Crop Production and Marketing Management

Level IV

Based on March 2018, Version 3 Occupational standards

Module Title **Planning and Implementing Chemical Use Program**

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LG # 49	LO #1- Identify the requirements of chemical use

Instruction sheet

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

- Accessing and interpreting *Chemical* use requirements
- Accessing and Interpreting *legalization and safety procedures*
- using and providing *Personal protective equipment*
- identifying Industry standards for chemical use
- confirming or arranging appropriate insurance policy

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

- Chemical use requirements relevant to the workplace access and interpret.
- Legalisation and safety procedures surrounding the use of chemicals access and interpret.
- Personal protective equipment use and provide to others for transport, storage and application of chemicals.
- Industry standards for chemical use identify.
- Appropriate insurance policy cover confirm or arrange.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets

7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Accessing and interpreting chemical use requirements

1.1 Introduction

Pesticides include naturally occurring and man-made substances which are used to control destructive pests such as insects, plant disease organisms, and weeds, including many other living organisms such as nematodes, arthropods other than insects, and vertebrates that endanger our food supply, health, or comfort. In particular, the term pesticide refers to chemical substances that are biologically active and interfere with normal biological processes of living organisms deemed to be pests, whether these are insects, mold or fungi, weeds or noxious plants. Pesticides are widely used in most areas of crop production to minimize infestations by pests and thus protect crops from potential yield losses and reduction of product quality**.**

1.2 types of pesticides

- **Algaecides:** (e.g. copper sulphate and swimming pool disinfectants) prevent, eliminate or suppress algal growth.
- **Animal dips and sprays:** Control external parasites on animals. These include flea powders and liquids used externally. (Products such as injections and tablets that are applied internally are classified as veterinary products, not pesticides.)
- **Antifouling paints:** Discourage living organisms from attaching to or growing on boats and structures submerged in water.
- **Bactericides:** Destroy, suppress or prevent the spread of bacteria. Examples include swimming pool disinfection products and chemicals used to control black spot (bacterial blight) on plants. (Disinfectants for household and industrial use are not pesticides.)
- **Baits:** Attract and control pests including vertebrate animals such as foxes and rabbits, or invertebrate animals such as cockroaches, ants and snails.
- **Biological agricultural products:** Pesticides with an active constituent with a living organism or derived from living organisms. The APVMA defines four main types of biological agricultural products

✓ biological chemicals such as pheromones, hormones, growth regulators, enzymes and vitamins

- ✓ extracts including plant extracts and oils
- ✓ microbes including bacteria, fungi, viruses and protozoa
- ✓ Living organisms including microscopic insects, plants and animals and some genetically modified organisms.

- **Defoliants:** Cause the leaves or foliage to drop from a plant.
- **Desiccants:** Artificially accelerate the drying of plant tissue.
- **Fungicides:** Prevent, destroy or suppress fungi. They are often used to control mound on fruit trees and grape vines.
- **Herbicides:** Destroy, suppress or prevent the spread of a weed or other unwanted vegetation.
- **Insecticides:** Destroy, repel, suppress or generally prevent infestations or attacks by insects. Fly sprays and surface sprays are insecticides.
- **Termiticides:** Are a group of insecticides that are used on termites, while mites and spiders are arachnids, not insects, the products used to control them, especially in domestic situations, described as insecticides.
- **Miticides:** Are products specifically used to control mites.
- **Molluscicides:** Prevent, destroy, repel or suppress molluscs, such as garden snails.
- **Nematocides :** Prevent, destroy, repel or suppress nematodes (also known as roundworms).
- **Plant growth regulators:** Accelerate or retard the rate of growth or rate of maturation, or alter the behavior of ornamental or crop plants (not including fertilizers).
- **Post-harvest fruit dips and sprays:** Are applied after harvest to prevent rotting and mould on fruit and vegetables during storage. They may contain bactericides and fungicides.
- **Preservatives:** (e.g. copper chrome arsenate (CCA) and creosote)—prevent attack by pests, and are often used to protect timber.
- **Repellents:** Repel rather than destroy pests. Personal insect repellents used to discourage biting insects like mosquitoes fall into this category.

- **Rodenticides:** Control rodents such as rats and mice.

1.3 Pesticide Formulations

Pesticides are highly toxic chemicals that must be diluted for the safety of the people who handle it during transportation and application. In addition to improving safety, pesticides are formulated to also enhance their effectiveness, ease of application, handling and shelf life. A pesticide formulation consists of the active ingredients (a.i.) and other inert ingredients (adjuvants).

Table 1 Common Pesticide Formulations

FORMULATION	DESCRIPTION	ADVANTAGE(S)	DISADVANTAGE(S)
Bait (B)	The a.i. mixed with food or other substance attractive to the pest. Baits usually have less than 5% a.i.	Ready to use. Entire treatment area need not be covered. Controls pests which move in and out of an area	Attractive to children and pets. Pest may prefer crop or other food. May attract and kill non-target organisms
Dry Flowable (DF)	Finely ground, insoluble a.i. mixed with a liquid to form a suspension	Easy to handle and apply.	
Dust (D)	Fine, dry particles with 1–10% a.i.	No mixing required. Simple application equipment needed	Drift and applicator hazard. Tends to be expensive
Emulsifiable Concentrate(E,EC)	a.i. dissolved in petroleum solvent and mixed with emulsifier to facilitate mixing with water.	Easy to handle. Requires little agitation. Not abrasive	May be phytotoxic. Easily absorbed through skin. May corrode rubber, plastic

Flowable (F)	Finely ground, insoluble a.i. mixed with a liquid to form a suspension	Easy to handle and apply	
Granule (G)	Relatively large, coarse granules of an absorptive medium impregnated with 1–15% a.i. Applied to soil for control of soil pests or foliar pests if the a.i. is systemic.	No mixing or dilution required. Low drift. Low applicator hazard. Simple application equipment needed.	More expensive than WP or EC. May need to be incorporated in soil. Needs moisture to activate.
Ready-to-Use Low Concentration Solution (RTU)	Consists of a small amount of a.i. (often 1% or less per unit volume) dissolved in organic solvent	Requires no further dilution before application. Usually does not stain fabrics nor has unpleasant odours. Especially useful for structural and institutional pests and for household use	May not be readily available. High cost per unit of a.i.
Solution (S)	The a.i. and additive/s form a true solution when mixed with water.	Requires no agitation.	May not be readily available.
Soluble Powder (SP)	Fine particles that dissolve readily in	Easy to transport and store. Low	nhalation hazard while mixing. Few SP

	water to form a true solution.	phytotoxicity. Easily measured and mixed. Lower skin absorption than liquid formulations.	formulations available
Ultra-low-volume concentrate (ULV)	Highly concentrated solution which is applied with little or no dilution at very low volumes	Requires no mixing. Ideal in conditions where water availability is restricted	Requires specialised equipment which is very expensive. Drifts even when wind is light.
Wettable Powder (WP	Dry, finely ground, dust-like formulation containing 50% or more of a.i which can be mixed with water for application. Particles insoluble in water	Easy to transport and store. Low phytotoxicity. Easily measured and mixed. Lower skin absorption than liquid formulations.	Inhalation hazard while mixing. Requires constant agitation to keep particles suspended. Abrasive to pumps and nozzles
Encapsulated formulation (CS)	Pesticide particles surrounded by, or absorbed to, an encapsulating material. May be applied as sprays, or directly for soil treatments. Encapsulation prolongs the active life of the pesticide by providing a timed and slow release of the a.i. once it is applied.	Increased safety to applicator. Lower immediate environmental hazard than other formulations. Easy to mix and apply.	Constant agitation necessary. Bees may pick up capsules and carry them back to the hives where released pesticide may kill entire hive. Persists longer in the environment.

1.4 Understanding pesticide benefits

There are many kinds of benefits that may be attributed to pesticides but often these benefits go unnoticed by the public. The most obvious and easiest benefits to calculate are economic benefits for the farmers derived from the protection of commodity yield and quality and the reduction of other costly inputs such as labor and fuel. Estimates of global losses from pests for eight crops in some regions showed that pest-induced losses were more than 50% of attainable crop output. Insects caused destruction of 15% of crops, disease pathogens and weeds 13% each, and postharvest pest infestations another 10%. Without pesticides, food production would drop and food prices would soar. With lower production and higher prices, farmers would be less competitive in global markets for major commodities. Preventing or reducing agricultural losses to pests with the use of pesticides improves yields and thus ensures reliable supplies of agricultural produce at prices which are affordable to consumers and improves the quality of the produce in terms of cosmetic appeal which is also important to buyers.

Pesticides are also widely used in a variety of other settings, some of which most of the general public are not aware of. In the same way that pests in agriculture and public health cause undesirable effects such as losses, spoilage and damage, those organisms when unchecked, have a negative impact on human activities, infrastructure, and the materials of everyday life. Pesticides play a major and often unseen role in preventing this negative impact. Thus, benefits from pesticides can accrue to a number of different recipients, not only to farmers or consumers, but also to the society. For example, trees and bush growing beneath power lines would cause power outages, if left unchecked. Herbicide use eliminates the problem and provides unobstructed access for maintenance and repairs. Road crews use herbicides to control vegetation along high-ways for safety reasons; clear roadsides, thereby increasing visibility for drivers and allow water to escape more efficiently during a downpour or flooding. Herbicides are used also to manage invasive weeds in parks, wetlands, and natural areas.

1.5 Understanding pesticide risks

No field of human endeavor is entirely free of risk. All aspects of our daily life are surrounded by some degree of risk. Even to do nothing can incur a risk. In every case, we have to consider all risks of any activity in the light of all its benefits. This applies equally to the safe and effective pesticide use. For decades, discussions among scientists and the public have focused on the real, predicted, and perceived risks that pesticides pose to people and the environment.

As pointed out earlier, pesticides are beneficial, yet they pose risk. But, what are the dangers from any particular pesticide? How many and which organisms are at risk? Are we willing to accept the potential risks in pursuit of the benefits? These questions have to be addressed and, ultimately, authorities must decide what constitutes acceptable risk. The issue is not only whether pesticides are dangerous, but also to whom or what they are dangerous, and to what degree.

Self-check 1	**Written test**

Name…… ID…… Date…….

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

Test I: give short answer

1. Define chemicals.(5 point)
2. What is pesticide risk?
3. Mention the benefits of pesticide.
4. _____Pesticide particles surrounded by, or absorbed to, an encapsulating material.

Test II: say true or false

1. Pesticide is not used to promote crop yields.
2. Ne need of pesticide in Ethiopia.
3. No field of human endeavor is entirely free of risk.

Test III: choose the best answer

1. ____is used to control pests.
   A. Pesticide
   B. Insecticide
   C. Herbicide
   D. All
2. Discourage living organisms from attaching to or growing on boats and structures submerged in water.
   A. Antifouling paints
   B. Herbicides
   C. Repellents
   D. Insecticide
3. No mixing or dilution required.
   A. Dust (D)
   B. Granule (G)
   C. Solution (S)
   D. Soluble Powder

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

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

Information sheet 2 - Accessing and Interpreting legalization and safety procedures

2.1 Introduction

The primary federal statutes that give the EPA the authority to regulate pesticides are the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug, and Cosmetic Act (FFDCA).

Ethiopia has made some efforts to formulate policies and legislations that help to avoid and/or reduce the negative impacts of pesticides on humans and the ecosystem.

2.2 Pesticide laws and regulations

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides for federal regulation of pesticide distribution, sale, and use. All pesticides distributed or sold in the United States must be registered (licensed) by EPA. Before EPA may register a pesticide under FIFRA, the applicant must show, among other things, that using the pesticide according to specifications "will not generally cause unreasonable adverse effects on the environment."

