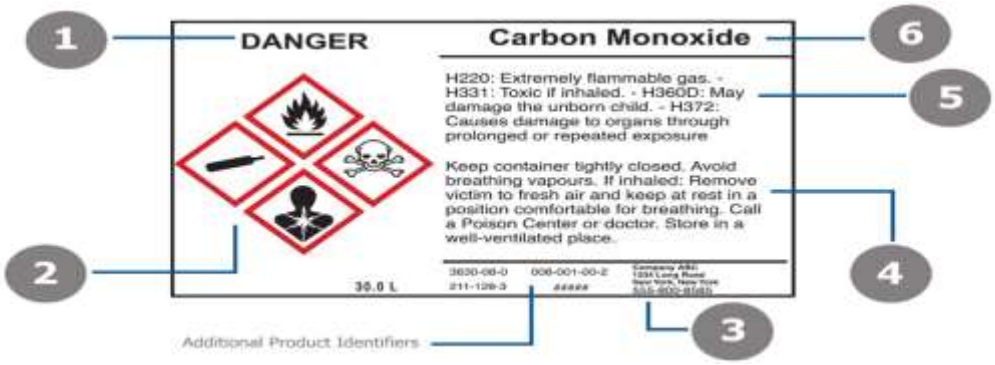
- **Secondary or Workplace Containers** –

Containers into which bulk chemicals are transferred from primary containers for use in production or chemical application areas. Secondary containers are usually smaller than primary containers and could include spray bottles, jugs, or jars. These containers usually hold chemicals that are transferred from a primary container. Secondary containers must comply with labeling requirements except when the following criteria are met:

- The material is used within the work shift of the individual who makes the transfer
- The worker who made the transfer is in the work area the entire time during use
- The container stays within the work area and in the possession of the worker who filled the container.

Figure- 2 secondary chemical container

The Six Elements of a chemical container Label



1. **Product Identifier** – Name of the product
2. **Pictograms** – Graphic giving information about the potential hazard(s) of the product
3. **Signal Word** – Descriptive word/statement that explains the potential hazard of the product. Examples “Danger” or “Warning”
4. **Hazard Statements** – Explanation of the product’s potential hazard
5. **Precautionary Statements** – Statement(s) that convey information on how to prevent or minimize the negative effects of coming in contact with the product. Precautionary statements fall into 4 categories: prevention, response, storage and disposal.
6. **Supplier Information** – Contact information for the manufacturer/supplier of the product including company name, address and telephone number.

☞ **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.

Relabeling must 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.

Self-Check -1	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define labeling (5)?
2. List the importance of labeling(5)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Using, maintaining and storing application and personal protective equipment

2.1. Personal protective equipment requirements

It commonly referred to as "**PPE**", is **equipment** worn to minimize exposure to a variety of hazards. Examples of **PPE** include such items as gloves, foot and eye **protection**, **protective** hearing devices (earplugs, muffs) hard hats, respirators and full body suits. There are four primary **types** of eye protection, of which each has its own limitations, including general safety glasses, laser safety glasses, chemical splash goggles and impact goggles. Full face protection is achieved by wearing face shields **Personal protective equipment**, commonly referred to as "**PPE**", is **equipment** worn to minimize exposure to a variety of hazards. Examples of **PPE** include such items as gloves, foot and eye **protection**, **protective** hearing devices (earplugs, muffs) hard hats, respirators and full body suits. Employers have duties concerning the provision and **use of personal protective equipment** (**PPE**) at work.

PPE is equipment that will protect the user against health or safety risks at work. It can include items such as safety helmets, gloves, eye protection, high-visibility clothing, safety footwear and safety harnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. **Personal protective equipment** may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.

Generally, the most suitable equipment for applying chemicals must be carefully chosen. Always use equipment correctly and take good care of it. Before using any equipment, it should be checked thoroughly to be absolutely sure that everything is working properly. The equipment needs to be calibrated properly so that it applies the exact amount of chemical necessary. Be sure there are no leaks in hoses, pumps, or tanks. Check for loose connections and worn spots in hoses that could leak or burst if belts, pulleys, or drive chains are exposed, put guards around them so that the operator, children, or other people cannot be injured. The spray tank should have a tight lid so that neither the operator nor others will be splashed and spray materials will not leak onto the ground.

2.2. Types of personal protective equipment

Selecting the right PPE to sufficiently reduce exposure to hazards is essential to laboratory safety. There are four primary **types** of eye protection of which each has its own limitations

including general safety glasses, laser safety glasses, chemical splash goggles and impact goggles. Full face protection is achieved by wearing face shields.

For the purpose of this site, PPE will be classified into categories: eye and face protection, hand protection, body protection, respiratory protection and hearing protection. Each category includes its own corresponding safety equipment that will be described below:

- Respiratory protection - for example, disposable, cartridge, airline, half or full face.
- Eye protection – for example, spectacles/goggles, shields, visors
- Hearing protection – for example, ear muffs and plugs.
- Hand protection – for example, gloves and barrier creams

2.3. Instructions for use, maintenance and storage of personal protective equipment and application equipment

- Follow label instructions for use (crops, target pests, application rates [doses] and water volume rates).
- Do not exceed maximum spray solution concentrations.
- Use label specified equipment and methods such as those specifying nozzle types and pressures.
- Do not exceed the label stated doses and frequency of use.

⌘ Check, calibrate and maintain application equipment activities:

- Check spraying equipment before use
- DO ensure any leaks are repaired before use.
- Check the nozzle is working correctly, is clean and do replace if necessary.
- Calibrate spraying equipment at least once a season depending on the amount of use (or whenever the field condition/crop, operator, nozzle, application rate or other spraying requirements are changed).
- Clean spraying equipment after use
- Store spraying equipment securely away from children, animals and feed.
- PPE Storage and maintenance
- Always store protective equipment separately from crop protection products.
- Wash gloves, aprons and boots and face shields after use.
- Wash spray clothing separately from domestic washing.
- Change respirator filters following the manufacturers guidelines

Figure-1.using PPE to apply chemical on horticultural crop

Applicators may have little or no control over the availability of low-toxicity products or the toxicity of specific formulated products. However, exposure can be significantly reduced or nearly eliminated by using personal protective clothing and equipment. For example, over 90 percent of all pesticide exposure comes from dermal exposure, primarily to the hands and forearms. By wearing a pair of chemically resistant gloves, this exposure can be reduced at least 90 percent. Therefore, by wearing the correct PPE, the hazard of pesticide use can be reduced to an insignificant level for the applicator.

Self-Check -2	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Define PPE and its importance (5)

2. List the type of PPE and their elements (5)

Note: **Satisfactory rating -10 points** **Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

3.1. Identifying a hazardous substances

In relation to chemicals, a hazard is a set of inherent properties of the substance, mixture, article or process that may cause adverse effects to organisms or the environment. There are two broad types of hazards associated with hazardous chemicals which may present an immediate or long term injury or illness to people. These are:

☞ **Health hazards** – These are properties of a chemical that have the potential to cause adverse health effects. Exposure usually occurs through inhalation, skin contact or ingestion. Adverse health effects can be acute (short term) or chronic (long term). Typical acute health effects include headaches, nausea or vomiting and skin corrosion, while chronic health effects include asthma, dermatitis, nerve damage or cancer.

☞ **Physicochemical hazards** – These are physical or chemical properties of the substance, mixture or article that pose risks to workers other than health risks, as they do not occur as a consequence of the biological interaction of the chemical with people. They arise through inappropriate handling or use and can often result in injury to people and/or damage to property as a result of the intrinsic physical hazard. Examples of physicochemical hazards include flammable, corrosive, explosive, chemically reactive zand oxidising chemicals.

Label element	Examples
Signal words – these provide an immediate warning to the reader	Danger or Warning
Hazard statements – these describe the nature and severity of the chemical hazard based on a chemical's classification	May cause cancer Fatal if inhaled Flammable liquid and vapour Causes severe skin burns and eye damage May cause respiratory irritation
Pictograms – these provide a pictorial representation of the type of hazard that can be easily recognised at a glance	

Table -1 *examples of hazard information on a label*

The Dangerous *Substances* and Explosive Atmospheres Regulations are concerned with protection against ... their work activity; identify the preventive and protective *measures* that need to be taken to ... Risk assessment is the key to *compliance* with DSEAR. .... Never transfer or "*decant*" gas from one cylinder to another. The verb decants means "to pour." Kids moving water

back and forth between two cups, your dad pouring a bucket of soapy water in the sink, or a wine expert emptying a bottle of wine into a fancy glass container all of them are decanting liquids. Decanting is also a chemical laboratory process used to separate mixtures. In its simplest form, it just means allowing a mixture of solid and liquid or two immiscible liquids to settle and separate by gravity, typically, a small amount of the lighter liquid is left behind. Decantation is a process used to separate a mixture. It usually involves removing the liquid portion of a substance while leaving behind the sediment. This process is used in a variety of instances.

Labels let workers and others, such as emergency services, know what hazardous substances are in containers at the workplace and inform them about the associated hazards. Many businesses buy substances in drums or large containers and then decant or transfer smaller amounts into other containers for easier use or storage. If you do this, follow the recommendations in this guide to transfer the substances safely and correctly label the new containers.

To identify if a substance is hazardous, check the product's container label and/or the SDS which is available from the supplier. If a product is not classified as a hazardous chemical under the Work Health and Safety Act 2011, a SDS is not required and therefore may not be available. OSHA has updated the requirements for labeling of hazardous chemicals under its Hazard Communication Standard (HCS). All labels are required to have pictograms, a signal word, hazard and precautionary statements, the product identifier, and supplier identification.

Identify the hazards:

1. Identify which substances are harmful by reading the product labels and safety data sheets (SDS)
2. If you are in doubt, contact your supplier.
3. Remember to think about harmful substances produced by your processes, such as cutting or grinding, or to which workers may be otherwise exposed.

Common hazardous substances in the workplace include:

Acids, caustic substances, disinfectants, glues, heavy metals, including mercury, lead, cadmium and aluminium, paint, pesticides and petroleum products.

Self-Check -3	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List and explain each of two broad types of hazards associated with hazardous chemicals which may present an immediate or long term injury or illness to people(5)
2. Define the decanting of substances**(5)**

Note: **Satisfactory rating -10 points** **Unsatisfactory – below10 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Following safe working practices

4.1. Identifying available hazard while applying chemicals

A **hazard** is anything that has the potential to cause harm, in terms of injury, ill-health or damage to the environment. For example, working with dangerous chemicals or processes which give rise to dusts or fumes. **Risk** is the chance (e.g. high, medium or low) that a person or the environment will be harmed by the hazard. It also considers how severe the harm or ill-health could be. Safe work practices are generally written methods outlining how to perform a task with minimum risk to people, equipment, materials, environment, and processes. Safe work practices are generally written methods outlining how to perform a task with minimum risk to people, equipment, materials, environment, and processes. Safe job procedures are a series of specific steps that guide a worker through a task from start to finish in a chronological order. Safe job procedures are designed to reduce the risk by minimizing potential exposure. Safe job procedures are a series of specific steps that guide a worker through a task from start to finish in a chronological order. The number of practices/procedures and the degree of detail will depend on the range of work activities your company performs.

It is important that management and supervision are involved in the development of safe work practices and that they provide adequate training for workers likely to follow these practices. If you must use pesticides as part of your business or employment you must have received adequate instruction and guidance in the safe, efficient and human use of pesticides and be competent for the duties you are required to perform.

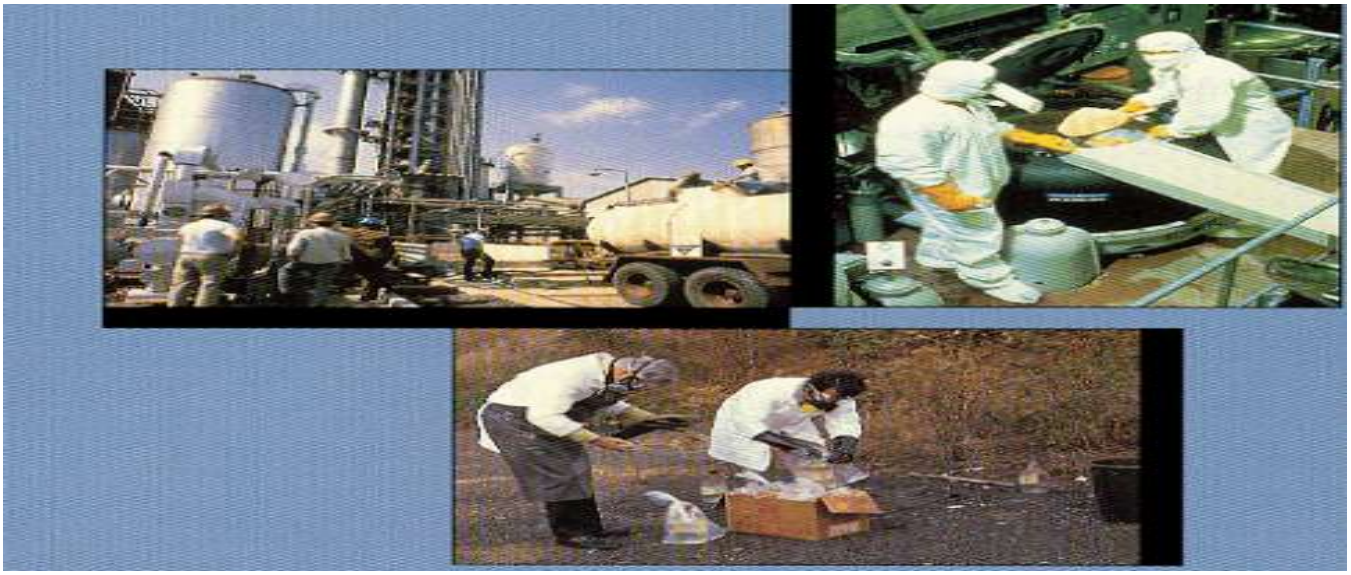


Figure-1safety in chemical at work area

4.2. Development and Delivery methods of safe working practices

- ⇨ **Safe work practices** should be developed as a result of completing a Hazard Assessment and should closely reflect the activities most common in the company's type or sector of construction.

- ⇨ **Safe job procedures** are usually developed by management and workers as a result of a Hazard Assessment, accident investigation and/or as a supplement to a safe work practice.
- ⇨ All safe work practices should be kept in a location central to the work being performed and readily available to the workforce. Some safe work practices will require specific job procedures, which clearly set out in a chronological order each step in a process. Safe work procedures should be included in the company's "Worker Orientation" program. All workers should be aware of the fact that safe job procedures have been established, are in effect, are written down and must be followed.

4.1. Identifying roles and responsibilities of people in the work place

The Worker Protection Standard (WPS), which addresses the protection of agricultural workers from pesticide exposure. The WPS includes requirements designed to reduce the risks of illness or injury to agricultural workers and pesticide handlers from occupational or accidental exposure to pesticides in the production of agricultural plants on farms and in nurseries, greenhouses, and forests. The WPS expands the scope of prior worker protection regulations to identify two types of agricultural employees:

- **pesticide handlers**—those who handle agricultural pesticides (mix, load, apply, clean or repair contaminated equipment, act as flaggers, etc.) and
- **Agricultural workers**—those who perform tasks related to the cultivation and harvesting of plants on farms or in greenhouses, nurseries, or forests where pesticides are used.

The WPS holds growers/ employers responsible for compliance. The regulations expand requirements for the employer to make sure that employees are provided with the following:

- warnings about pesticide applications
- clean and properly maintained personal protective equipment (PPE), which employers must ensure is used

- restrictions on reentry by personnel to treated areas (all pesticides used on farms and in forests, nurseries, and greenhouses have specific **restricted entry intervals** (REIs) that are listed on the label under the “Agricultural Use Requirements” section)
- decontamination facilities
- pesticide safety training and information
- notification of pesticide applications and information about the pesticide(s) used
- maintained contact with handlers when applying highly toxic pesticides
- emergency assistance when required
- a pesticide safety poster placed in an area where it can be seen easily by all workers and handlers
- information for pesticide handlers and early-entry workers about pesticide label safety information
- a centrally located listing of recent pesticide applications on the premises

4.1.1. **Recognizing safety procedures involved in chemical handling and using**

- Always store protective equipment separately from crop protection products.
- Wash gloves, aprons, boots and face shields after use.
- Wash spray clothing separately from domestic washing.
- Change respirator filters following the manufacturers guidelines

4.2. Safety in the use of chemicals at work

Chemicals are used in virtually all work activities, thus presenting certain risks in workplaces all over the world. Many new chemicals are put on to the market every year. It is therefore essential to establish a systematic approach to safety in the use of chemicals at work. This code of practice provides guidance on the implementation of the Chemicals Convention, 1990 (No. 170), and Recommendation, 1990 (No. 177), for all those engaged in framing provisions: competent authorities, managers of chemical companies and emergency services. It will also be of use to suppliers, employers and workers' organizations. The practical recommendations of the code cover all the elements necessary to ensure an efficient flow of information from manufacturers or importers to users of chemicals. They will also enable employers to formulate measures to protect workers, the public and the environment. The subjects covered include classification systems, labelling and marking, chemical safety data sheets, design and installation, control measures, work systems, personal protection, information and training, medical surveillance, emergency procedures, monitoring and reporting, and confidentiality. Price:

4.2.1 Organizational procedures that are followed with regard to chemicals

✓ **Read and understand the Crop Production Product (CPP) label**.

Check that the CPP has not expired.

Check, when selecting CPPs for use, the WHO hazard classification color coding band and chose the least hazardous

Handle and transport CPPs with caution

Transport CPPs separately from foodstuff or animals.

- ✓ **Use the CPP only for the use as stated on label**

Follow label instructions for use (crops, target pests, application rates [doses] and water volume rates).

Do not exceed maximum spray solution concentrations

Use label specified equipment and methods such as those specifying nozzle types and pressures

Do not exceed the label stated doses and frequency of use

Apply the CPP ‘on time’ when crop/pest/weather conditions are as stated

Wear appropriate Personal Protective clothing and Equipment (PPE).

Self-Check -4	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. explain safe work practices(5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	Identifying chemical spill procedures

5.1. Following procedures in the events of chemicals spill

A worker handling a hazardous chemical should be aware of the correct procedures in the event of a spill. This information can be sourced through a SDS and if necessary explicitly detailed in a documented safe work procedure. Controls, such as double containment, bunding, drip trays or raised edges around work areas, must be in place to minimise the effects of a chemical spill. Spill management and response strategies should be included during laboratory emergency planning with personnel trained in the procedures. A quick response by laboratory personnel to a chemical spill is likely to limit the consequences, whether it is a minor or major spill.

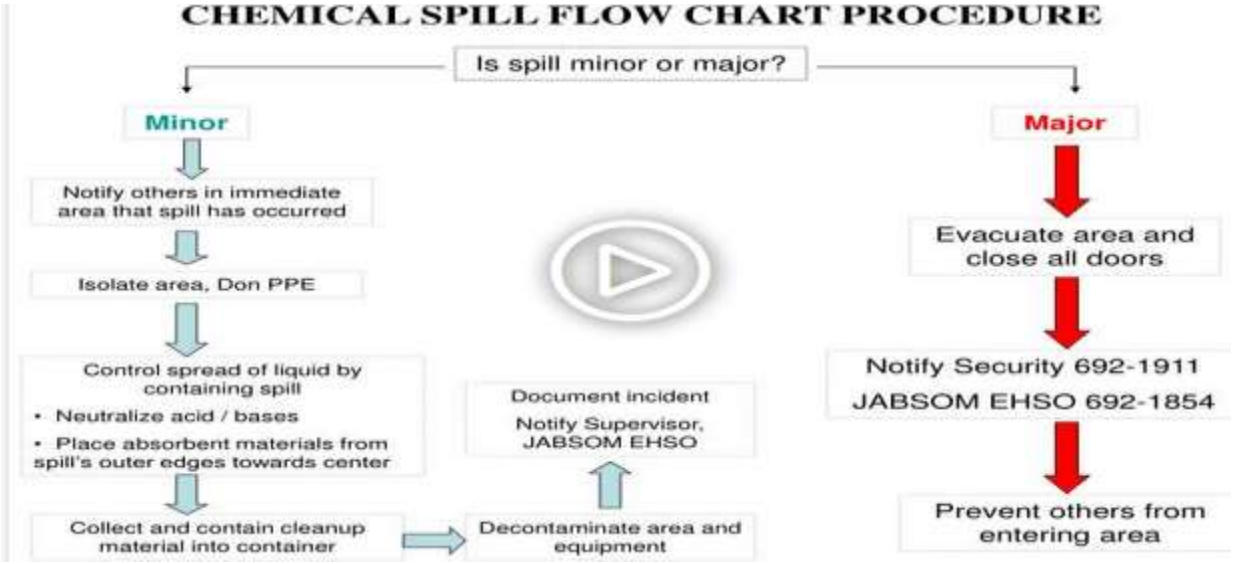


Figure-1chemical spill flow procedures

In the event of a chemical **spill**, the individual(s) who caused the **spill** is responsible for prompt and proper clean-up. It is also their responsibility to have **spill** control and personal protective equipment appropriate for the chemicals being handled readily available. **Location** If the **chemical** is outside of the laboratory or outside of the area where the material is normally used, and/or there is no trained person available to **clean up** the **spill**. A **minor chemical spill** is one that the individual can **clean up. Chemical spill**. The inadvertent release of a liquid **chemical** regarded as hazardous to human health, irrespective of the volume or place of release indoors or environmental—which, in a workplace, is identified with hazardous materials labels