FIFRA defines the term "unreasonable adverse effects on the environment" to mean:
(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or

(2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act."

2.3 Ethiopia national policy on pesticides

As yet there is no specific policy instrument that deals with the production, storage and distribution and use of pesticides in Ethiopia. However, there is a general provision in the environmental policy of Ethiopia that highlight on the need for precaution measures with regard to hazardous chemicals, in which pesticides are also included. The most relevant provisions with regard to pesticides in the environmental policy Ethiopia are:

A. To provide adequate regulation of agriculture (crop and livestock) chemicals and micro-organisms;
B. To formulate and implement a country-wide strategy and guidelines on the management of wastes from the medical, agriculture and other sectors that may

use potentially hazardous biological organisms, their fragments or chemicals, and to issue the necessary regulations to enforce them;

C. To establish a system for monitoring compliance with land, air and water pollution control standards and regulations, the handling and storage of hazardous and dangerous materials, mining operations, public and industrial hygiene, waste disposal, and water quality;
D. To maintain an up-to-date register of toxic, hazardous and radioactive substances, and to make the information available on request;
E. To create by law an effective system of control, distribution, utilization and disposal after use of expiry of chemicals, biological organisms or fragments of organisms that could be hazardous but are required for use;
F. To hold as legally liable an employer who deploys employees in using or handling hazardous materials without adequately training them on how to deal with the hazard and without adequate equipment to protect each one of them from physical harm or disease that is caused by working conditions whether the harm or disease starts in the place of work or away from it; and
G. To foster better understanding of the dangerous effects of chemicals and organisms and their fragments through the provision of information in a form understandable to users, and provide or enforce the provision of information on the appropriate methods and technologies for the reatment and disposal of wastes.

2.4 Ethiopia laws and legislation on pesticide

Ethiopia has issued a Special Decree on pesticide registration and control (Special Decree no. 20/1990) in order to lay a scheme of control which would make it possible to minimize, to extent realizable, the adverse effect that utilization of pesticides might cause to humans, animals, plants and the environment. This Special Decree requires not only for pesticide registration and control but also promotes safer pesticide handling and use. As per the Special Decree, pesticide importers should obtain, from the Ministry of Agricultural and Rural Development, a license up on fulfillment of certain requirements including trained personnel, proper storage facilities, and safety devices. The Regional Agricultural and Rural Development Bureaus issue licenses to pesticide dealers and distributors with delegated authority from the Ministry.

The Special decree also requires that pesticide may not be allowed to enter the country unless it is packed and labeled as per the requirement. Furthermore, pesticide samples are taken and analyzed to confirm that the products meet the required quality standard.

2.5 International pest management requirements

- **International conventions**

Ethiopia is party to four international conventions, which directly or indirectly deal with pesticides production and use. These include:

i. Persistent organic pollutants of Stockholm convention, which tries to completely eliminate organochlorine and other equally dangerous organohalogene chemicals from the earth.
ii. Bamako Convention, which prohibits the importation of hazardous wastes into, and their movement in, Africa.
iii. Basel Convention, which strictly regulates the movement of hazardous waste globally. Recently, it has incorporated the prohibition of the importation of hazardous wastes into developing countries from the Bamako Convention.
iv. The first prior informed consent or Rotterdam convention, which tries to ensure that anybody buying a chemical has complete and accurate information about the nature and impacts of that chemical before he/she decides and notifies his/her consent in writing to the exporter.

2.6 Pesticide Safety

Using pesticides safely depends on many things. Some of the most important factors include selecting the appropriate product, and using that product according to the label directions. The label directions are written to minimize the risk of problems and to define the legal uses for the product.

- Make sure kids, pets, and anyone non-essential to the application is out of the area before mixing and applying pesticides.
- Be sure to wear clothing that will protect you when using pesticides. Consider wearing a long sleeve shirt, long pants, and closed-toe shoes in addition to any other protective clothing or equipment required by the label.
- Mix pesticides outdoors or in well-ventilated areas.

- Mix only what you need to use in the short term to avoid storing or disposing of excess pesticide.
- Be prepared for a pesticide spill. Have paper towels, sawdust or kitty litter, garbage bags, and non-absorbent gloves on hand to contain the spill. Avoid using excessive amounts of water, as this may only spread the pesticide and could be harmful to the environment.
- Read the first aid instructions on the label before using the product.
- Remove personal items, such as toys, clothing, or tools from the spray area to avoid contamination.
- When spraying pesticides indoors, make sure the area is well ventilated.
- When applying pesticides as a spray or dust outside, avoid windy conditions and close the doors and windows to your home.
- After using pesticides, wash your hands before smoking or eating.

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test 1 give short answer

1. What is pesticide safety?
2. Compare Ethiopia pest management policy with international.
3. List International conventions of pesticide use policy.

Test 2 say true or false

1. Read the first aid instructions on the label before using the product.
2. When spraying pesticides indoors, make sure the area is well ventilated.
3. After using pesticides, wash your hands before smoking or eating.
4. Mix only what you need to use in the short term to avoid storing or disposing of excess pesticide.
5. Bamako Convention, which prohibits the importation of hazardous wastes into, and their movement in, Africa.
6. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) provides for federal regulation of pesticide distribution, sale, and use.

Tests 3 choose the best answer.

1) Identify false statement

A. Be prepared for a pesticide spill
B. Smoking pesticide is permissible during spraying
C. After using pesticides, wash your hands
D. None

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

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

Information Sheet 3- using and providing personal protective equipment

3.1. Introduction

PPE is an acronym that stands for personal protective equipment. It is equipment that is designed to protect the user against safety or health risks at work.

It can include essential items such as gloves, safety helmets, eye protection, safety footwear, high-visibility clothing, and safety harnesses. Respiratory protective equipment (RPE) is part of PPE.

For health workers, PPE is essential in cases of highly infectious diseases such as Ebola and COVID-19. It is crucial for health workers to protect themselves while handling patients and working in high-risk environments so as not to get infected.

It is essential to make the workplace safe, and that includes providing easy to follow instructions, procedures, training as well as supervision to encourage individuals to work both safely and responsibly.

3.2. Choose the right PPE

It is important to wear the right PPE for the job. In general, the more toxic a pesticide is, the more PPE is needed to keep the user safe. Consider the job at hand and what type of application that will be made. Will you apply a fumigant? The proper respirator will offer respiratory protection. Will you apply liquid spray solutions? Long pants, long-sleeved shirt, shoes and socks, gloves, and protective glasses are all good PPE for the job and might be required by the label. Usually the label lists specific PPE required to apply the pesticide, but if a label doesn't list PPE requirements, use your common sense and best judgment. Keep in mind which route(s) of exposure pose risks and adequately protect them this applies to mixing, loading, and cleaning of application equipment as well.

1. **Body Protection**

Many pesticide labels require protective clothing such as long-sleeved shirt, pants, socks, and shoes or boots. Clothing should be pesticide-free and made of tightly woven fabric. Other pesticide labels may require the applicator to wear a waterproof or chemical resistant coverall, or use a chemical-resistant apron if duties include mixing and/or loading pesticides. Aprons should cover the front of the body from chest to boots

2. **Hand and Foot Protection**

Most pesticide exposures occur dermally, through the hands, especially during mixing and loading. It is also important to wear gloves when handling or applying pesticides; rinsing or disposing of pesticide containers; repairing contaminated application equipment; or washing contaminated PPE.

Chemical-resistant gloves are required by most pesticide labels, but not all. Even if a label doesn't require wearing gloves, it is still a good idea to wear waterproof or rubber gloves, unless working with a fumigant. A wide variety of gloves is available for different types of applications and different levels of chemical-resistance. Gloves should be unlined, made of the proper material for the pesticide product, and long enough to cover the wrist and lower forearm. Latex and nitrile gloves are readily available in many stores, but keep in mind that latex gloves are not chemical-resistant, and nitrile gloves must be at least 15ml thick to provide adequate protection. Do not wear leather gloves for any task, and only use fabric gloves if required by the label when using fumigants or some granular pesticides. The pesticide label will tell you which glove type is needed.

Applicators should wear unlined boots when mixing pesticides or walking through a treated areas. They should be made of be made of a chemical resistant material (e.g. neoprene, nitrile, or polyvinyl chloride) and reach above the ankle. Pant legs should be worn on the outside of the boot to prevent liquid pesticides from running down into the boot and being absorbed through the skin.

3. Head and Neck Protection

The human head is very absorptive and requires protection from pesticides. Absorption is increased while sweating too, so keeping cool is always preferable. PPE that protects the head includes chemical-resistant hats, face shields, and protective glasses or goggles. Headwear should be waterproof, washable material and not made of leather or fabric or contain sweatbands as pesticides can accumulate there. Baseball caps and straw hats are not chemical-resistant and readily absorb pesticide residues. Headwear should be washed after use along with the other protective clothing used. Wear chemical-resistant safety goggles or a face shield when mixing pesticides, and possibly when spraying pesticides

4. Respiratory Protection

Respiratory protection is often required when working with fumigant products or highly volatile pesticides. There are many respiratory devices that can protect you. Air-purifying respirators can protect you from hazardous vapors. Dust masks will protect your lungs from small particles, but not hazardous vapors. The pesticide label will tell you what type of respiratory protection is required for the pesticide application. If you are unsure which type of protective respiratory device to use, check the product label, the safety data sheet (SDS) for the product, or ask the professionals who sell safety equipment for help. Only use respirators that have been approved by the National Institute of Occupational Safety and Health (NIOSH) and make certain you FIT TEST it to ensure a proper seal between your face and the face piece before you purchase. A fit test may either be qualitative or quantitative. A qualitative fit test relies on the person's sensation (smell, taste, irritation) to a particular test agent while the quantitative test uses measuring instruments to measure leakage around the face seal. You should also FIT CHECK your equipment before every use by following the manufacturer's instructions. A fit check tests whether the respirator is properly seated to the face before making an application. After an application, always thoroughly wash the respirator and store the cartridges in an air-tight storage container. It is important to realize that all container or cartridge-type respirators need to have their containers or cartridges replaced after a certain amount of uses or time. Also, the use of respirators by employees in the workplace now requires that a medical evaluation is conducted to assess the worker's ability to use a respirator without adverse health effects.

3.3. Cleaning and disposing of PPE

It is important to clean and discard PPE without causing contamination to yourself, garbage collectors or the environment. Some PPE, like non disposable gloves and certain respirator parts, can be washed with hot, soapy water and reused. Protective clothing, if not too soiled, can be laundered but should be laundered alone and separate from the family laundry. If laundering, select a, heavy duty cycle with prewash and extra rinse, use hot water and heavy-duty detergent. After washing contaminated PPE, run a complete cycle through the empty washer. If a dryer is used, dry on the high heat setting. Clothing should be line-dried to avoid contaminating the dryer, if possible. Clothing that is drenched

with a pesticide product should be discarded as household hazardous waste and not cleaned. Personal protective equipment does not last forever and will eventually degrade. Know the recommended life span for PPE such as gloves, protective clothing, respirators and their filters, etc.

Gloves should be checked for integrity by filling clean gloves with water and checking for leaks. Once PPE has reached the end of its service, ensure that it is disposed of properly. Discarded PPE should be rendered 'unusable' so that no one else will be tempted to reuse it. For example, cut the fingers off gloves before discarding. PPE that is disposable and washable should be cleaned with soap and water to remove pesticide residues. Once it is properly cleaned, it is acceptable to dispose of as regular garbage.