⌘ Dispensing

Agrochemicals such as fertilizers, dusts and granules may be supplied ready for use. Dispensing agrochemicals in this way requires particular care to ensure that it is carried out safely and efficiently. This will include:

- Reading the label
- Setting out the agrochemical
- Wearing appropriate protective clothing, particularly gloves
- Adding the dispensed agrochemical to the applicator
- Carefully emptying packs of agrochemical dusts and powders into applicators

Figure-2 safety procedures during using agrochemical

5.2. **Chemical Spill Management**

All laboratory workers should wear appropriate personal protective clothing and equipment (PPCE) when attending to a chemical spill, for example, lab coats, gloves, safety glasses, goggles, face shields and/or respirator as appropriate to the risk. When preparing an emergency procedure for use of a hazardous substance you should consider the immediate danger to persons and ensure effective containment and clean up, appropriate disposal of waste material and notification to all relevant authorities.

Self-Check -5	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain the importance of identifying chemical spill (5)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

References

Mohanty MK, Behera BM, Jena SK, Srikanth S, Mogane C, Samal S, Behera AA: Knowledge attitude and practice of pesticide use among agricultural workers in Puducherry, South India. J For Legal Med 2013, 20:1028–1031.

Damalas CA, Abdollahzadeh G: Farmers' use of personal protective equipment during handling of plant protection products: determinants of implementation. Sci Total Environ 2016, 571:730–736.

Andrade-Rivas F, Rother HA: Chemical exposure reduction: factors impacting on South African herbicide sprayers' personal protective equipment compliance and high risk work Practices. Environ Res 2015, 142:34–45.

HORTICULTURAL CROP PRODUCTION

Level -II

Learning Guide#62

Unit of Competence: - Apply Chemicals under Supervision

Module Title: - Applying Chemicals under Supervision

LG Code: AGR HCP2 M15 LO3-LG-62

TTLM Code: AGR HCP2 TTLM 0120v1

LO 3:- Apply chemicals

Instruction Sheet	Learning Guide #62

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

- Recognizing identified hazards and associated risks
- Following accurate and effective application dose of chemicals

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

- Recognize, identify hazards and associated risks
- Follow accurate and effective application dose of chemicals

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3-7.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1 and 2” **in page 57 and 66**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).
6. If you earned a satisfactory evaluation proceed to “Information Sheet 2”. However, if your rating is unsatisfactory, see your teacher for further instructions or go back to Learning Activity #1.
7. Do LAP Test available on page-70

Information sheet-1	Recognizing identified hazards and associated risks

1.1. Identifying hazards and associated risks

Chemicals are sprayed to control pests and diseases on farms, around the home and in gardens, parks and reserves. When chemicals are used, droplets are produced that can remain suspended in air and may be carried by wind away from the target area. This is known as 'spray drift' .the different types of chemicals used in agriculture are: Herbicides (To kill weeds), Insecticides: (To kill bugs), Fungicides: (To get rid of disease) Soil fumigants, desiccants, harvest aids, and plant growth regulators. Natural pesticides: Pesticides are not limited to conventional agriculture

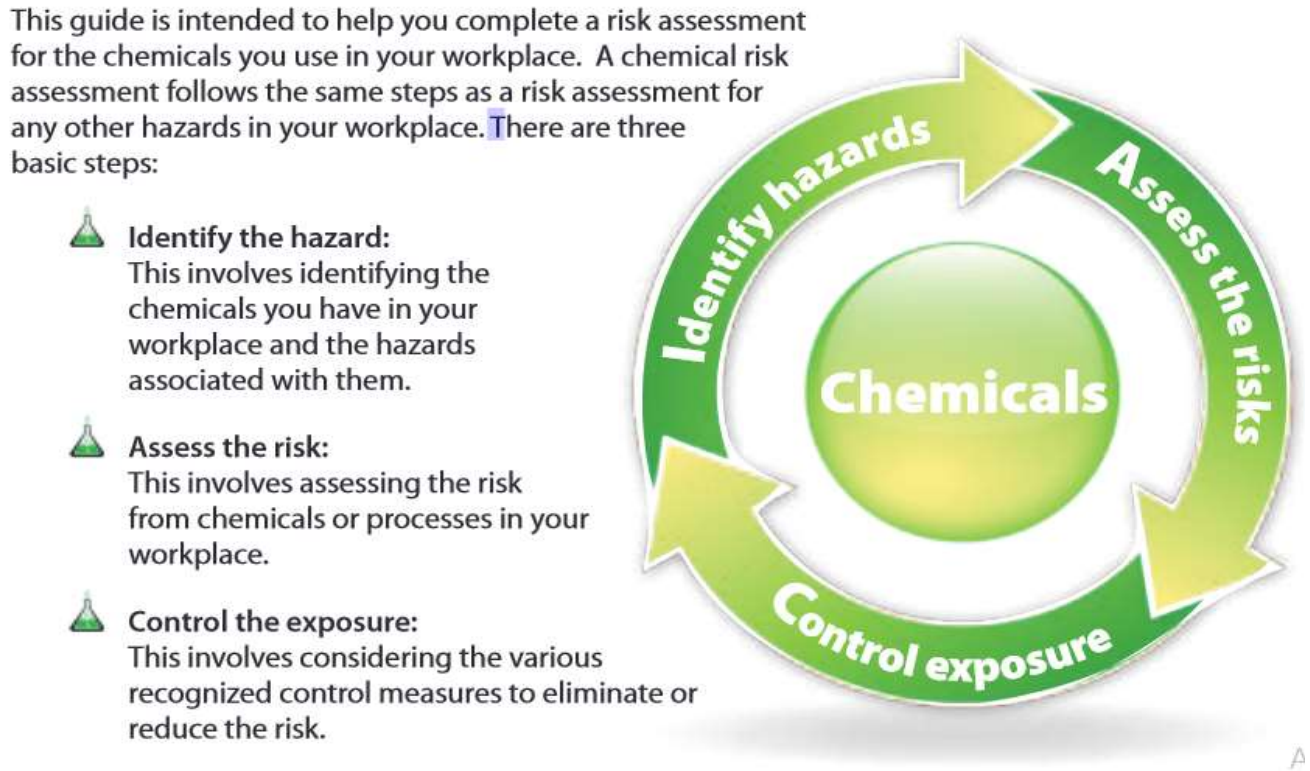


Figure-1 chemical risk assessment

All chemicals are hazardous, but they all can be used safely if we know how to control their hazardous characteristics while we use them. The suppliers of chemicals used in our schools are aware of and fulfill their responsibilities to inform their customers of the hazardous characteristics of the chemicals they provide. Suppliers provide this information both by labels on the containers and by Material Safety Data Sheets (MSDSs) (provided separately). According to the U.S. Occupational Safety and Health Administration (OSHA) and, in some cases, corresponding state regulations, it is the employer's responsibility to ensure that this important precautionary information is conveyed to teachers. Typically, a supervisor informs teachers on behalf of the principal. All must work together to ensure that teachers and students use and handle chemicals

with appropriate care and precaution. It is the intent of this learning guide to assist all those responsible, particularly supervisors and teachers, in fulfilling these responsibilities.

1.1.1. Chemical label and Material Safety Data Sheets

The most important tool to the farmers/users in the safe use of pesticides is to read out the instructions given on the labels of the container and leaflet/MSDS put in with container. Generally, the information given on the labels and leaflet are based on the scientific data. It is, therefore, advisable to follow them.

Some of the information given on the labels is as under.

a) Trade and common of the product
b) Composition of the product including net content of the pesticides
c) Name of the firm and address
d) Manufacturing license and batch number
e) Date of manufacturing and expiry date
f) Direction for use
g) Safety precautions
h) First aid advise
i) Method of disposal

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. The labels also contain a diamond shaped warning which is divided into two triangles by a horizontal line. The colour and words written on the triangle have significant signals.

Figure-1 significant signals of chemical

Table 1: Colour of the triangle on label and its significance

Particular	Extremely toxic	Highly toxic	Moderately toxic	Slightly toxic
Colour of the lower triangle	Red	Yellow	Blue	Green
Single word in upper triangle	POISON	POISON	DANGER	CAUTION

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. Like other information such as directions on how to use the particular chemical, its hazard will be given on labels and MSDS. The hazards may be listed on labels and the MSDS for the chemical concerned and may include flammability, toxicity, health hazards, and damage to non-target organisms, uneven surfaces, trip points, solar radiation, manual handling, faulty equipment, environmental damage or residues in foods.

1.1.1. Assessing and controlling Risks to others and the environment

The chemical risks that may be assessed include spillage, contact of chemical with skin or eyes, accidental ingestion, incorrect concentrations in mixtures, faulty or inappropriate storage containers, incorrectly calibrated equipment, spray drift, contamination of waterways, incorrect disposal of unused chemicals or faulty equipment. Once the chemical risks are assessed the control measure should be taken.

1.2. Effects of chemicals on the environment

Many employers are not aware of the hazards associated with toxic chemicals and often do not know how to dispose of chemical wastes safely. As a result, these employers often simply “dump” waste chemicals into the environment. Convenient dumping grounds are the ocean, rivers, lakes, fields, roadsides, etc. Toxic chemicals which are improperly disposed of may eventually end up in your drinking water, in the places where your children play, in the soil where your food is grown, etc.

Your home “environment” can be exposed to the chemicals in your workplace, too.

Your family can be exposed to your workplace hazards if you bring chemicals or other workplace contaminants home with you on your clothes, hair or skin. Therefore, it is not advisable to take workplace hazards home with you. It is the responsibility of the farmers to ensure correct usage and slaughter or production-withholding periods are observed. The details of the precautions in

safe use of pesticides including antidotes or counter effect of poisoning given in the leaflet or on the label should read out carefully and follow.

Checking labels

Labels are the primary, initial source of warning for farmers/users when handling hazardous chemical substances.