3.4. Avoiding heat stress when wearing PPE

There is an increased risk for handlers and applicators to be susceptible to heat stress when wearing PPE for mixing/ loading and application tasks. PPE is intended to keep pesticides from entering the body, but it also interferes with the body's natural cooling system--sweat evaporation. Heat stress occurs when the body builds up more heat than it can deal with and doesn't cool as quickly. There are several factors that combine to cause heat stress: heat factors like temperature, humidity, air movement, and sunlight; the workload or effort the task requires; PPE; hydration; and scheduling. If possible, adjust tasks or workplace conditions to minimize those impacts. Wearing PPE can limit the body's ability to cool down. Hydration is key to preventing heat stress. Applicators should drink plenty of water, beginning the night prior to applications, and continuing to rehydrate during and after the task is completed. Tasks that require a lot of PPE, or a heavy workload, should be scheduled for the coolest part of the day. Breaks should be scheduled frequently to allow the body to cool. Employees should be allowed to adjust to heat and workload gradually by doing 2 hours of light work in the heat for several days in a row. Gradually increase the work period and workload for the next several days. Select a level of PPE appropriate for the task. This is based on the label's minimum PPE requirement and the user's experience to determine if more PPE is needed. Do not over protect if heat stress is a concern. Persons who get dangerously hot should stop work immediately and cool down

Self-check – 3	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Write all PPE with their functions.
2. Differentiate glove and goggle.

Test II: say true or false

1. PPE is an acronym that stands for personal protective equipment
2. Gloves should be checked for integrity by filling clean gloves with water and checking for leaks.
3. Most pesticide exposures occur dermally, through the hands, especially during mixing and loading.
4. PPE is not recommended for herbicide applications.
5. Beginning the night prior to applications, and continuing to rehydrate during and after the task is completed.

Test III: choose the best answer

1. What is the use of PPE
   A. To avoid chemical spill
   B. To protect chemical hazards
   C. To reduce chemical contamination
   D. All

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

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

Information Sheet 4- identifying Industry standards of chemical use

4.1. Introduction

Definition: A set of criteria within an industry relating to the standard functioning and carrying out of operations in their respective fields of production. In other words, it is the generally accepted requirements followed by the members of an industry

4.2. Industry standards

Industry standards are instructions on the chemical label, in an operator's manual, on a Material Safety Data Sheets (MSDS), in an industry standard, from an OHS manual or other regulation, or a hazardous substances regulation.

- **Label**

Pesticide label is the information printed on the product container. All labels, which are essentially the manufacturer's license to sell, provide the important facts about Distribution, Storage, Sale, Use, Disposal, and Safety Measures Required for the Pesticide.

Labels contain:

- ✓ Restricted use pesticide statement;
- ✓ Product name,
- ✓ Brand, or trademark;
- ✓ Ingredient statement
- ✓ Hazard warning statement;
- ✓ Signal word;
- ✓ First aid statement etc.

- **Operator's manual**

The operations manual is the documentation by which an organisation provides guidance for members and employees to perform their functions correctly and reasonably efficiently. It documents the approved standard procedures for performing operations safely to produce goods and provide services.

- **Material Safety Data Sheets (MSDS)**

A material safety data sheet is a technical document which provides detailed and. comprehensive information on a controlled product related to:

- ✓ Health effects of exposure to the product.
- ✓ Hazard evaluation related to the product's handling, storage or use.
- ✓ Measure to protect workers at risk of exposure.

- **Hazardous substances regulation**

A hazardous substance is any product or chemical that has explosive, flammable, oxidising, toxic, corrosive or toxic properties.

The Health and Safety at Work (Hazardous Substances) Regulations 2017 set out the rules for work-related activities involving hazardous substances. All empty chemical containers pose a risk to people and environment.

Self-Check – 4	**Written test**

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. _____is the generally accepted requirements followed by the members of an industry.
2. _____is the information printed on the product container.
3. What is hazardous substance?
4. _____is a technical document which provides detailed and. comprehensive information on a controlled product.

Test II: say true or false

1. A hazardous substance is any product or chemical that has explosive, flammable, oxidizing, toxic, corrosive or toxic properties.
2. All empty chemical containers pose a risk to people and environment.
3. All labels have the contents and information.
4. The Health and Safety at Work (Hazardous Substances) Regulations 2017 set out the rules for work-related activities involving hazardous substances.
5. The operations manual is the documentation by which an organization provides guidance for members and employees.

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

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

Information Sheet 5 - confirming or arranging appropriate insurance policy

5.1 Introduction

Agricultural insurance protects against loss of or damage to crops and livestock. it has great potential to provide value to low-income farmers and their communities, both by protecting farmers when shocks occur and by encouraging greater investment in agriculture. Agricultural insurance can indemnify policy holders for losses, though such indemnity products are relatively rare due to high costs of administration and the risk of fraud.

Ethiopian insurance corporation (EIC) is committed to provide adequate insurance covers for all agricultural projects that are financed by financial institutions and individual farmers (commercial & small holder).

5.2 Confirming crop insurance policy

Crop insurance is a risk management tool aimed at protecting farm yields. Among the strategies used to manage farm risk, this instrument is one of the most widespread given that it compensates losses due to the action of unfavorable weather conditions. In practice, insurance provides claims if the yield falls below a threshold defined in the contract, thus providing significant revenue stabilization over the years.

5.3 Insurance for chemical applicators

Chemical applicators work in various industries and professions, including agriculture, aquatics, household and exterior cleaning, janitorial services, landscaping, pest control, and more. Insurance for chemical applicators is important for your clients to meet state requirements. In many situations, there is a legal requirement to hold insurance, given the risks of chemicals being used incorrectly or inadvertently causing harm.

Some clients may be under the impression that their general liability insurance will be sufficient in chemical application situations. It is important for them to carefully look at their coverage, as many insurers do not automatically include insurance for chemical applicators. In fact, it may be an exception within their general policy.

Chemical applicators working as contractors for others also need to check their own coverage. There is a strong likelihood that applicators will not be personally covered under someone else's policy. Your clients should be wary of assuming there is adequate coverage only to find out there is no insurance when it is too late.

Self-Check – 5	Written test

Name…… ID…… Date…….

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

Test I: Short Answer Questions

1. What is Ethiopia insurance policy covers?

Test II: say true or false

1. Ethiopian insurance corporation (EIC) is committed to provide adequate insurance covers for all agricultural projects.
2. Chemical applicators work in various industries and professions
3. Chemical applicators work in various industries and professions.
4. Ethiopia has chemical use insurance.
5. Crops insurance policy in Ethiopia has covered all natural and manmade hazards.
6. Agricultural insurance protects against loss of or damage to crops and livestock.
7. Chemical applicators working as contractors for others also need to check their own coverage.
8. In many situations, there is a legal requirement to hold insurance, given the risks of chemicals being used incorrectly or inadvertently causing harm.

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

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

Operation Sheet 1- Read chemical label information

Objective:

- To obtain information
- To get evidence etc.

Tools and equipment's

- Agro chemicals
- Pen
- Not book etc.

Labels contain:

- Restricted use pesticide statement;
- Product name,
- Brand, or trademark;
- Ingredient statement
- Hazard warning statement;
- Signal word;
- First aid statement etc.

LAP TEST	Demonstration

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: Read and interpret chemical label information's.

LG #50	LO #2- Monitor the implementation of safety requirements

Instruction sheet

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

- Monitoring Implementation of safety procedure and rules
- Investigating and reporting Safety incidents
- Identifying safety hazards in the transport, storage and application of the chemical
- Identifying Risk control measures
- Implementing environment residue controlling measures

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

- Implementation of safety procedure and rules by others monitor.
- Safety incidents investigate and report in accordance with directions, standards and legislative requirements.
- Safety hazards in the transport, storage and application of the chemicals identify.
- Risk control measures identify to minimize risk involve in chemical use.
- Measures for controlling residue in the environment and produce implement.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “operation sheets
7. Perform “the Learning activity performance test” which is placed following “operation sheets” ,

8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Monitoring Implementation of safety procedure and rules

1.1 Introductions

Safety monitoring is a proactive strategy aimed at preventing accidents and occupational ill health by identifying deficiencies in procedures, whether management procedures, work practices, systems of work, compliance with legal requirements or emergency and personal protection arrangements.

1.2 Monitoring Safety

Safety monitoring is the routine examination of the status of a system, equipment, workplace, working environment or the human body.

In terms of health and safety at work, monitoring can be anything from observing the way a worker performs a task to chemical monitoring and analysis to determine concentrations of toxic chemicals in the air.

Safety monitoring may take a number of forms depending on the levels of sophistication required and may include:

- Safety inspections
- Audits
- Surveys
- Sampling exercises.

In practice, monitoring programs will likely involve several of these techniques.

There are three key benefits from a monitoring program.

1. Measuring the performance of the system. e.g. Monitoring the level of a particular substance in air to confirm that extraction systems are working correctly.
2. Reinforcement of management control and influence: involving all levels of management in the monitoring process reinforces the message that safety matters should be taken seriously.
3. Improving the system of safe working, e.g. looking at which procedures are working well and which need adjustment or even a complete overall.

- **Safety Inspections**

A safety inspection is generally taken to mean a scheduled inspection of a workplace or part of a workplace. While the principal objective of a safety inspection is to identify

hazards and assess the risks, this form of monitoring may also examine maintenance standards, working practices, environmental conditions and compliance with written safety procedures.

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- **Safety Audits**

Safety audit is a process that systematically measures the organization's management of its health and safety program against a series of specific and attainable standards, to determine if there is compliance.

- **Safety Surveys**

A health and safety survey is a detailed examination of a critical area of operation, e.g. materials handling operation, perhaps revealed as a weak spot from an audit.

- **Safety sampling**

Safety sampling exercises are designed to measure, by random sampling, the accident potential in a specific workplace, or at a particular process or work activity, by identifying safety defects or omissions.

Self-Check – 1	**Written test**

Name…… ID…… Date…….

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

Teat I: Short Answer Questions

1. What is safety inspection?
2. List safety monitoring activities.
3. Explain safety audits.

Test II: say true or false

1. Safety monitoring is a proactive strategy aimed at preventing accidents and occupational ill health
2. Safety sampling exercises are designed to measure, by random sampling, the accident potential in a specific workplace.
3. Safety inspection doesn't include pesticide use precaution.
4. Safety audit is a process that systematically measures the organization's management of its health and safety program against a series of specific and attainable standards.
5. Materials handling operation, perhaps revealed as a weak spot from an audit.
6. The principal objective of a safety inspection is to identify hazards and assess the risks.
7. In terms of health and safety at work, monitoring can be anything from observing the way a worker performs a task to chemical monitoring and analysis.

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

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

Information Sheet 2- Investigating and reporting Safety incidents

2.1 Introduction

An incident is any unplanned event that causes injury. A dangerous occurrence is any event that could have caused injury, but did not. The term “incident” will be used to describe both incidents and dangerous occurrences.

n incident investigation is the account and analysis of an incident based on information gathered by a thorough examination of all contributing factors and causes involved.

2.2 Investigating safety incidents

An incident investigation should:

- Determine what actually happened,
- Determine the cause or causes of the incident,
- Identify any unsafe conditions, acts or procedures,
- Help management to identify practical corrective actions,
- Determines whether due diligence was observed,
- Show the commitment of management that an adequate investigation system is in place.

The purpose of these activities is not to find fault or lay blame, but rather to identify the basic causes of incidents so that controls can be put in place to prevent further occurrences. Information from the investigation should be put on the record, but not used to discipline anyone. This policy encourages witnesses to tell investigators everything they know.