Proper Chemical Labeling

The relevant authorities and/or Laboratory supervisors, further farmers MUST ensure that all incoming containers of hazardous materials bear a label specifying the following:

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

So, for proper handling any chemical container should be checked whether it is bearing proper labels or not before use. If it has no labels using the chemical is not advisable

Pesticide types

A. Based on similarities in chemical structure and pesticidal activity

1. Organo chlorine

These are chlorinated hydrocarbon pesticides and include DDT, chlordane, HCH, etc. All contain atoms of carbon, chlorine and hydrogen, and are generally very persistent with long residual effects. Nowadays, the use of most of the chlorinated hydrocarbons has been banned in many countries.

2. Organophosphates

These are pesticides those having phosphorus atoms. These pesticides have two most important properties such as higher potency and low residual life. E.g. monocrotophus, parathinon, oxydemetonmethyl, etc.

3. Carbamates

A class of pesticides derived mainly from esters of carbamic acid with the general formula HO-CONH2; they all contain carbon, hydrogen, nitrogen and sulphur. A distinict limitation of carbamates in pest management is their toxicity to Hymenoptera, including both pollinators and parasitoids, e.g. carbaryl, carbofuran, etc.

4. Pyrethroids

The term pyrethroid comes from “pyrethrum”, and “oid” means something resembles, something

else. They have extremely high pesticidal activity at extremely low doses and are biodegradable in nature.

- **Based on types of pests to be controlled:**

Insecticides – kill insects

Fungicides – kill fungi

Herbicides – kill weeds

Bactericides – kill bacteria

Algaecides – kill algae

Nematicides – kill nematodes

Rodenticides kill rodents

The others are ovicides (kill eggs), molluscicides (kill snails and slugs), ovicides (kill or repel birds), piscicides (kill fish) attractants, chemosterillants, repellents, defoliants (remove leaves), predicides (kill predators), growth regulators (stimulate or retard growth of plant or insects) and pheromones (attract insects).Depending on the type pests to be controlled, the selection of pesticides and their formulation for proper use is an important step towards safety. Following points should be taken into considerations:

i. Identify the pest to be controlled
ii. Select recommended pesticide and recommended formulation of the pesticide against the said pest.
iii. Purchase the quantity of pesticide needed for the current season.

An outstanding chemical is effective at low rates, economical to manufacture, had a broad spectrum of uses, is safe and easy to handle and apply, and is relatively benign to the environment.

- **Pesticide formulations**

Formulation means a mixture of one or more pesticidal active ingredients with inert ingredients such as diluents, etc. Active ingredients are the chemicals in a pesticide product that control pests. Inert ingredients are the chemicals in a pesticide product that added to dilute the pesticide or make the product safer, more effective, easier to mix, apply, and more convenient to handle.

i. **Dusts:** Finely divided particles (of a pesticide etc.), for application in the dry condition, widely used in seed treatment. With no mixing, it is effective in hard-to-reach area such as cracks and crevices. Disadvantages: easily drift off target during application; residue easily moved off target by air movement or water; irritating eyes, nose, throat, and skin.
ii. **Granules**: A dry pesticide product, which consists of an active ingredient mixed with a carrier such as coarse particles of clay, often used to soil to control weeds, nematodes,

and insects living in the soil.

Advantages: no mixing; low drift hazard; little hazard to applicator.

Disadvantages: not to stick to foliage; need to be incorporated into soil; need moisture to start pesticidal action; hazardous to non target species such as waterfowl.

iii. **Wettable powder (wp):** Wettable powders are pesticides formulated on a dry particle and contain ingredients that allow the particles to mix with water, most widely used formulations.

Advantages: less harm to non-targeted plants, animals; easy to mix; less skin and eye absorption than EC.

Disadvantages: requiring good and constant agitation in tank; abrasive to pumps and nozzles; often clogging nozzles and screens.

iv. **Water soluble powders (Wsp):** Soluble powders are dry formulations of pesticides that go into true solution when mixed with water.

Advantages: less harm to non-targeted plants, animals; easy to mix; less skin and eye absorption than EC.

Disadvantages: inhalation hazard to applicator while pouring power

v. **Emulsified concentrated (EC):** Liquid formulation that when added to water spontaneously disperses as fine droplets to form an emulsion.

Advantages: little agitation required; not abrasive; do not plug screens or nozzles.

Disadvantages: easily absorbed through skin of humans or animals, flammable - stored or used away from heat or open flame; corrosive to equipment.

Self-Check -1	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Write down the importance of Identifying hazards and associated risks (5)

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

2.1. Requirements for the selection, preparation and adjustment of equipment

✡ Hand operated sprayers

These are sprayers in which pressure is operated with human power or force. Many small capacity sprayer e.g. knapsack or back pack, foot sprayer, rocker sprayers, bucket sprayer are common hand operated sprayers. Among these knap sack sprayer is very important (popular) due to its convenience in application as well as low cost of pump.

✠ Care and maintenance of sprayers

1. Clean sprayers properly and store them in dry place.
2. Drain the tank of sprayer and flush it with clean water, wash the pump nozzle before and after use.
3. Overhaul the machines regularly and replace the worn-out parts. Grease and oil the moving parts.
4. Do not bend hose at acute angles when in use.
5. Filter sprays liquid to avoid clogging of the nozzle.

2.2. Defining and calculating mixing rates

For all types of pesticides, there are four basic ways of stating dosages:

1. Amount of active ingredient (pure chemical) needed per hectare or acre.
2. Amount of actual formulation (i.e. Sevin 50 WP or Furadan 3 G, etc.) needed per hectare or acre.
3. Amount of actual formulation needed per liter or gallon of water.
4. Percentage concentration in the spray water.

2.2.1. Amount of active ingredient needed per hectare or acre:

The dosage of pesticide might be given as 2 kg active ingredient carbaryl per hectare, meaning 2 kg of pure Sevin (100%). Since actual pesticide formulations vary in strength from l percent up to 95 percent, it takes some math to figure out how much of a given formulation is needed to supply a given amount of active ingredient. If the local agricultural supply store sells carbaryl 50 percent WP, the farmer would need 4 kg for each hectare in order to supply 2 kg active ingredient. Note that nothing is said about how much water the farmer should mix with the pesticide when he sprays it on the plants. This will depend on plant size, plant density, and the degree of coverage desired. The only way to find out how much water is needed is to calibrate the sprayer.

2.2.2. Calibration calculation

Step 1 Recording important information

• Write down these measurements:

Chemical application rate------ litres per hectare (L/ha) (Remember: you get this rate from the **Directions for use** on the label) and **Water application rate**-------- litres per hectare (L/ha) (Remember: you get this rate from the General Instructions on the label)

Tank size litres----- (L)

Pump pressure -------kilopascals (kPa) or bars

Type and size of nozzle----------

Step 2 Taking measurements

(Remember to write the amount in litres (L):1000 mL=1 L, 500 mL= 0.5 L 100 mL= 0.1 L and 150 mL= 0.15 L).

• Measure nozzle output:

Water sprayed into jug in one minute = -----litres (L)

• Measure sprays width:

(Remember to write the width and distance in metres (m): 100 cm = 1 m, 50 cm = 0.5 m and 45 cm = 0.45). Spray width = ---metres (m)

• Measure walking speed :(Remember to write the width and distance in metres (m): 100 cm = 1 m

50 cm = 0.5 m and 45 cm = 0.45).

Distance walked in one minute = metres per minute (M/min)

Step 3 Calibrating equipment

• Use this formula to work out your sprayer application rate:

Your sprayer application rate (L/ha) = nozzle output (L/min) x 10000 ÷ spray width (m) ÷ walking speed (m /min).

☞ **Your sprayer application rate--------** = ----x 10000 ÷----÷------

(L/ha) = L/ha

✡ **Check: Is your rate within the range of the water application rate on the label?**

If not, change the nozzle, the pump pressure or your walking speed and work out the sprayer application rate again.

Step-4 Calculating the amount of chemical per tank

- Use this formula to work out how much chemical to put in your tank

Amount of chemical pertank(L)	=	chemical applicatio n rate (L/ha)	x	tank size (L)	÷	your sprayer applicatio n rate (L/ha)

• **Now change the amount from litres (L) to milliliters (mL):**

_____L=mL _____ (Remember: 1 litre (L) = 1000 milliliters (mL))

Step 5 Calculating the area, tanks and chemical for this job

• Use this formula to find the area to be sprayed in square metres**:**

Area to be sprayed (m^2) = length (m) x width (m).

Area to be sprayed (m^2) =___ x____ =_____ m^2

• Now change the area from square metres to hectares

Area in hectares (ha**)** =____ m^2 ÷ 10000 =_____ ha (Remember: 10000 m^2 = 1 hectare)

• Use this formula to work out the number of tanks to use

Number of tanks = size of area (h) x your sprayer Application rate (L/ha) ÷ your tank size (L)

Number of tanks =___ x___ ÷____ =_____ tanks

• Use this formula to work out the total amount of chemical for this job

Total amount of chemical = number of tanks x amount of chemical for this job (mL) per tank (mL)

Total amount of chemical =_____ x_____ =_____ mL for this job (mL).

✓ Now copy important information onto another sheet called the **CALIBRATION RECORD** sheet. It may be useful when doing other calibrations.

2.2.3. Amount of actual formulation needed per hectare or acre:

A recommendation calling for 4 liters of Malathion 50 percent per hectare, for example, is somewhat simpler than Type I since it is given in terms of actual formulation rather than active ingredient. However, the farmer still needs to know how much formulation he needs for his field's area and how much water it will take to provide adequate coverage with his sprayer. This requires sprayer calibration.

i) How to convert recommendation from an active ingredient basis to actual formulation basis

a) For solid formulations (WP's, EC's, G's)

$$\text{Actual formulation needed Kg/ha} = \frac{amount\ of\ a.i.\ recommended\ (kg/ha)}{\%\ active\ ingredient\ in\ formulation}$$

Example: a recommendation for aphids calls for using Malathion at 2 kg active ingredient/hectare. How much Malathion 40% WP would be needed per hectare?

Solution:

$$\frac{kg/ha\ of\ Malthion}{40\%\ WP\ needed} = \frac{2kg}{40\%} = \frac{2kg}{0.4} = 5kg$$

b) For liquid formulations (EC's)

Actual formulation needed Liters/ha of = $\frac{kg/ha\ of\ a.i.\ recommended}{\%\ a.i.\ in\ EC}$

Example: How much Perfekthion 20% EC would be needed per hectare if a recommended for mites calls for 0.2 kg a. i. Perfekthion per hectare?

Solution:

Liters of Perfekthion 20% EC needed = $\frac{0.2kg}{20\%} = \frac{0.2}{0.2} = 1liter$

ii. How to determine the amount of actual formulation needed for a farmer's field, given the dosage per hectare. Once you know how much actual formulation is needed per hectare or acre, you can easily calculate how much is needed for farmers' fields by multiplying the field size in hectares times the dosage per hectare.

Amount of formulation needed kg/ha= $\frac{amount\ of\ formulation\ needed/ha\ X\ field\ area\ (sq.m)}{10{,}000}$

✡ **Amount of actual formulation needed per liter or gallon of water**:

If the recommendation is expressed as for example, 5 cc of Malathion 50% EC per liters of water, no sprayer calibration or dosage calculation is needed. The drawback is that the amount of pesticide the farmer actually applies on his field depends entirely on how fast he or she walks while spraying, how coarse or fine the spray is, and how much pressure is used. Determine first whether the spray's percentage strength is to be calculated in terms of active ingredient or in terms of actual formulation.

For example, one recommendation might be expressed as 2 percent strength spray in terms of pure Malathion. Another recommendation might call for using a 0.1 percent strength spray of Lebaycid 50 percent EC for controlling thrips on peanuts. For wettable powders when using WP's, a percentage strength spray is based on weight of pesticide to weight of water. Since 1 liter of water weighs 1 kg, these formulas can be used:

Grams of WP needed per liter of water = $\frac{\%\ strength spray\ desired\ X\ 1000}{\%\ a.i.\ in\ wettable\ powder}$

cc (ml) of EC needed per liter of water = $\frac{\%\ strength spray\ desired\ X\ 1000}{\%\ a.i.\ in\ \text{the EC}}$

Exercise*:* How many grams of Malathion 40% WP should be added per liter of water to make up a 2% strength spray for controlling white fly.

Solution:

Grams of 40%WP needed = $(0.02 \times 1000)/0.4 = 200/4 = 50$

✡ **Percentage concentration in the spray water:**

This is basically the same as Type 3, except that the concentration of pesticide in the spray water is given in terms of percent rather than cc/liter. Following the directions and standards for mixing chemicals is very important to achieve good result as well as to increase the effectiveness of the chemical in controlling the pest. Directions and standards may include the instructions on the chemicals label, in an operator's manual, on a MSDS, in an industry standard, or from Codes of Practice and advisory material explaining legislation relevant to chemical use.

- Following accurate and effective application dose of chemicals

2.3. Assessing metrological conditions and forecasts prior to and during application

The weather conditions during application have a great effect on pesticide drift and hence need to be assessed in advance. The metrological conditions affecting chemical application may include rain, wind, temperature, relative humidity, inversion or stable air conditions.

i. ***Wind velocity:*** Air movements, both horizontal and vertical, cause pesticides to move away from where you are spraying. The higher the wind speed, the larger the amount of pesticide that will be carried away. Pesticides should never be applied during high wind conditions (greater than 10 mph).

ii. ***Wind direction:*** This is particularly important when wind direction is likely to move drifted pesticides onto nearby sensitive crops or other sensitive areas. Drift to sensitive areas often can be avoided by spraying when the air is moving away from these areas.

iii. ***Vertical air movement:*** Drift may also increase when warming air near the soil rises. Applications should be done at times when air and soil temperatures are most similar, often during early morning and late evening. At this time, vertical air movements are lowest. If the air near the soil surface is cooler than the air above, an "inversion" exists. Small spray particles remain suspended in the cool air during temperature inversions, and the particles do not settle readily onto soil or plants. Later the suspended particles move out of the crop on winds and drift. Pesticide applications should be avoided during inversions.

iv. ***Temperature and humidity:*** They can affect pesticide drift. When the temperature is high and humidity low, particles evaporate most rapidly. This evaporation causes droplet sizes to decrease and drift more readily. Volatile pesticides also evaporate more rapidly with high temperatures. Pesticides should be applied when the temperature is cool.

2.3.1. Following application equipment calibration procedures

Application equipment calibration is the way to find out how much water is needed to mix with the pesticide to spray on plants. The amount of water needed will depend on plant size, plant density, and the degree of coverage desired. No sprayer calibration is needed if the chemical dosage is expressed as the amount of actual formulation needed per liter or gallon of water.

2.3.2. Implementing equipment calibration

Calibration of hand held spraying equipment

- Always follow high hygiene standards when working with crop protection products
- Spraying equipment must be calibrated at least once in every season of use
- Keep calibration records
- Product labels often contain recommendations on optimum application volumes, timing and the choice of nozzles
- There are many different ways to calibrate spraying equipment
- This module contains several examples of calibration procedures for the following spraying equipment:-
    - Single nozzle knapsack and lance sprayers
    - Multi nozzle boom sprayers
    - Hand held mist blowers
    - Compression sprayers

Factors affecting application volume -

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

Before carrying out any calibration:

- Fill the sprayer with water and test that the sprayer is working well and has no leaks.
- Check that the nozzle is functioning correctly. Change the nozzle if needed.

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.

Calibration process

1. Fill the knapsacks spray tank to maximum rated capacity with clean water.
2. Set the correct operating pressure.
3. 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

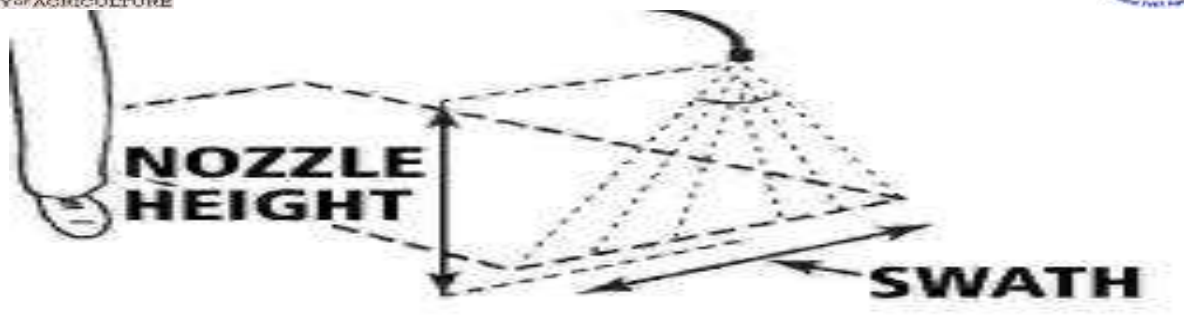


Figure-1 nozzles swath width

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

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

Solution:

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

2.4. Procedures and precautions for the use of the chemicals

When handled carelessly, pesticides can be hazardous and therefore, necessary precautions in handling and storage need to be followed to avoid possible hazards.

⌘ **Safety precaution**

✓ **On transportation**

a. Never carry pesticides in the passenger section.
b. Never allow children, other passengers, and pets to ride with pesticides.
c. Never transport pesticides with food, clothing, or other things meant to be eaten or in contact with people or animals.

d. Never leave your vehicle unattended when transporting pesticides in an unlocked trunk compartment or open-bed truck.
e. Consider transporting highly volatile pesticides in separate trips from other chemicals.

✓ **On storage**

a. The structure should have a concrete floor which is impermeable and easy to wash.
b. The structure should be fire resistant, explosion-proof, and located away from other buildings.
c. Adequate ventilation is needed to prevent exposure of the pesticides to extreme heat and reduce the concentration of toxic or flammable vapors in the building.
d. Lighting in storage facilities must be sufficient to allow easy identification of stored materials.
e. Pesticide storage areas should not be used for other purposes. Pesticides should never be stored with food, feed, seed, planting stock, fertilizers, or veterinary supplies.
f. Pesticides should also be stored separately from protective equipment such as respirators, goggles, and protective clothing.
g. Running water and materials for safely handling small-scale pesticide accidents should be located near storage facilities.

✓ **On application equipment**

a. The applicator must know the safe operation of application equipment and that all equipment is inspected and in good operating condition before each use, and choose applicable equipment before use.

✓ **On use in the field (Precautions during spraying)**

a. Stir the spray solution thoroughly with a stick before moving them to spray tank.
b. Ensure enough time for absorption of pesticide on foliage, often rain-free period of 3-4 hour after spraying.
c. Avoid spraying during heavy winds, the wind speed less than 8 kg/h.
d. Avoid spraying during high temperature or strong sunshine to prevent volatilization or photodecomposition of some pesticides.
e. Ensure spraying should not be repeated on crop plants one time to avoid damage.
f. Wear protective clothing and gloves or eye protector if toxic to eyes.
g. Check nozzle before each use, cleaning it with water and brush if blocked, never through mouth for blowing it.
h. Avoid smoking or eating during and in between the spray interval.

i. Following pre-harvest interval requirements; the pre-harvest interval is vital to reducing the hazards of pesticide use. It is the minimum amount of time that must elapse between the last pesticide application and harvest.

j. Applying a pesticide only to crops listed on the label; pesticides can be applied to only those crops that are specifically listed on the label. Since pesticides degrade at different rates depending on how the crop is grown, use of a pesticide on a crop may depend on how the crop is produced as well as what is grown.

k. Applying a pesticide only by methods listed on the label; the methods that can be used to apply a pesticide are also specified on the label. Complying with these instructions helps reduce the possibility of excess residues on harvested produce.

l. Applying a pesticide at or below the rate specified on the label. Use of a larger amount of a pesticide than the label specifies can also cause harmful residues on a crop.

Self-Check -2	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

2. Adperson walks with speed of 0.5km/hr covers swath of 0.25mwide. How much area he will be cover in one hour(5)
3. How many grams of Malathion 50% WP should be added per liter of water to make up a 2.5% strength spray for controlling white fly(5)

Note: **Satisfactory rating -10 points** **Unsatisfactory – below10 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation sheet-1	Applying chemical

Calibration of sprayers

Calibration is a test measurement of the output of a chemical /pesticide application equipment under typical operating condition to ensure the application of correct amount of pesticides.

Materials: knapsacks, water, ppe, type of crop, water can…etc

To identify the required quantity of pesticide and water for application per area.

STEPI. Checking and adjusting the different parts of the sprayer before using it for spraying purpose. Example start checking of the sprayer from the nozzle up to the internal part,

a. Checking for clogs: During calibration checking for any coarse particles that blocks the flow of liquid through the pipe to the nozzle.
b. Checking for leak .During calibration checking for whether there is the flow of liquid outside the nozzle or not
c. Checking for nozzle uniformity

If calibration is not done properly mean that either too much chemical per unit area or too low pesticide per unit area

- ✓ If dosage is too much per unit area, the negative effect will be
  - I. The crop may be damaged(phytotoxicity)
  - II. Leads to high residue in the target(crop)
  - III. Wastage and pollutes the environment(water, soil)
- ✓ If dosage is too low per unit area, the negative effect will be
  - I. Failure of controlling the target
  - II. Pest may develop resistance /adaptation
  - III. It will be wastage of time and money

Step II. Determine the amount of liquid used to cover known area mostly a hectare through the following steps.