Incident investigation steps

The process of investigating an incident involves gathering evidence, analyzing it then making recommendations in a written report. Steps include:

1. Preparation
2. Visiting the scene
3. Conducting interviews
4. Examination of physical evidence
5. Analyzing the evidence preparing the report

- **Preparation**

As little time as possible should be lost between the incident event and the beginning of the investigation. The ideal situation would be to have all the necessary resources

available before the incident so that the investigator(s) can attend immediately to their tasks.

- **Visiting the scene**

Speed and thoroughness are both necessary in incident investigations. Memories fade and evidence disappears. Balancing the numerous activities to be undertaken when visiting the scene is a great challenge for the investigator.

- **Conducting interviews**

One of the main methods of gathering information in an incident investigation is by interviewing people who were at the incident scene. Interviews should also be conducted with anyone who can give relevant information, even if they were not present.

- **Examination of physical evidence**

As noted under the section “Visiting the Scene” collecting evidence/samples will be one of the first steps in an incident investigation. Once you have collected evidence, you will need to examine it closely in order to draw conclusions about what happened. This may involve sending the evidence to an expert for analysis (e.g. engineer, health professional, manufacturer) Physical evidence found at the scene is usually more reliable than evidence obtained from your witnesses.

- **Analyzing the evidence**

Once the evidence (witness accounts, documentary or physical) has been gathered, you are ready to begin analysis. By this stage, you should know how the incident happened and what the immediate causes were. Use this information to determine why the incident occurred. Usually the fundamental causes can be found by simply asking “why.”

- **Preparing the report**

The intent of the report is to effect change. If after an investigation, there are no recommendations or actions taken to improve the safety and health at the workplace, it is likely incidents will continue to happen and workers will feel a sense of irresponsibility on the part of the employer and safety and health committee.

WORKPLACE SAFETY AND HEALTH COMMITTEE

INCIDENT INVESTIGATION SUMMARY REPORT

INDUSTRIAL -------- CONSTRUCTION--------- SERVICE SECTOR -------

FIRE ---------- EXPLOSION ---------- SPILL---------- OTHE----------

EMPLOYER NAME: _____

DEPARTMENT: _____

ADDRESS:_____

INJURY: YES ========== NO ==========

DATE and TIME of INCIDENT: ----------

NVESTIGATING COMMITTEE MEMBERS:----------

Self-Check – 2	**Written test**

Name…… ID…… Date…….

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

Test I: give short answer

1. _____s any unplanned event that causes injury.
2. Write process of investigating an incident.

Test II: say true or false

1. The intent of the report is to effect change.
2. Incident is a planned activate.
3. Collecting evidence/samples will be one of the first steps in an incident investigation.
4. After an investigation, there are no recommendations or actions taken to improve the safety and health at the workplace
5. Physical evidence found at the scene is usually more reliable than evidence obtained from your witnesses.
6. Visiting the Scene" collecting evidence/samples will be one of the first steps in an incident investigation.
7. Information from the investigation should be put on the record, but not used to discipline anyone.

Test III: choice

1. _____is any unplanned event that causes injury.

   A. Incident
   B. Hazard
   C. Poison
   D. Exposure

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

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

Information sheet 3 - Identifying Safety hazards

3.1 Introduction

Safety with pesticides should be a concern of everyone involved with these chemicals. Although pesticides provide real benefits, they can also be dangerous if mishandled or misused. An accidental death from pesticides is a rarity, but skin disorders and health problems are not. Additionally, improper handling or use of pesticides can result in harmful effects to the environment.

Pesticide safety begins with the selection of the proper product and proceeds through the transportation, storage, mixing, loading, application, and disposal of the pesticide and its container.

3.2 Hazards

A hazard is a source or a situation with the potential for harm in terms of human injury or ill-health, damage to property, damage to the environment, or a combination of these. An unwanted event is a situation or condition where there is a loss of control of the hazard that leads to harm.

- **Flammability**

Flammability is the ease with which a material is ignited, the intensity with which it burns and releases heat once ignited, its propensity to spread fire, and the rate at which it generates smoke and toxic combustion products during gasification and burning.

- **Toxicity**

Toxicity is degree to which a substance (toxin or poison) can harm humans or animals. Acute toxicity involves harmful effects in an organism through a single or short-term exposure.

- **Health hazards**

Health hazards are chemical, physical or biological factors in our environment that can have negative impacts on our short- or long-term health. Exposure can occur through touch, inhalation, and ingestion. Understanding the risks of these hazards can help us to take action to avoid or mitigate these risks

- **Damage to non-target organisms**

Non-target organisms (NTO) are species not targeted for control using a particular Cry protein expressed in transgenic plants, but may become exposed to it by feeding directly on plant tissues or indirectly on herbivores or parasites, or by direct ingestion via the environment, such as in the soil or water.

- **Environmental damage**

Environmental damage or degradation is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable.

- **Off target spray drift**

Off-target spray drift can cause injury or damage to plants, animals, environment or property. It can also affect human health. There are 2 types of spray drift: droplet drift the direct airborne movement of liquid droplets away from the target intended to be sprayed.

- **Residues in foods**

Pesticides are widely used in producing food. These pesticides may remain in small amounts (called residues) in or on fruits, vegetables, grains, and other foods. To ensure the safety of the food supply for human consumption, EPA regulates the amount of each pesticide that may remain in and on foods.

3.3 Identifying safety hazards

- **Transportation**

✓ Pesticides should never be transported inside the passenger compartment of an automobile or truck cab; put them in the trunk or in the back of the truck.

✓ Never transport them where they could come in contact with people, groceries, and livestock feed or other products, which might become contaminated.

✓ When transporting pesticides in a truck, see that they are secured to prevent spillage or loss due to sudden starts, stops, turns, etc.

✓ Should there be an accident or spill immediately inform the local police and fire officials of the quantity and name of the pesticide involved.

- ✓ Even small spills or releases, particularly of extremely hazardous pesticides, must be reported to the State Emergency Response Commission and your Local Emergency Planning Committee (LEPC).

Applicators of pesticides, particularly in populated areas, must take special precautions to secure products transported to the application site.

Allowing containers of pesticides to remain unattended on the back of an open truck is inviting an accident, and a costly lawsuit.

Commercial transporters of pesticides must meet special requirements: vehicles must carry placards, bills of lading, labels of the product, etc.

- **Storage**
  - ✓ Keep pesticides, other poisons, and related materials locked in a cabinet, room, or separate building designated solely for the storage of these materials. Metal storage cabinets, such as discarded school lockers, provide excellent storage for homeowners or other users of small amounts of pesticides.
  - ✓ Post the cabinet, room or facility with a sign, "PESTICIDES-POISONS, KEEP OUT", or similar signs.
  - ✓ Control access to this facility to only one, two, or three highly trusted, responsible and informed individuals.
  - ✓ Never store pesticides where food, feed, seed, fertilizers or other products can become contaminated.
  - ✓ Store pesticides in their original containers. It's the law.
  - ✓ The facility should be reasonably fireproof and well-ventilated. Temperatures should be kept between freezing and 100 degrees F.
  - ✓ Sealed concrete floors with no floor drains, concrete block walls, and metal shelves are recommended instead of wooden structures.
  - ✓ With shelf storage, store dry pesticides on the top shelves, liquids on the lower shelves.
  - ✓ Electrical fixtures should be of the dust - and explosion - proof type.
  - ✓ Provide adequate space for the secure storage of empty pesticide containers until proper disposal of them is possible.

Those businesses with large quantities of pesticides to store should have a separate building for this purpose. In addition to the above features, this facility should also include the following characteristics.

- ✓ Have a concrete mixing/loading pad adjacent to the storage facility. This pad should be roofed to keep rainwater out and the pad should be sloped to capture spilled material.
- ✓ When feasible, the facility should be downwind and downhill from sensitive areas such as homes, play areas, feedlots, animal shelters, gardens, and ground water sources.
- ✓ The facility should be located in an area not subject to flooding.
- ✓ A water supply should be furnished for mixing, loading, tank rinsing and cleanup
- ✓ Showers and clean-up stations should be supplied for the persons who mix, load and apply the pesticides.
- ✓ Fire detectors and fire-fighting equipment should be available.
- ✓ A telephone should be convenient, with all emergency numbers posted.
- ✓ A current inventory of all materials in storage, along with a label of all materials, should be maintained in a secure area away from the storage area. The local fire department and the Local Emergency Planning Committee (LEPC) should be provided with an updated copy of this inventory, along with a Material Safety Data Sheet (MSDS) for each extremely hazardous pesticide you have in storage.
- ✓ Equip the storage area with the needed personal protective equipment and materials to prevent accidents and to handle accidents and spills. Activated charcoal, absorptive clay, vermiculite, clay-granule cat litter, or sawdust are good materials to absorb liquid spills.
- ✓ Date and identify all pesticides when they are placed into storage, and store no more than will be needed for one season. Establish a policy of first-in first-used so that pesticides do not become outdated.
- ✓ Have your fire insurance carrier inspect your pesticide storage facility periodically. It is intelligent management, and may reduce your insurance premium.
- ✓

- **Application**

When applying pesticides, applicators are not exposed to the same high concentration of pesticide as they are during the mixing and loading operation, However, the time length of exposure is much longer, thus the cumulative exposure may be equal to or greater than that during the mixing/loading operation.

Pesticide applications are made with everything from hand sprayers and dusters, to irrigation equipment, to large airblast grove sprayers and aircraft. Whatever equipment is used, many of the safety precautions are the same.

- ✓ Read and follow the label. Applications made that vary from label requirements are violations of federal law.
- ✓ Use the correct equipment and make sure it is properly maintained and adjusted. Screens, strainers, and nozzles should be clean and functioning properly. Nozzles should be of the right type and properly adjusted and all lines, valves and seals should be checked for leaks.
- ✓ The application equipment should be accurately calibrated on a regular basis. Whenever you have any suspicion that the equipment is applying an inaccurate amount, recalibrate the equipment. Your operator's manual should provide information on calibration of the equipment. Additional information is available through your county's Cooperative Extension Service.
- ✓ Wear the proper protective clothing and equipment.
- ✓ Check the weather forecast frequently to determine if conditions will be favourable for the application and effectiveness of the pesticide.
- ✓ Avoid spraying near sensitive areas where drift could damage neighbouring crops or the environment. When spraying must be done in these areas, attempt to spray when the air is still, humidity is high, and any potential drift will be away from sensitive areas.
- ✓ Lower pressures, proper boom and nozzle adjustments, larger nozzle size and drift-reducing additives (if the label permits) will reduce drift.
- ✓ Do not make field adjustments to the sprayer in a recently sprayed, still wet area. Move to an unsprayed area.

- ✓ Never attempt to clean a nozzle, screen, or hose by blowing or sucking on it with your mouth. Use small, soft-bristle brushes and/or an air pressure bulb for these purposes.
- ✓ Always empty a tank by spraying the entire contents onto the vegetation or other area for which it was intended. Never drain a spray tank onto the ground. Never mix more than you need!

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Say true or false

1. Wear the proper protective clothing and equipment.
2. Use the correct equipment and make sure it is properly maintained and adjusted
3. Store pesticides in their original containers. It's the law.
4. Fire detectors and fire-fighting equipment should be available.
5. When transporting pesticides in a truck, see that they are secured to prevent spillage or loss due to sudden starts, stops, turns, etc.
6. Always empty a tank by spraying the entire contents onto the vegetation or other area.
7. Never attempt to clean a nozzle, screen, or hose by blowing or sucking on it with your mouth.
8. Larger nozzle size and drift-reducing additives (if the label permits) will reduce drift.
9. Equip the storage area with the needed personal protective equipment and materials

Give short answer

1. List precautions during PPE wearing.

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

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

Information Sheet 4- Identifying risk control measures

4.1. Introduction

Many people believe that some pesticides are "safe," while others are "dangerous." Actually, all chemicals, including all pesticides, have the potential to be hazardous. Even products that are considered low in toxicity, natural, or organic can be hazardous if someone or something comes in contact with enough of the substance.