How to calibrate the manual sprayer?

1) Measure and lay out a known area usually 10m*10m=100m^2
2) fill the sprayers with water to known marker(1/2-3/4)or insert known amount of water
3) spray known area using normal spraying techniques, height above the target /40-60cm)for manual sprayer
4) find out the amount of water used to spray the known area by:
   - ❖ Refilling to its previous level /mark
   - ❖ Measuring the remained water in the tank.
5) Calculate the volume of application rate /this is the amount of liquid required to spray a given area. (a ha of crop land)

VAR=Volume of liquid used to spray known area*10000m^2/ha

Area sprayed m^2

6) Determine the number of spray loads per ha

Load per ha=tank per ha=VAR Litter/ha

Tank capacity (litter /tank)

7) Determine the dilution rate for each sprayer

Calculate the amount of chemical l to add per tank at each time of spraying

Amount of chemical (litter per tank) == recommended production rate/ha*tank capacity

Volume of application rate

Operation Sheet 2	**handling and applying pesticides**

- **How to handle and applying pesticides**
- **Material: pesticide, PPE, pegs, meter tape, rope, water, water can, sprayers…etc**

Step 1- Read and follow all label instructions.

Step 2- Read the warning label.

Step 3- Use only appropriate containers for measuring, mixing, and applying pesticides.

Step 4 Mix only the amount of the product you intend to use

Step 5 Wash all equipment after each use

Step 6 Use appropriate safety equipment

Step 7 Never smoke, drink, or eat while applying pesticides

Step 8 Keep people and animals out of areas treated with insecticides and other chemicals for the period recommended on the product label.

Step 9 Be extremely careful applying pesticides in buildings or homes.

Step 10 do not use pesticides after any expiration dates on the package.

Step 11 Use pesticides only at the intervals recommended by the manufacturer.

Step 12 Apply pesticides in the early morning or late evening to avoid excessive drift (wind is normally lower during these time periods), and to prevent exposing beneficial insects like bees and ladybugs to the effects of them

Step 13 Be aware that certain pesticides are systemically active, meaning the chemical is absorbed by the plant tissues and distributed throughout the plant.

Step 14 Alternate suitable pesticides to obtain the best results in pest control.

Step 15 Always look for the most environmentally sound, and least toxic pest control method

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1.Show, the ways of handle and applying pesticides

Task 2. Identify, the step of Calibration

References

1. **WorkCover Authority of NSW** – provides useful information on chemical safety http://www.workcover.nsw.gov.au/healthsafety/healthsafetytopics/Chemicalsafety/Pages/default.aspx
2. Pest Genie - is a database specialising in information about plant protection and animal health products, including both labels and Material Safety Data Sheets www.pestgenie.com.au
3. Yarpuz-Bozdogan N, Bozdogan AM: Assessment of dermal bystander exposure in pesticide applications using different types of nozzles. J Food Agric Environ 2009, 7:678–682.
4. Damalas CA, Khan M: Pesticide use in vegetable crops in Pakistan: insights through an ordered probit model. Crop Prot 2017, 99:59–64.

HORTICULTURAL CROP PRODUCTION

Level -II

Learning Guide#63

Unit of Competence: - Apply Chemicals under Supervision

Module Title: - Applying Chemicals under Supervision

LG Code: AGR HCP2 M15 LO4-LG-63

TTLM Code: AGR HCP2 TTLM 0120v1

LO 4:- Follow instructions to empty and clean equipment and containers

Instruction Sheet	Learning Guide #63

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

- Identify instructions for clean-up
- Follow appropriate cleanup methods
- Identifying instructions of disposal

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

- Identifying instructions for clean-up and instructions of disposal
- Following appropriate cleanup methods

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described in number 3 to 5.
3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
4. Accomplish the “Self-check 1,2 and 3” **in page -75,77 and 81**
5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

1.1. Cleaning chemicals, equipment and technique

The role of environmental cleaning is to reduce the number of infectious agents that may be present on surfaces and minimise the risk of transfer of micro-organisms from one person/object to another, thereby reducing the risk of infection. Cleaning is a process which intends to remove foreign material (e.g. dust, soil, blood, secretions, excretions and micro-organisms) from a surface or an object through the use of water, detergent and mechanical action/friction. Although cleaning is known to successfully reduce the microbial load on surfaces there are some circumstances where disinfection is also required to be performed. Disinfection is a process which intends to kill or remove pathogenic micro-organisms but which cannot usually kill bacterial spores. Some elements such as toilets, bidets and commodes must always be cleaned with detergent and disinfectant as a part of standard precautions.

However there are some situations where the cleaning of all elements is upgraded to detergent and disinfectant as a means of minimising the risk of transmission of disease between patients. This is referred to as transmission-based precautions. There are three important factors which together help ensure the cleaning and disinfection practices within the healthcare facility are of a high standard. These include: chemicals, equipment and techniques. All cleaning services staff should be aware of the importance of each factor and how they interrelate. For example, if the cleaning chemicals that are used in the facility are adequate for the purpose, but cleaning equipment is dirty (e.g. unclean mops or buckets) or the cleaning technique is poor, then the cleaning/disinfection of the area will be sub-standard.

Figure-1 important factors of cleaning

1.2. Cleaning chemicals

There are two main groups of cleaning chemicals that are to be used in the healthcare facility: >Detergents: A detergent is a surfactant that facilitates the removal of dirt and organic matter. Most hard surfaces can be adequately cleaned with warm water and a neutral detergent as per the manufacturer's instructions. Allowing the cleaned surfaces to dry is an important aspect of cleaning.>Disinfectants: A disinfectant is a chemical agent that rapidly kills or inactivates most infectious agents. Disinfectants are not to be used as general cleaning agents, unless combined with a detergent as a combination cleaning agent (detergent-disinfectant).

1.3. Cleaning equipment

In general, all cleaning equipment used in healthcare facilities should be fit for purpose, cleaned and stored dry between use, well maintained and used appropriately. Other factors regarding cleaning equipment are discussed below.

1.4. Requirement instructions for cleaning

- ⇨ 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.

Wash chemical-soiled clothing

Spray clothing should be changed and washed daily.

Self-Check -1	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List the requirement of instructions for cleaning(5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet-2	Following appropriate cleanup methods

2.1. Requirements of cleaning chemical

Chemical cleaning of water systems can be divided into two classifications: pre-operational and remedial. Pre-operational cleaning is performed to prepare the water-contacted metal surfaces to receive chemical treatment, which provides protection from scale, corrosion, and microbiological growth. Remedial cleaning is performed to restore water systems that have been fouled with scale, corrosion products, and microbiological growth due to inadequate or ineffective water treatment. Cleaning, particularly remedial-type cleaning, is often performed by outside contractors familiar with cleaning procedures, techniques, and safety.

Pre-operational cleaning is performed to remove these materials and prepare metal surfaces to receive corrosion protection from chemical treatment. Pre-operational cleaning agents that are used include detergents, wetting agents, rust removers, and dispersants. Remedial cleaning is performed to restore a water system that is fouled with scale, corrosion products, or microbiological biomass due to inadequate or ineffective water treatment. The problem could have resulted from using improper chemical technology, failure to maintain treatment levels within control parameters, or the failure of pre-treatment equipment.

2.2. CLEANING METHODS

2.2.1. MECHANICAL METHODS.

Mechanical methods are the oldest techniques used for removing deposits. To perform an adequate mechanical-type cleaning, the equipment to be cleaned may need to be partially or entirely dismantled. Even when equipment is dismantled, some areas may be extremely difficult to reach and clean. Chemical cleaning has largely replaced mechanical process equipment cleaning as the most satisfactory method of removing deposits; however, mechanical methods such as wire brushing, tumbling, scraping, and abrasive blasting with sand and grit are still employed in special applications.© J. Paul Guyer 2011 7

2.2.2 CLEANING AGENTS.

Cleaning agents may be broadly classified as being acid, alkaline, organic, or solvent cleaners. There is no general or universal cleaner that removes all deposits. The selection of a solvent or cleaning agent is based on the material's ability to remove or dissolve the deposit, as well as on cost considerations, safety hazards, and the effect of the cleaning material on the metals involved.

Self-Check -2	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List the type of chemical cleaning of water systems and discus on each of them (5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet-3	Identifying instructions of disposal

3.1. Disposal of containers and unused chemicals

Many liquid, gel or powder cleaners can be disposed of in the same way that the product is used, such as down the drain. Plastic bottles and aerosol cans can often be recycled when empty. Products with hazardous **chemicals** like oven cleaners should be taken to a local waste **disposal** location. **Dispose of pesticides** as instructed on the product label. Look for the "Storage and **Disposal**" statement on your **pesticide** label. If any product remains in the container it must be disposed of as household hazardous waste. 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.

Disposing methods

1. **Identifying the Proper Waste Disposal Method**

1.1. **Read the product label,**

Figure-2 reading label of chemical

1.2. **Read the material safety data sheet**

The MSDS gives you important information about the chemical: its toxicity, reactivity, and disposal considerations. Every chemical product you buy should come with an MSDS sheet.

However, you can also use the online MSDS database to look up the MSDS for the specific formulation of the chemical you wish to dispose.

Figure-3 reads materials safety data sheets

1.3. **Search the list of hazardous wastes.**

The Environmental Protection Agency (EPA) has many resources on determining if your waste is considered hazardous and what kind of special disposal is necessary.

2. Disposing of Common Chemicals methods

It includes:

Use proper safety precautions, dilute bleach and hydrogen peroxide to pour down the drain, Store solvents for special collection, Recycle automotive fluids, Drain all aerosol canisters and Return pool chemicals back to your local pool store.

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

Agrochemical waste should ***never be dumped indiscriminately***

3. Agrochemicals should never be disposed of so as to ***cause any risk*** to people, animals, crops, water supplies or the environment.
4. ***Advice should be sough***t from the supplier, local authority or community leader.
5. ***Accumulation*** of waste should be avoided.
6. Waste should be disposed of as ***soon as possible.***
7. The ***user should read the label on the package*** or container for any specific advice on waste disposal.

8. 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.
9. All other containers ***should always be cleaned*** thoroughly before disposal.
10. Care should be taken to ensure that the ***water used for rinsing does not contaminate*** the environment; particularly drinking-water, for example.
11. Liquid containers should be drained out before cleaning.
12. 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.
13. Packages of dry powders and ***granules must be shaken out thoroughly*** into a mixing vessel or the applicator tank.
14. Containers may be ***buried on premises owned*** or occupied by the agrochemical user.
15. A record should be kept of the dates and the material buried.

Self-Check -3	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List the general steps should be observed during disposal of waste (5)

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

References

1. WorkCover Authority of NSW – provides useful information on chemical safety http://www.workcover.nsw.gov.au/healthsafety/healthsafetytopics/Chemicalsafety/Pages/default.
2. Pest Genie - is a database specialising in information about plant protection and animal health products, including both labels and Material Safety Data Sheets
3. Chemical Spill Management Guidelines,2015

HORTICULTURAL CROP PRODUCTION

Level -II

Learning Guide#64

Unit of Competence: - Applying Chemicals under Supervision

Module Title: - Applying Chemicals under Supervision

LG Code: AGR HCP2 M15 LO5-LG-64

TTLM Code: AGR HCP2 TTLM 0120v1

LO 5:- Complete chemical records

Instruction Sheet	Learning Guide #64

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

- Recording chemical inventory
- Reporting chemical application details

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

- Record chemical inventory and Report chemical application details

  Learning Instructions:

  1. Read the specific objectives of this Learning Guide.
  2. Follow the instructions described in number 3 to 5.
  3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
  4. Accomplish the “Self-check 1 and 2” **in page 81 and 91.**
  5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

1.1. Legal requirements for record keeping

Record keeping requirements may vary between state and territory regulatory authorities. You should check to ensure your record keeping is adequate. To assist risk management, accurate records should be kept of all aspects related to the assessment and control of pesticide storage and pesticide use. Records should be made on prepared forms so that they can be easily completed and understood. Computerised records are acceptable, providing employees are trained to use these. For pesticides classified as hazardous substances, it is compulsory under the hazardous substance legislation for employers and self-employed to keep:

- A list of all pesticides and any other hazardous substances stored or used on the site.
- A register of MSDS (Material Safety Data Sheets), each one of which must be less than five years old.

❁ **Employers must also keep the following records**:

Risk assessments indicating a significant risk to employees at the workplace records of health surveillance records of monitoring records of training. Suitable record forms should be available from your occupational health and safety authority. Keeping these records is good practice, even if it is not a legal requirement. Some of these may be combined with other occupational health and safety records for the workplace, for example records of training or health surveillance**.**

- Records can ***establish proof of proper use*** or they are helpful in finding the cause of error, if an error is made.
- They can also ***provide information*** to trace residue and /or damage problems.
- Records can also ***save money***.
- They ***allow the Farmer to compare the results*** obtained from different chemicals.
- It ***helps improve Pest control*** practices and efficiency too.
- They also help to reduce ***chemical misuse***.
- Careful records from year to year guides the farmer in buying only the amount of Chemicals needed.

1.2. Rerecording chemical inventory

⊗ **Information needed:-**

- ✡ Time of day and date of application
- ✡ Crop or target
- ✡ Pest, weed and diseases
- ✡ Equipment used
- ✡ Agrochemical used

- ✡ Common name
- ✡ Trade name
- ✡ Formulation and % active ingredient
- ✡ Lot number (in case of cross-contamination or failure to control)
- ✡ Total formulation added to tank or hopper
- ✡ Amount of mixture used
- ✡ Amount or numbers treated (hectares, buildings, sheep, etc.)

⊗ Additional comments:-

✓ Location

✓ Weather

✓ Applicator

✓ Severity of infestation

Self-Check -1	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List the Information needed rerecording chemical inventory (5)

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

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

2.1. Pesticide application

There are different types of application equipment. The type of equipment to be used ***depends*** on:

- The ***scale o***f operation; and
- The form in which the agrochemical is applied.

Users should ensure that the training has adequately covered the following aspects of application:

- ⌘ Choice of equipment
- ⌘ Checking of equipment to ensure proper functioning
- ⌘ Filling the applicator with the agrochemical
- ⌘ Calibrating
- ⌘ Operating
- ⌘ Safety precautions and emergency measures in the event of malfunction or accident
- ⌘ cleaning, maintenance and replacement of spare parts
- ⌘ Fault-finding
- ⌘ Attending to simple repairs.

Users should ensure that the users' instruction manual (or similar operating instructions guide) giving detailed instructions on:

- Operating procedures
- Replacement of spare parts and
- Repairs.

Pre-spraying precautions

- Read and understand labeled instructions and any other information provided
- Assess the risks of application to people, animals and the environment
- Seek the necessary advice before you commence application.
- Ensure that the user is competent and that he or she has received effective
- The user should also be familiar with the requirements under the law and guidance given in codes of practice.
- Check application equipment to ensure that it operates satisfactorily without leaking or spilling and is calibrated for the necessary application rates.

- Check that protective clothing and other safety equipment including breathing apparatus, if required, is complete
- Decide how the work is going to be done and set up an action plan
- Check that weather conditions are satisfactory, particularly to avoid excessive wind speeds and consequent spray drift.
- Warn people nearby if they might be affected in any way or have a need to know. They may include bee-keepers, school authorities, or someone in charge of water supplies or sensitive plants or animals.
- Ensure the safe disposal of empty containers, tank washings and surplus pesticides.

Precautions during application

- Do not apply agrochemicals without adequate training.
- Wear appropriate protective clothing
- Avoid blow-back from granule or powdered materials when transferring container
- Mix only the correct amount of agrochemical required for a particular task
- Handle containers carefully to prevent gurgling or spillage
- Do not eat, drink or smoke while applying agrochemicals

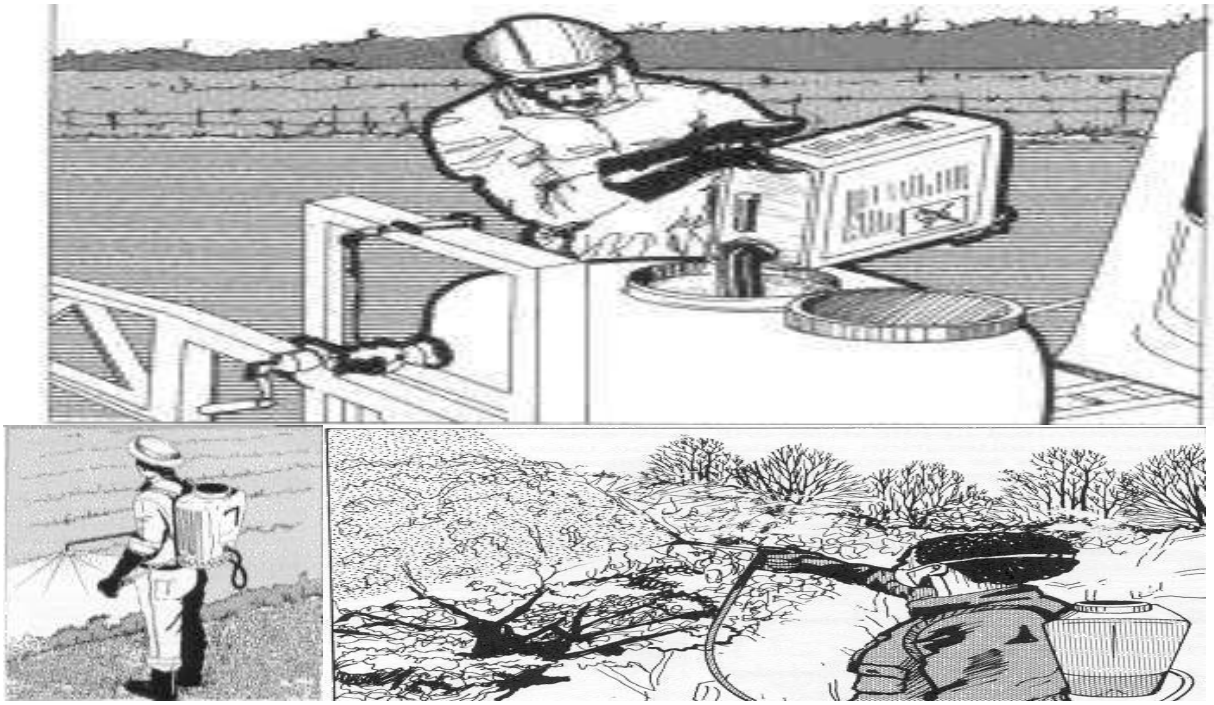
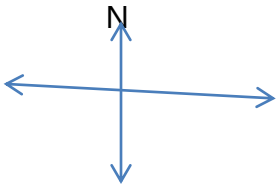


Figure-1the ways of using chemical

Post-spraying precautions

- Thoroughly wash hands, face and neck
- Return unused agrochemicals to safe storage and safely dispose of empty containers
- Decontaminate application equipment by washing it thoroughly
- The washings should be drained
- Gloves should be washed inside and out and allowed to dry.
- Respiratory protection equipment should be wiped clean.
- Bathe or washthoroughly again after completing the above four actions.
- Complete a record of use so as to provide information about the agrochemicals used
- Remove warning signs.

2.1. Spray application record format

Spraying information		Sketch map showing where on the simple label Sketch map 
Name of chemical		
Crop sprayed		
Pest / disease		
Size of area sprayed		
Equipment used		
Date of calibration		
Date of application		
Time started		
Time finished		
Application rate (from label)		
Amount of chemical used for this job		

Weather information	
Wind speed	
Wind direction	
Temperature	
Humidity	
Did the weather change while spraying?	Yes / No If yes, give details

General information	
Property Address	
Owner, manager or occupier of the land:	
Name	
Address	
Phone number	
Person applying the chemical:	
Name	
Address	
Phone number	

☞ *Signature of the person applying the chemical:* _____

Self-Check -2	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Explain pre and post precaution? 5 pts
2. Discus application procedures of chemicals? 5pts
3. What is the importance of record keeping? 5pts

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

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

HORTICULTURAL CROP PRODUCTION

Level -II

Learning Guide#65

Unit of Competence: - Applying Chemicals under Supervision

Module Title: - Applying Chemicals under Supervision

LG Code: AGR HCP2 M15 LO6-LG-65

TTLM Code: AGR HCP2 TTLM 0120v1

LO6:-Transport, handle and store chemicals

Instruction Sheet	Learning Guide #64

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

- Following transport, handling and storage requirements for chemicals
- Following requirements for storage of chemicals

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

- Follow transport, handle and storage requirements for chemicals

  Learning Instructions:

  1. Read the specific objectives of this Learning Guide.
  2. Follow the instructions described in number 3 to 5.
  3. Read the information written in the “Information Sheets 1”. Try to understand what are being discussed. Ask you teacher for assistance if you have hard time understanding them.
  4. Accomplish the “Self-check 1 and 2 ” **in page -97 and 102**
  5. Ask from your teacher the key to correction (key answers) or you can request your teacher to correct your work. (You are to get the key answer only after you finished answering the Self-check 1).