The toxicity of a pesticide, its formulation, and how much you touch, eat, or breathe in, are all important considerations. The likelihood of experiencing some health effect as a result of using a product is referred to as the pesticide risk. The risk of any pesticide use depends on which pesticide is used, how much pesticide is applied, how often the pesticide is applied, and who or what has contact with the pesticide

4.2. Pesticide Risk

Your risk from the use of pesticides depends on two things: the toxicity of the pesticide, and the amount of exposure. In other words,

Risk = Toxicity x Exposure

Toxicity can range from low to high, and can vary depending on the route of exposure. The pesticide Signal Word is a way to determine a pesticide's general level of toxicity.

Exposure takes place when a pesticide is breathed in, touches the skin, or gets eaten.

4.3. Pesticide exposure

The chance of developing a health problem from a pesticide depends on two things: the toxicity of the pesticide and the amount of exposure. In order for a pesticide to affect you, you must be exposed to the pesticide by some route such as eating it (ingestion), breathing it (inhalation), or getting it on your skin or in your eyes (dermal exposure).

Even if a very toxic pesticide is used near your home, the risk may still be low. If you are not exposed to the pesticide, it can't harm you. In some cases, a pesticide can be used without people coming into contact with it at all.

4.4. Pesticide toxicity

To help people understand the toxicity of products, pesticides are classified in groups from low to high toxicity. Because the risk or chance of a problem depends on both the toxicity and the amount of exposure, even pesticides that are low in toxicity can be hazardous if the exposure is high. The signal word describes the toxicity of the pesticide. The toxicity of a pesticide is its capacity or ability to cause injury or illness. The toxicity of a particular pesticide is determined by subjecting test animals to varying dosages of the active ingredient (a.i.) and each of its formulated products. The active ingredient is the chemical component in the pesticide product that controls the pest. The two types of toxicity are acute and chronic.

Acute toxicity of a pesticide refers to the chemical's ability to cause injury to a person or animal from a single exposure, generally of short duration. The four routes of exposure are dermal (skin), inhalation (lungs), oral (mouth), and eyes. Acute toxicity is determined by examining the dermal toxicity, inhalation toxicity, and oral toxicity of test animals. In addition, eye and skin irritation are also examined.

Acute toxicity is measured as the amount or concentration of a toxicant the a.i. required to kill 50 percent of the animals in a test population. This measure is usually expressed as LD50 (lethal dose 50) or LC50 (lethal concentration 50). Additionally, the LD50 and LC50 values are based on a single dosage and are recorded in milligrams of pesticide per kilogram of body weight (mg/kg) of the test animal or in parts per million (ppm). LD50 and LC50 values are useful in comparing the toxicities of different active ingredients and different formulations containing the same active ingredient.

The lower the LD50 *or* LC50 *of a* pesticide product, the greater toxicity to human and animal. Pesticides with a high LD50 are the least toxic to humans if used according to the directions on the product label.

The chronic toxicity of a pesticide is determined by subjecting test animals to long-term exposure to the active ingredient. Any harmful effects that occur from small doses repeated over a period of time are termed chronic effects. Some of the

suspected chronic effects from exposure to certain pesticides include birth defects, production of tumors, blood disorders, and neurotoxic effects (nerve disorders). The chronic toxicity of a pesticide is more difficult to determine through laboratory analysis than acute toxicity.

Products are categorized on the basis of their relative acute toxicity (their LD50 or LC50 values). Pesticides that are classified as highly toxic (Toxicity Category I) on the basis of either oral, dermal, or inhalation toxicity must have the signal words DANGER and POISON printed in red with a skull and crossbones symbol prominently displayed on the front panel of the package label. The Spanish equivalent for DANGER, "PELIGRO," must also appear on the labels of highly toxic chemicals. The acute (single dosage) oral LD50 for pesticide products in this group ranges from a trace amount to 50 mg/kg. For example, exposure of a few drops of a material taken orally could be fatal to a 150-pound person.

Some pesticide products have the signal word DANGER without the skull and crossbones symbol. This is because possible skin and eye effects are more severe than suggested by the acute toxicity (LD50) of the product.

Pesticide products considered moderately toxic (Toxicity Category II) must have the signal word WARNING and "AVISO" (the Spanish equivalent) displayed on the product label. In this category, the acute oral LD_{50} ranges from 50 to 500 mg/kg. A teaspoon to an ounce of this material could be fatal to a 150-pound person.

Pesticide products classified as either slightly toxic or relatively nontoxic (Toxicity Categories III and IV) are required to have the signal word CAUTION on the pesticide label. Acute oral LD_{50} values in this group are greater than 500 mg/kg. An ounce or more of this material could be fatal to a 150-pound person.

Despite the fact that some pesticide products are considered only slightly toxic or relatively nontoxic, all pesticides can be hazardous to humans, animals, other organisms, and the environment if the instructions on the product label are not followed. Use the pesticide only as recommended by the manufacturer. As the applicator, you are legally responsible for any misuse of a pesticide.

Table 1 summarizes the LD_{50} and LC_{50} values for each route of exposure for the four toxicity categories and their associated signal word. For example, an active ingredient with a dermal LD_{50} of 1,000 mg/kg would be in Toxicity Category II with a WARNING signal word. Keep in mind, an active ingredient may have a high LD_{50} placing it in a Toxicity Category II, III, or IV but also have corrosive eye/skin effects that take priority and place it in Toxicity Category I.

Although every pesticide is different and the product label should be consult to determine the personal protective equipment (PPE) requirements for each chemical.

Table1. Toxicity Categories for Active Ingredients

Routes of Exposure	**Toxicity Cat. I**	**Toxicity Cat. II**	**Toxicity Cat. III**	**Toxicity Cat. IV**
Oral LD_{50}	Up to and including 50 mg/kg	50-500 mg/kg	500-5,000 mg/kg	>5,000 mg/kg
Inhalation LC_{50}	Up to and including 0.2 mg/l	0.2-2 mg/l	2-20 mg/l	>20 mg/l
Dermal LD_{50}	Up to and including 200 mg/kg	200-2,000 mg/kg	2,000-20,000 mg/kg	>20,000 mg/kg
Eye Effects	Corrosive corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days; irritation persisting for 7 days	No corneal opacity; irritation reversible within 7 days	No irritation
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours
Signal Word	DANGER POISON	WARNING	CAUTION	CAUTION

4.5. Pesticide risk control measures

After conducting a risk assessment, you should identify and implement all practicable measures for eliminating or reducing the likelihood of injury, illness or disease. Risks to health should be controlled according to the hierarchy of control specified in the

regulations. The hierarchy is simply a list of control measures that must be applied as far as practicable in the priority order specified.

The OHS Regulations specify a four-level hierarchy

Level 1 – Elimination

Elimination is the most effective control measure, and involves removing the risk by changing work processes or ceasing use of the product. Where elimination is not practicable, you need to reduce the risk as far as practicable by applying the controls in the order specified (as levels 2–4).

Level 2 – Substitution, isolation or engineering controls

Substitution involves replacing currently used pesticides with substances that are less hazardous or toxic, or available in a less hazardous form (for example, using pellets instead of dust).

Isolation involves separating people from the pesticide by distance or barriers to prevent or reduce exposure (for example, using an extension nozzle)

Engineering controls are physical controls that:

- Eliminate or reduce the generation of substances
- Suppress or contain substances
- Limit the area of contamination in the event of spills and leaks – for example
  - ✓ Bunting chemical storage shelves
  - ✓ Separating the driver's cabin from chemical storage area on vehicles
  - ✓ Using coarse spray nozzles
  - ✓ Using slab injectors fitted with a safety shield
  - ✓ Using exhaust ventilation in chemical storage shed.

Level 3 – Administrative controls

Administrative controls need to be implemented where the control measures in level 2 are not practicable or do not adequately reduce the risk. Administrative controls are systems of work or safe work practices that help to reduce employee exposure to pesticides, and include such things as:

- Ensuring lids of pesticide containers are replaced securely when not in use
- Cleaning up spills immediately

- Prohibiting eating, drinking and smoking while using pesticides
- Providing training to staff
- Ensuring regular cleaning of work vehicles and PPE.

Level 4 – Personal protective equipment

Where the controls measures in levels 2 and 3 are not practicable or do not adequately reduce the risks, then appropriate personal protective equipment (PPE) should be used in accordance with the product label or MSDS. It is likely that PPE will usually be used in combination with other control measures.

Self-Check – 4	**Written test**

Name…… ID…… Date…….

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

Test I: Short answer questions

1 _____is the most effective control measure, and involves removing the risk by changing work processes.

2 _____involves replacing currently used pesticides with substances that are less hazardous or toxic.

Test II: say true or false

1. Many people believe that some pesticides are "safe
2. Cleaning up spills immediately
3. Prohibiting eating, drinking and smoking while using pesticides.
4. Where the controls measures in levels 2 and 3 are not practicable or do not adequately reduce the risks, then appropriate personal protective equipment (PPE) should be used.

Test III: choose the best answer.

1. Engineering controls are:
   A. Eliminate the generation of substances
   B. Reduce the generation of substances
   C. Suppress or contain substances
   D. All
2. Involves replacing currently used pesticides with substances that are less hazardous or toxic.
   A. Substitution
   B. Isolation
   C. Evacuation
   D. Safety

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

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

Information Sheet 5- Implementing environment residue controlling measures

5.1 Introduction

While agrochemicals increase plant and animal crop production, they can also damage the environment. Excessive use of fertilizers has led to the contamination of groundwater

with nitrate, a chemical compound that in large concentrations is poisonous to humans and animals.

The use of toxic agrochemicals can also result in environmental problems. During many uses of pesticides in agriculture, the exposure of other organisms, including humans, is not well controlled and hence there occur a lot of problems.

5.2 Impacts of agrochemicals on the environment

The negative impacts of agrochemicals are harming our environment with their chemical resources, which seem to produce an adverse effect on humans, animals, and nature in whole.

- **Impacts on Soil**
  - ✓ They may destroy helpful bacteria's in soil
  - ✓ Increase nitrate content in the soil which is poisonous to man and animals
  - ✓ Imbalances pH levels of soil
  - ✓ Destroy soil organisms
  - ✓ May create hurdle in growth effects
  - ✓ Causes residual effects
- **Impacts on Water:**
  - ✓ Usually, make water unfit for humans and animals consumption.
  - ✓ Diffusion of Agrochemicals in larger water bodies promotes the growth of algae which is again hazardous.
  - ✓ Excess chemicals may lead to eutrophication.
  - ✓ Lead12 to water pollution thereby affecting aquatic habitats.
  - ✓ Changes in the chemical properties of water.

- **Impacts on Air:**
  - ✓ Pesticide particles diffuse with air altering their nature and make it unfit for consumption.

- ✓ The wind carries polluted air to other parts and thereby spreading their ill effects all over.
- ✓ Depending on weather conditions prevailing, a large amount of spray may evaporate in the environment.
- ✓ Air polluted by agrochemicals in this way is inhaled by surrounding living organisms causing drastic effects on their health.

5.3 Control measures for agrochemicals

The choice of safe technology is important. There may be several types of spray equipment available in the market, which are often best for safety. The adoption of safe working systems will minimize the risk. The arrangement of safe working time, particularly in hot and humid climates, would be relevant for controlling. Agrochemical users should remember to seek advice when needed.

To preserve this superiority, HPM Chemicals and Fertilizers Ltd. have played a major role. With a major contribution in the agro-chemical sector, the company is adamant about serving India, the land of Agriculture.

Self-Check – 5	Written test

Name…… ID…… Date…….

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

Test I: Short answer questions

1. How agrochemicals increase plant and animal crop production?
2. List impact of chemicals on:

   Air_____

   __

   Soil_____

   _____

   Environment

   _____

   ____

Test II true or false

1. The choice of safe technology is important.
2. Depending on weather conditions prevailing, a large amount of spray may evaporate in the environment.
3. Pesticide particles diffuse with air altering their nature and make it unfit for consumption.
4. Diffusion of Agrochemicals in larger water bodies promotes the growth of algae which is again hazardous.
5. Excess chemicals may lead to Eutrophication.
6. Agrochemical users should remember to seek advice when needed.

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

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

Operation Sheet 1- process of investigating an incident

Objective:

- To obtain information
- To get evidence etc.

Tools and equipment's

- PPE
- Not book
- Pen etc.

Procedures

1. Preparation
2. Visiting the scene
3. Conducting interviews
4. Examination of physical evidence
5. Analyzing the evidence preparing the report

LAP TEST	**Demonstration**

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: investigate incident.

LG # 51	LO #3 - Plan and implement a maintenance program for chemical use equipment
Instruction sheet	

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

- Establishing maintenance of application and personal protective equipment plan
- Supervising maintenance plan Implementation
- Identifying and repairing or replacing faulty or damage equipment

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

- Plan for maintenance of application and personal protective equipment establish according to manufacturer's instructions.
- Implementation of maintenance plan supervises.
- Faulty or damage equipment identify and repair or replace.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the "Information Sheets". Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the "Self-checks" which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to "Operation sheets
7. Perform "the Learning activity performance test" which is placed following "Operation sheets" ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to "Operation sheets".

Information sheet 1- Establishing plan for maintenance of application and personal protective equipment

1.1 Introduction

The work of keeping something in proper condition, care or upkeep including: taking steps to avoid something breaking down (preventative maintenance) and bringing something back to working order (corrective maintenance).

1.2 Maintenance of personal protective equipment

- ✓ Protective clothing should be removed as soon as all operations involving pesticides are completed. It should not be worn in places or situations where the wearer will come into contact with other persons.
- ✓ All protective gear should be washed or cleaned properly after each daily use. They should be washed separately, not with family laundry. They should not be washed in streams or ponds.
- ✓ Respirators should be thoroughly cleaned to remove pesticide residues. Cartridges should be replaced regularly, in accordance with the manufacturer's recommendations. The life span of the cartridge is usually given in terms of the length of time used. If you are wearing the respirator properly and you still smell the pesticide, it may be an indication that the cartridge needs to be replaced.
- ✓ All protective gear should be kept apart (e.g. in a cupboard or box) from everyday working clothes. They should not be stored in the same room or cupboard as pesticides

1.3 Maintenance of application equipment

Maintenance of pesticide application equipment includes regular inspection of the spray tank, pump, hoses, line strainers, pressure gauge, fittings, nozzle tips and strainers. Check the sprayer prior to and following extended storage, and before each use. Always wear personal protective equipment when handling spray equipment.

- **Spray tanks:** Spray tanks are made of stainless or galvanized steel, fiberglass or plastic, including polyethylene or polypropylene. These materials are fairly non-absorptive, so no pesticide residues should be left in them after being cleaned. However, fiberglass tank linings, if scratched, will absorb pesticides. Cracks and chips in the epoxy coating of galvanized tanks must be repaired with epoxy material; otherwise, the exposed metal may corrode. Periodically check tanks for

cracks, rust or corrosion that will weaken the tank and eventually develop into a leak. Make sure the spray tank is securely fastened to the sprayer.

- **Pump and pump seals:** The pump and all its components must be in good working condition. Pump seals, 'O' rings or cup washers of leather or synthetic material may dry out and shrink if the sprayer has not been used for an extended period or stored improperly. The solvents in some pesticide formulations can damage pump seals, resulting in leaks around the pump or inefficient pumping.
- **Hoses:** Replace hoses that are cracked or leaking. Hoses used to apply pesticides can never be completely decontaminated. There will always be some pesticide residue left in them. Those that are replaced must be properly disposed of and not reused for any other purpose.
- **Line strainers and screens:** Always use strainers and screens when the equipment is in operation. These filter out debris and foreign particles that can plug nozzles and reduce sprayer performance.
- **Pressure gauges:** Fluid pressure in the spray system is monitored by a pressure gauge. The gauge measures spray pressure through the nozzles when located between the pressure regulator and the spray nozzles. Consequently, a change in pressure can mean a potential malfunction. Make sure pressure gauges are in good working condition and properly calibrated.
- **Fittings and clamps:** Loose or cracked fittings are frequently a source of leaks. Make sure fittings and clamps are snug prior to putting the system under pressure and pumping liquid. Once the system is under pressure, check for leaks.
- **Nozzle tips and strainers:** Check nozzles routinely to make sure they are not plugged. Worn nozzles mean more chemical sprayed and often result in an irregular spray pattern and inconsistent results. Nozzle openings may also change, especially when abrasive formulations, such as wettable powders, are frequently used. Replace them when wear causes flow to exceed that of a new tip by five to 10 percent.

Self-Check – 1	**Written test**

Name…… ID…… Date…….

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

Test I: give short answer

1. Mention equipment maintenance plan.
2. Write the purpose of nozzle tip.

Test II: say true or false

1. Protective clothing should be removed as soon as all operations involving pesticides are completed.
2. Replace hoses that are cracked or leaking.
3. Spray tanks are made of stainless or galvanized steel.
4. Loose or cracked fittings are frequently a source of leaks.
5. Check nozzles routinely to make sure they are not plugged.
6. Fluid pressure in the spray system is monitored by a pressure gauge.
7. The gauge measures spray pressure through the nozzles when located between the pressure regulator and the spray nozzles.
8. Always use strainers and screens when the equipment is in operation.
9. The life span of the cartridge is usually given in terms of the length of time used.

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

Note: Satisfactory rating – 20 points Unsatisfactory - below 20 points

Information Sheet 2- Supervising maintenance plan implementation

2.1 Introduction

A maintenance supervisor coordinates the installation, maintenance and repair work in sprayers. They manage a team of workers, regularly inspect sites, execute work as necessary, maintain equipment and assign workers to various jobs.

2.2 Maintenance plan Implementation

Periodically check to make sure filters are clean and free of debris.

Rinse the tank twice with water after each use. Be sure to pressurize the tank and spray water through the hose, wand and nozzle tip. Add a couple of drops of dish soap to the rinse water and continue to rinse the tank until all the bubbles are gone, “By removing the spray solution, you are able to prevent chemical attack within the tank and prevent any cross contamination of residual spray solution the next time you use the tank,” she says. After rinsing the tank at the end of the season, leave it upside down with the pump removed in a warm, dry location.

Be sure to always use the right sprayer for the right chemical. In some cases, manufacturers design certain tanks to be more resistant to chemicals with low pH levels.

When a handheld sprayer is set down between uses while out on the job, tip the tank with the bottom side up and spray out any product left in the hose and wand until only air is flowing. “This will reduce the chance of spray solution gumming up the filters and hose.

If the nozzle tip becomes clogged, remove the tip and rinse it with water. “Do not try to poke a hole through the nozzle opening as you could damage it, and this may affect your spray pattern,

Self-Check – 2	**Written test**

Name…… ID…… Date…….

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

Short Answer Questions

1. What is the reason for maintenance”
2. Periodically check to make sure filters are clean. Why?
3. Are you sue maintenance is important?

True or false

1. If the nozzle tip becomes clogged, remove the tip and rinse it with water.
2. Always use the right sprayer for the right chemical.
3. Tip the tank with the bottom side up and spray out any product left in the hose and wand until only air is flowing.
4. Be sure to always use the right sprayer for the right chemical.
5. Manage a team of workers, regularly inspect sites, and execute work as necessary.
6. Periodically check to make sure filters are clean and free of debris.
7. Rinse the tank twice with water after each use.

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

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

Information sheet 3 - Identifying and repairing or replacing faulty or damage equipment

3.1 Introduction

Replacing equipment is the larger investment; so many technicians choose to repair the equipment instead of replacing it. But the costs that go along with frequent breakdowns lower productivity, defective output, rising labor costs, and unmet production schedules can sometimes be greater than the cost of replacing the equipment outright.

Leaving your decisions to guesswork can be a costly and dangerous approach. If you aren't using a computerized maintenance management system (CMMS) effectively, you'll be forced to make decisions reactively, and as soon as something breaks down, you'll need to make a quick decision on what to do. With productivity plummeting, your decision will likely be made from an emotional standpoint, rather than solid data to support your decision.

3.2 Repairing or replacing faulty or damage equipment

On dangerous or risky job sites, and within certain environments, personal protective equipment (PPE) must be worn at all times. It makes perfect sense, because the gear is designed specifically to mitigate severe or fatal accidents. Helmets, for example, protect the head from falling objects, overhead fixtures, and much more.

Some other notable PPE items include eyewear, steel-toed or reinforced boots, gloves, face shields, respiratory equipment, and high-visibility vests. While some of these may not necessarily expire, all protective gear must remain in top-notch and safe working condition.

Rips or tears in gloves are going to render them useless when working with dangerous chemicals or materials. Therefore, the gear must be regularly inspected and replaced, if and when failures or damage are discovered.

Unfortunately, identifying the replacement period isn't always straightforward. Some gear may not show visible damage, even when the time is right.

Establish inspection protocols and standards

The first step is to either assign a few workers specifically for PPE inspections or to delegate the work to each individual on the team every person is responsible for their equipment, in other words.

Then, you must define an audit period, whether that's before a shift starts every day or night, or before the gear is doled out.

Inspectors should follow a standard process to identify potential damage and failure points. If and when a negative factor is found, the gear should immediately be taken out of circulation. Bear in mind, it's necessary to have extra replacement gear on hand for when this inevitably occurs.

Here's what inspectors should be looking for:

1. Discoloration or material degradation
2. Rips, tears, holes, cracks, indentions, or visible damage
3. The age of the equipment's compared to the manufacturer's expiration date
4. How many owners the gear has had
5. Missing components such as fuel, filters, or other resources
6. Failing straps, locks, adapters, or security devices

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Mention inspector's duty.
2. Discuss all planting process.
3. List PPE items.
4. Replacing equipment is the larger investment why?

Test II: say true or false

1. Replacing equipment is the larger investment
2. The costs that go along with frequent breakdowns lower productivity, defective output, rising labor costs, and unmet production schedules.
3. Inspectors should follow a standard process.
4. If you aren't using a computerized maintenance management system (CMMS) effectively, you'll be forced to make decisions reactively.
5. On dangerous or risky job sites, and within certain environments, personal protective equipment (PPE) must be worn at all times.
6. Identifying the replacement period isn't always straightforward.

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

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

Operation sheet 1– inspections of equipment

Objective

- To maintain or replace equipment's

Tools and equipment's

- Sprayer
- PPE etc.