Information sheet-1	Following transport, handling and storage requirements for chemicals

1.1. **Instructions for transport, handling and storage of chemicals**

Transporting products

- Be aware of any local legislation regarding the transport of products.
- Be prepared for any accidental spillage or emergency situation.
- Transport seperately products or spraying equipment from foodstuff, livestock or humans.
- Ensure crop protection products are in their original containers and that the seals are still OK and tightened to avoid the possibility of leaks and spills.
- When transporting spraying equipment ensure it is washed and clean before leaving the field.
- Clean up any spillages using absorbant material such as sand or soil.
- If transporting heavy containers ensure that there is equipment available to enable safe on and off loading.

When transporting products from the farmstead to the field only take what is required for the job, always transport in the original containers, do not decant

Correct and safe storage of crop protection products is essential to:-

1. Protect human health
2. Protect the environment
3. Maintain product integrity and effectiveness

Most product labels require that the product is stored within a locked facility

Follow the storage instructions on the label. Some products require separation from other products

Secure storage protects the products integrity and reduces the risk of theft

Always understand the storage hazard warning on the label.

A suitable storage site for pesticides protects:

• People and animals from accidental exposure.

• The environment from accidental contamination.

• Stored products from damage (from temperature extremes and excess moisture).

All pesticides should be stored under lock and key, outside the home. Storage facilities should be well-ventilated and well-lit. Pesticide storage areas should be located away from water sources such as ponds or wells. However, a supply of clean water for decontamination is recommended. Use non-porous materials for flooring and shelving. It is important to arrange materials in the storage site so cross-contamination does not occur. Do not store pesticides with food, feed, seed, or fertilizer. An emergency plan should be worked out with local authorities, notifying them of the contents of pesticide storage facilities. If substantial quantities of highly toxic pesticides are stored, you must notify (according to law) your local emergency response Council. Proper records should be maintained to provide an up-to-date list of contents at all times. Always store pesticides in their original containers and keep them tightly closed. Never keep pesticides in unmarked containers.

Product storage: management

- Periodically check that stored products are in good condition and have not passed their expiry date
- Record all products in store; their delivery and their use
- Check condition of products at delivery
- Keep the store clean and tidy.
- Avoid trip hazards
- Have absorbant materials available to mop up spillages.
- Do not store liquid products above dry formulations.
- Do not store personal protective equipment in product stores.
- Products must only be stored in their original containers.

Instructions for use, maintenance and storage of personal protective equipment and application equipment

- Follow label instructions for use (crops, target pests, application rates [doses] and water volume rates).
- Do not exceed maximum spray solution concentrations.
- Use label specified equipment and methods such as those specifying nozzle types and pressures'
- Do not exceed the label stated doses and frequency of use.

Check, calibrate and maintain application equipment.

- Check spraying equipment before use
- DO ensure any leaks are repaired before use.
- Check the nozzle is working correctly, is clean and do replace if necessary.
- Calibrate spraying equipment at least once a season depending on the amount of use (or whenever the field condition/crop, operator, nozzle, application rate or other spraying requirements are changed).
- Clean spraying equipment after use .
- Store spraying equipment securely away from children, animals and feed.

PPE Storage and maintenance

- Always store protective equipment separately from crop protection products.
- Wash gloves, aprons, boots and face shields after use.
- Wash spray clothing separately from domestic washing.
- Change respirator filters following the manufacturers guidelines

Applicators may have little or no control over the availability of low-toxicity products or the toxicity of specific formulated products. However, exposure can be significantly reduced or nearly eliminated by using personal protective clothing and equipment. For example, over 90 percent of all pesticide exposure

comes from dermal exposure, primarily to the hands and forearms. By wearing a pair of chemically resistant gloves, this exposure can be reduced at least 90 percent. Therefore, by wearing the correct PPE, the hazard of pesticide use can be reduced to an insignificant level for the applicator.

Self-Check -1	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. Correct and safe storage of crop protection products(5)
2. List the instructions for use, maintenance and storage of personal protective equipment and application equipment(5)

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**
You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information sheet-2	Following requirements for storage of chemicals

2.1. Safety rules which have to be followed in working areas

Efficient and economical control of insects, plant diseases, and weeds is a factor in the production of all crops. Both management costs and losses resulting from inadequate control can reach tremendous proportions. The use of today's pesticides requires a great degree of precision. In some instances, rates are given in ounces per acre. This requires that pesticide users know how to calibrate equipment and follow detailed directions on product labels.

All pesticides should be used with care.

The following suggestions will help minimize the likelihood of injury (from exposure to such chemicals) to people, animals, and non-target plants and animals:

- ❖ Read the Label
- ❖ Store Pesticides Properly
- ❖ Avoid Physical Contact with Pesticides
- ❖ Dispose of Pesticides Correctly

✡ Ensure good personal hygiene.

- Wash splashes of Crop Protection Products immediately from skin and/or eyes.
- Have available an adequate supply of drinking water to avoid dehydration.
- Do not eat, smoke or drink whilst handling, working with or applying Crop Protection Products.
- Wash yourself and clothes after working with Crop Protection Products.
- Wash spray clothes separately from the domestic washing.
- Wash before drinking and or eating.
- Do not work with CPP if you feel unwell before you start.

✓ **Appropriate application and personal protective equipment in working areas**

Toxicity is a measure of the ability of a pesticide to cause injury, which is property of the chemical itself. Pesticide toxicity is determined by exposing test animals to different dosages of the active ingredient. Tests are also done with each different formulation of the product (for example, liquids, dusts, and granules). By understanding the difference in toxicity levels of pesticides, a user can minimize the potential hazard by selecting the pesticide with the lowest toxicity that will control the pest. Some herbicides, such as highly volatile esters of 2,4-D (e.g., isopropyl and butyl esters), are capable of causing injury to adjacent crops by movement in the vapor phase after the spray has dried on the plant or soil surfaces. Use the amine, low-volatility ester or oil-soluble amine formulations to reduce the possibility of vapor drift.

The farmer and the applicator are liable for damages caused by particle drift or volatility.

Select Pesticide Products Wisely: Two or more pesticides may be equally effective in a given situation. Also, the same active ingredient may be available in a variety of formulations. Your selection of a pesticide and its formulation will be determined by the:

1. Site/crop to be treated.
2. Pest species involved.
3. Product availability.
4. Equipment availability.
5. Hazards to humans, domestic animals, wildlife, and desirable plants.
6. Time of application.
7. Relative total costs of materials and application.

All recommended rates of application are based on the amount of active ingredient in a given product. Many commercial products vary in the percentage of active ingredient. The label will give the exact amount of active ingredient in the container and the amount of product to be used in a given area

The 5 Golden Rules for chemical application

1. Before using any crop protection product, always read its label and make sure you understand all safety needs
2. Handle crop protection products carefully at all times to avoid contact or contamination
3. Maintain sprayers well, fixing, for example, any leaks before starting an application.
4. Practice good personal hygiene
5. Use appropriate protective clothing as last line of defence and not to become careless and increase exposure risks.

Procedures which are followed in the event of an accident or spillage of chemicals

Safety equipment should include:

1. Hazard warning signs, outside and inside the store
2. Emergency procedures in the event of an accident (with contact telephone numbers)
3. Fire extinguisher
4. First aid kit
5. Clean water to wash off spills
6. Absorbant material to soak up any spills
7. Waste bin for contaminated waste

The effects, or symptoms, of pesticide poisoning can be broadly defined as either topical or systemic. Topical effects generally develop at the site of pesticide contact and are a result of either the pesticide's irritant properties (either the active and/ or inert ingredient) or an allergic response by the victim. Dermatitis, or inflammation of the skin, is accepted as the most commonly reported topical effect associated with pesticide exposure. Symptoms of dermatitis range from reddening of the skin to rashes and/ or blisters. Some individuals exhibit allergic reactions when using pesticides or when these materials are applied in or around the homes or places or work. Symptoms of allergic reactions range from reddening and itching of the skin and eyes to respiratory discomfort often resembling an asthmatic condition.

In the event of any leakage -

- Keep people away from any spillage.
- Contain the spillage by placing soil or sand around the spill.
- Carefully add more soil or sand to absorb spill.
- Sweep or shovel up the absorbed spill and place in strong bag.
- Label bag and seek help from product supplier for best disposal options.
- If the spillage involves a significant volume notify to local emergency services.

Systemic effects are quite different from topical effects. They often occur away from the original point of contact, as a result of the pesticide being absorbed into and distributed throughout the body. Systemic effects often include nausea, vomiting, fatigue, headache, and intestinal disorders.

Seeking prompt medical attention is important; however the development of certain symptoms is not always the result of exposure to a pesticide. Common illnesses such as the flu, heat exhaustion or heat stroke, pneumonia, asthma, respiratory and intestinal infections, and even a hangover can cause symptoms similar to pesticide exposure. Carefully consider all possible causes of your symptoms

General first aid instructions

Most important, be sure to protect yourself by wearing appropriate protective clothing and equipment if there is a likelihood of being directly exposed to a pesticide while administering first aid or removing the victim from an enclosed area.

- Have current labels and Material Safety Data Sheets (MSDS) available.

- Have emergency response telephone numbers readily available.
- Assemble a first aid kit with necessary supplies.
- Always have a source of clean water available. In an extreme emergency, even water from a farm pond, clean water irrigation system, or watering trough could be used to dilute the pesticide.
- If oral or dermal exposure occurred, the first objective is usually to dilute the pesticide and prevent absorption.
- If inhalation exposure occurs, first protect yourself, and then get the victim to fresh air immediately.
- Never give anything orally to an unconscious person.
- Become familiar with the proper techniques of artificial respiration; it may be necessary if a person's breathing has stopped or become impaired.

Self-Check -2	Written Test

Directions Answer all the questions listed below. Use the Answer sheet provided in the next page:

1. List **Procedures which are followed in the event of an accident or spillage of chemicals (5).**

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5 points**

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

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

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Profile of trainers participate on special Horticultural Crop Production TTLM development for level II at Adama 2020