What you inspect

1. Discoloration or material degradation
2. Rips, tears, holes, cracks, indentions, or visible damage
3. The age of the equipment's compared to the manufacturer's expiration date
4. How many owners the gear has had
5. Missing components such as fuel, filters, or other resources
6. Failing straps, locks, adapters, or security devices

Lap Test	Demonstration

Name…… ID……..

Date……

Time started: _____ Time finished: _____

Instructions: perform equipment inspections.

LG #52	LO #4 - Determine the suitability of a chemical for use in a control program

Instruction sheet

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

- Planning Integrated Pest Management (IPM) or Animal Health Strategy (AHS)
- Selecting Chemicals in the IPM or AHS
- Considering and Appling Alternatives to chemical treatments

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

- Integrated Pest Management (IPM) or Animal Health Strategy (AHS) plan.
- Chemicals included in the IPM or AHS select according to situation.
- Alternatives to chemical treatments consider and apply according to IPM or AHS.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information sheet 1- Planning Integrated Pest Management (IPM)

1.1. Introductions

IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and non-target organisms, and the environment. According to the Food and Agriculture Organization (FAO) of the United Nations*, IPM means considering all available pest control techniques and other measures that discourage the development of pest populations, while minimizing risks to human health and the environment.

1.2. Integrated pest management strategic planning

The IPM Strategic Planning process produces a formal, living document that describes the major pests, challenges and critical needs of an industry or commodity in detail. The document highlights major pests and pest management strategies; field activities; and critical pest management needs for a geographically defined population of stakeholders. The crop-stage approach to documenting current practices enables progress toward reducing economic, health and environmental risks. The process creates a formal structure for assessing status and progress in IPM, and also leverages targeted research investments, regulatory changes and education programs to encourage system wide responses.

IPM Strategic Planning strengthens agricultural networks by promoting long-term collaboration and consensus-building among key stakeholders, including farmers, researchers, Extension agents, private consultants, funding agencies and regulatory authorities.

IPM Strategic Planning refines the process by:

- Placing current management practices within a PAMS framework (prevention, avoidance, monitoring and suppression tactics).

- Incorporating a crop-stage approach to enable a more holistic, whole-season understanding of current activities and IPM status.
- Incorporating a formal process for collaboratively identifying industry needs to achieve broad IPM goals.
- Increasing efficiency with a shortened process and document, with less repetition.
- Establishing a three- to five-year schedule of routine updates that enable monitoring of changes and progress to keep systems moving forward.
- Pursuing better integration with research, Extension and regulatory nodes of the agricultural system, including increased collaboration with partners.
- Focusing follow-up on decision support and risk management, and providing a mechanism to document and track progress in IPM adoption over time and across pest management settings.

12 Steps to an IPM Strategic plan

1. **Define goals**

Identify a candidate industry or pest management setting. Considerations include industry interest; awareness of an industry's need for research; Extension and regulatory support to advance IPM; the scale and importance of the industry to the local economy; or known exposure to significant pest or pest-management risks.

2. **Secure guidance**

In the U.S., engage with your Regional IPM Canter. Share your ideas for how to organize the work group and the document, and engage in regular check-ins on the process and format. The centres can offer guidance and help with meeting facilitation, document review, inclusion in the National IPM Database and even potential funding through annual grant programs.

3**. Set boundaries**

Work with key industry and pest management personnel to identify an appropriate geographic scope for your IPM Strategic Plan, based on the needs of the industry and the local context. The goal of this process is to engage local research and Extension toward solving critical industry needs. These needs often vary by geographic region. In some cases, it can help to include up to three states, with region-specific information

within this defined area. In other cases, focusing on one state or geographic region can help to specify current challenges and critical needs, which can greatly amplify the research and Extension impacts.

4. Acquire funding

The budget should cover salaries, meeting costs, and travel reimbursements as needed (see sample budget, Appendix C). In the U.S., the USDA Regional IPM Centers offer competitive funding for these projects. Many commodity groups also support the process, in full or in part, through their own competitive funding cycles. Reach out to your candidate group to identify whether there is funding available and when the group calls for proposals. Plan to apply for full or partial funding if needed.

5. Create a work group

The group of about 25 people should include growers, pest managers, consultants, researchers, Extension personnel, and regulatory representatives. Commodity commissions, Extension faculty, and other growers and pest managers can help identify group members. Membership should reflect the makeup of the local or regional industry. The work group constitutes an advisory body that contributes to the final document, and partners with research and Extension workers to generate capacity for IPM advancement. The makeup of this group is critical to ensuring a document that speaks for an industry; ideally, growers should constitute at least half of the group. Ensure representation of the diversity of farm sizes and production systems within the local industry in the work group makeup, including groups and individuals that may have been historically underserved. An ideal group might contain 12 to 14 growers, two to three consultants, two to three researchers, two to three Extension faculty and one to three others as applicable (regulatory officials, state agency representatives or advocacy group members with connections to the industry).

6. Acquire data

Over a period of one to two months, gather information on major pest insects, diseases, weeds, vertebrates and emerging pests from the work group by phone and email.

Compile information on pest management efforts and the timing of pest management activities relative to crop growth stages.

7. Compile a draft

Using the pest and crop growth stage information, compile a document draft that includes all of the sections in the Document outline.

8. Meet

At a convenient time for the industry, organize a one-day meeting of work group members. At this meeting, the work group will detail current management activities for each crop stage, including target pests for each management strategy. They will also develop lists of critical pest management needs.

In most settings, information can be entered into the meeting draft of the document, with the document projected on a large screen and editing taking place live using document review mode. This helps facilitate group input and provides validity checks on the information entered. The group will:

- Review past IPM strategic plans, if applicable, and measure progress on each top critical need.
- Briefly discuss major pests and crop stages.
- Detail current pest management activities conducted during each of the main crop stages of production, and assigning target pests to each activity.
- Document critical pest management needs for research, regulation and education for each crop stage. Ensure that farmers, consultants, and other pest management decision-makers are the main source of this information, with input from researchers and others where it clarifies or expands upon industry needs.
- In addition to collaboratively completing the crop-stage and pest-specific PAMS tables and needs, ask the group to work together to identify broader IPM goals. Then, list actionable steps that support the goals. Goals could include reduced pesticide use and alternatives to pesticides; decision-support tools; and protection of human health, soil health, pollinators, and water quality.
- In small groups, complete seasonal pest occurrence, management activity, and pesticide risk and efficacy tables for currently used pesticides.

- As a final stage, present crop-stage-specific needs and broader IPM needs on posters, and ask each participant to vote for their top three research, education and regulatory needs. From that exercise, develop a short list of priorities.
- Evaluate the meeting against process and learning objectives.

9. Refine

Within one to two months of the meeting, edit, validate, and refine the document draft with work group members via phone and email, and create a final draft to share with group members for their review and approval.

10. Publish

Submit the document to your university as an Extension publication, and include additional lead authors from the work group as determined by their contributions to the document draft.

11. Share it widely

Maintain engagement with associated research and Extension faculty to publicize the document and promote its use; disseminate the lists of needs; and facilitate targeted research and education. Maintain engagement with industry members, including local commissions or commodity boards. Use the needs identified through the process to set industry funding priorities.

12. Update and track progress

Develop a process to check on follow-up and progress, and update the formal process every three to five years with an in-person meeting. In the update, review the last completed document and follow these steps:

Self-Check – 1	**Written test**

Name…… ID…… Date…….

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

Test I: give short answer

1. List IPM options.
2. List 12 steps to an IPM Strategic plan

Test II: say true or false

1. An ecosystem-based strategy that focuses on long-term prevention of pests
2. Review past IPM strategic plans, if applicable, and measure progress on each top critical need.
3. IPM considering all available pest control techniques and other measures
4. Detail current pest management activities conducted during each of the main crop stages of production, and assigning target pests to each activity.
5. Pesticides are used only after monitoring indicates they are needed.
6. Within one to two months of the meeting, edit, validate, and refine the document draft with work group members.
7. Incorporating a formal process for collaboratively identifying industry needs to achieve broad IPM goals.
8. IPM means considering all available pest control techniques and other measures that encourage the development of pest populations.

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

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

Information Sheet 2- Selecting Chemicals in the IPM

2.1 Introduction

Pesticides are included as part of the IPM strategy, but they must be used with care and with attention to safety. There are certain considerations to keep in mind when using a pesticide, especially in regard to potential harm to non-target organisms.

2.2 Selecting chemicals

Acquire and consult the Safety Data Sheets (SDS) before deciding on a specific pesticide. These important documents give data on the potential hazards and safety precautions of various pesticides.

Criteria for choosing a pesticide include:

- **Safety is top priority**

  Questions to ask include what is the toxicity level of the pesticide (measured by LD50--the higher the LD50 number, the less toxic); how mobile is the pesticide and in what fashion can it be distributed (through air, soil, water, etc.); what is the residual life of the pesticide; and what are the environmental hazards listed on the label?

- **Species specificity**

  This is especially important to look for before using toxic chemicals since certain pesticides only affect the target animals or plants. Try to avoid getting broad spectrum pesticides that have potential to kill or harm many beneficial species along with the pest. If such a pesticide is the only option, try doing spot treatments to reduce the likelihood of affecting non-target organisms.

- **Effectiveness**

  For pesticides, it is a bit difficult to measure effectiveness because it can vary depending on where the chemicals are being applied. In a lab, for instance, a chemical may kill a large percentage of the target pest because it is a controlled environment, but in a real life situation, the number may be much smaller due to other factors such as killing off natural enemies, temperature changes, etc. Evaluating uses of a considered pesticide in similar situations as that of your school may help in estimating the kind of effect it will have.

- **Endurance**

An animal or plant's endurance to the effects of a pesticide may vary. Watch for success in pest control: if it at first seems to work well but then later populations grow despite continued use, there may be some built up resistance.

- **Pesticides vary in their speeds of interaction**

  Choosing a pesticide should be determined based on circumstances. If it is an emergency, a shorter lived, fast acting and more acutely toxic material (such as organophosphate for cockroaches) may be necessary. But a longer lasting, slow acting and less toxic material (such as boric acid) may be better for chronic pest problems.

- **Cost**

  This is always a consideration when deciding what chemicals to use. Determination of cost often is done by measuring dollars per volume-some new materials that are effective in lower doses may be more expensive than older pesticides that need larger amounts to do the job. A small container of more concentrated material may seem more expensive, but may be as effective as three times that much in another kind of pesticide.

- **Once a pesticide is selected, notify**

  Give notification to personnel, students, and parents about what pesticide will be (or has been) used and where it is going to be (or has been) applied so they are aware of any possible exposure. Ideally applications should be done when buildings are unoccupied, but regardless, it is best to give advanced notice that an application is scheduled so that everyone can take appropriate steps to ensure the safety of those involved.

Self-Check – 2	**Written test**

Name…… ID…… Date…….

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

Test I: give short answer

1. Explain IPM strategy.
2. Mention criteria for chemical selection in IPM.

Test II: say true or false

1. Pesticides are included as part of the IPM strategy
2. Cost always a consideration when deciding what chemicals to use
3. Choosing a pesticide should be determined based on circumstances.
4. Give notification to personnel, students, and parents about what pesticide will be (or has been) used.
5. Ideally applications should be done when buildings are unoccupied.
6. Always a consideration when deciding what chemicals to use.
7. Chemical may kill a large percentage of the target pest.

Note: Satisfactory rating – 20 points Unsatisfactory - below 20 points

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

Information Sheet 3- Considering and applying alternatives to chemical treatments

3.1. Introduction

In pest management, there are many alternatives to chemical pesticides, such as mechanical, biological, quarantine and integrated methods. There are also specialised forms of traps, such as blue, yellow and standard light traps, pheromone traps, pitfall traps, all of which can be used in a lure and kill approach.

3.2. The use of alternatives to agrochemicals

Good agricultural practice recognizes the importance of agrochemicals. When used correctly, they contribute to an improvement in agricultural production. However, excessive or indiscriminate use of agrochemicals may lead to health hazards, and damage to crops, livestock, wildlife and the environment. Alternatives to a dependence on agrochemicals may include the following:

1. **Cultural controls:** This is essentially the use of cultivation techniques for the benefit of the crop and to the disadvantage of pests of any kind. Crop rotation is the most effective cultural control. It avoids a buildup of crop-specific pests and a depletion of the plant nutrients in the soil. Crop rotation is also beneficial. It replenishes soil nutrients with decayed organic matter, improves the soil structure and helps weeding.
2. **Biological controls**: The natural enemies of pests are known as insect predators. Biological controls seek to encourage those insect predators which are harmless to the crop but which destroy the pests in the same way as agrochemical insecticides. Insect predators are a valuable alternative to agrochemicals and may be bred in captivity for a timely release to control an insect population.
3. **Breeding of pest-resistant plants**: Plant breeding seeks to develop improved varieties of crops such as rice, wheat and maize, which will respond well to cultivation and produce good yields. A resistance to crop diseases, particularly those caused by microorganisms such as viruses, fungi and bacteria, is an important part of this process. Information obtained during the breeding programs will also indicate ideal growing conditions and will be of value to the farmer. This may include information on nutritional requirements, planting density or the best time for planting and harvesting so as to avoid insect damage. Farmers should seek advice on varieties of crops resistant to pests in their locality.

4. **Physical controls:** Traps have a long history of use in the capture of various pests. They may be snares, or cages for vertebrates such as rats, rabbits and birds, or sticky tape, swats and lures for invertebrates such as snails, flies and other insects. In recent years these methods have become more sophisticated by including electronic triggering devices or the use of electricity as a light source. Pests attracted to hot electric bulbs get burnt. Physical controls are very useful in dealing with relatively small infestations of rodents or other pests, for example in food processing areas where agrochemicals should not be used.
5. **Integrated controls:** This is a combination of several control measures described above, plus the controlled use of agrochemicals. The measures are balanced with one another so as to obtain the best results. The practical implementation of integrated controls will often depend on circumstances. The component parts may be balanced differently according to cost, opportunity and the way in which a crop is threatened. In practice, integrated controls are commonly used as part of good agricultural practice throughout the world and are continuing to be developed as part of integrated pest management programs.

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Discuss alternatives of chemicals.
2. Explain integrated controls.
3. List physical controls.

Test II: say true or false

1. In pest management, there are many alternatives to chemical pesticides.
2. Chemicals are the first option in IPM.
3. Excessive or indiscriminate use of agrochemicals may lead to health hazards, and damage to crops.
4. The practical implementation of integrated controls will often depend on circumstances.
5. Integrated controls are commonly used as part of good agricultural practice.
6. Physical controls are very useful in dealing with relatively small infestations of rodents or other pests.
7. Plant breeding seeks to develop improved varieties of crops.

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

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

Operation sheet 1– IPM Strategic Plan

Steps:

- Define goals

- Secure guidance
- Set boundaries
- Acquire funding
- Create a work group

Lap Test	Demonstration

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: perform IPM plan

LG #53	LO # 5 - Ensure the correct selection and application of the chemical
Instruction sheet	

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

- Identifying Chemicals suitable for situation
- Selecting application equipment
- Implementing calibration of equipment
- Implementing Pre-operative checks and maintenance procedures
- Assessing Meteorological conditions for chemical application.
- Conducting Chemical application
- Dealing Chemical spills or accidents

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

- Chemicals suitable for situation are identify, and procedures for preparation, application and risk control read and interpreted.
- Application equipment select in accordance with procedures.
- Ensure calibration of equipment implement according to directions and standards.
- Pre-operative checks and maintenance procedures implement.
- Meteorological conditions assessed as appropriate to application prior to and during chemical application.
- Chemical application is conducted safely in accordance with hazards associate with the chemicals concern.
- Chemical spills or accidents are deal with according to procedures.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.

5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Identifying chemicals suitable for situation

1.1. Introduction

Agrochemicals or agrichemicals, is a common name given to chemicals which are used in agriculture, to aid plants and crops growth and safety. Agrochemicals were manufactured to protect agricultural crops from pests and for augmenting crop yields. It is a costly input for agriculture.

Agrochemicals are chemical agents used on farmlands to improve the nutrients in the field or crops. They improve crop growth by killing damaging insects. They are implemented in all forms of farming sectors such as horticulture, dairy farming, poultry, crop shifting, commercial planting, etc. The article sheds light on the various aspects of agrochemicals.

Various chemical products used in agriculture are called agrochemicals or agricultural chemicals. Chemicals such as pesticides, insecticides, natural herbicides, fungicides chemicals, and natural nematicides, all fall under the category of agrochemicals. It may also contain synthetic fertilizers, hormones, or other chemical growth agents, as well as raw animal manure concentrates. The quantities and standard of agricultural products are improved by agrochemicals.

1.2. Types of agrochemicals

Agrochemicals include pesticides, insecticides, herbicides, fungicides, along with fertilizers and soil conditioners. Insects and animals are a severe plant risk. When attracted to a source of food, the supply of this particular plant could significantly decrease. As the name suggests, pesticides defend crops by destroying, disabling, or avoiding such pests.

Many fungal species were also known for causing significant crop damage. Such materials prevent fungi from damaging any crop. In addition, a large number of fertilizers are natural. They are not agrochemical since no unique chemical formula has been developed or produced. Without them, healthy, reliable crops will be much harder to produce. The value of fertilizers is so high that a number chose synthetic agrochemical varieties to improve natural fertilizers.

1.3. Classifications of Agrochemicals

In most of the cases, agrochemicals refer to pesticides which include insecticides, herbicides, fungicides, rodenticides, molluscicides, and nematicides. Agrochemical also includes fertilizers and soil conditioners.

- **Pesticides:** Pesticide is a chemical or a substance used to destroy or control some types of plants or organisms also known as pests, which are harmful to cultivated plants or to animals. Pesticides mostly work through poisoning pests.
- **Insecticides:** It is used to destroy insects. Insecticides can be ovicides that kill eggs, larvicides to kill larvae. Pesticides examples: Organochlorines, organophosphates, carbamates, and pyrethroids.
- **Herbicides:** It is used to control or kill weeds and herbs. Herbicides examples: Gramoxone and glyphosate.
- **Fungicides:** It is used for controlling fungi and oomycetes. Fungicides examples: Mankocide.
- **Algaecides:** used for controlling algae. Also known as algicides.
- **Rodenticides:** It is used to prevent spread of rodents like rat, mice. Examples: Klerat.
- **Molluscicides:** used to control molluscs like snails and slugs. Examples: Slugit
- **Nematicides:** It is used to control or killing nematodes. Examples: Furadan.
- **Fertilizers:** This is chemical compounds used for promoting plant growth. They are used to mitigate nutrient deficiency in the soil. Typically, it is applied to soils or to plant tissues. Fertilizers can be categorized into two categories: organic and inorganic fertilizers. Organic fertilizers are naturally existing substances prepared through natural processes. Inorganic fertilizers, also referred to as synthetic fertilizers are manufactured artificially using chemical processes by utilizing natural deposits, which are altered chemically.
- **Soil conditioners:** To keep all soils in good condition, the best thing to do is to add things that keep it in good condition. These good things are called soil conditioners that include manure, compost, peat, livestock manures and leaves. All these things are laid on top of the soil and then mixed. Soil conditioners enhance aeration and water holding capacity of the soil.

- **Liming and acidifying agents:** Soils sometimes can be too acidic or too alkaline for proper growth of crops. In these cases, liming and acidifying products are added to soil to adjust its pH. When the soil is too acidic, calcite on the form of powdered limestone is added primarily, whereas for more alkaline soil sulfur compounds are added to neutralize.

Self-Check – 1	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. _____mostly work through poisoning pests.
2. _____ is used for controlling fungi and oomycetes
3. _____ is used to control or kill weeds and herbs.
4. What is weed?
5. What is pest?
6. What is pathogen disease?
7. What is an insect?

Test II: say true or false

1. Agrochemicals include pesticides, insecticides, herbicides, fungicides, along with fertilizers and soil conditioners. Irrigation is applied between field capacity and wilting point.
2. For more alkaline soil sulfur compounds are added to neutralize.

Test III: choice

1. It is used to control or kill weeds and herbs.
   A. Algaecides
   B. Fungicides
   C. Herbicides
   D. Insecticides
2. Chemical compounds used for promoting plant growth.
   A. Insecticides
   A. Fertilizers
   B. Fungicides
   C. Rodenticides

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

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

Information Sheet 2- Selecting application equipment

2.1. Introduction

A sprayer is a device used to spray a liquid, where sprayers are commonly used for projection of water, weed killers, crop performance materials, pest maintenance chemicals, as well as manufacturing and production line ingredients. In agriculture, a sprayer is a piece of equipment that is used to apply herbicides, pesticides, and fertilizers on agricultural crops. Sprayers range in size from man-portable units (typically backpacks with spray guns) to trailed sprayers that are connected to a tractor, to self-propelled units similar to tractors with boom mounts of 4–30 feet (1.2–9.1 m) up to 60–151 feet (18–46 m) in length depending on engineering design for tractor and land size

2.2. Types of sprayers

When selecting a sprayer, be certain that it will deliver the proper rate of pesticide uniformly over the target area. Most pesticide applications in vegetable crops are done with a hydraulic sprayer at either high or low pressures.

- **Hydraulic Sprayers**

Water is most often used with hydraulic spraying equipment as the means of carrying pesticide to the target area. The pesticide is mixed with enough water to obtain the desired application rate at a specific pressure and travel speed. The spray mixture flows through the spraying system under pressure and is released through one or more nozzles onto the target area.

- **Low-pressure Sprayers**

Low-pressure sprayers normally deliver low to moderate volumes at low pressure 15 to 100 pounds of pressure per square inch (psi). The spray mixture is applied through a boom equipped with nozzles. The boom usually is mounted on a tractor, truck, or trailer or the nozzle can be attached to a hand-held boom.

Low-pressure sprayers do not deliver sufficient volume to penetrate dense foliage. They are most useful in distributing dilute pesticide over large areas.

- **High-pressure Sprayers**

High-pressure sprayers deliver large volumes at high pressure. They are similar to low-pressure sprayers but deliver up to 50 gallons of spray per minute at pressures up to 800 psi. A boom delivers 200 to 600 gallons per acre. High-pressure sprayers provide thorough coverage and can penetrate dense foliage, but they can produce large numbers

of small spray droplets that can drift. These sprayers can provide low-pressure flow when fitted with proper pressure regulators.

Parts of a sprayer

To properly select, maintain, and operate your sprayer, you need to know its parts. The major components of a sprayer are tank, pump, agitator, flow control, and nozzles.

- **Tanks**

Suitable materials for spray tanks include stainless steel, polyethylene plastic, and fiberglass. Spray tanks made of aluminum, galvanized steel, and stainless steel are easily corroded by some pesticides and liquid fertilizers. The tank cover should form a watertight seal when closed to minimize spills. All tanks should have a drain plug at their lowest point and shut-off valves so that any liquid in the tank can be held without leaking if the pump, strainers, or other parts of the system need to be serviced.

Tank capacity markings must be accurate so that you can add the correct amount of water. A clear plastic tube (sight gauge) is mounted on metal tanks.

- **Agitators**

Agitation is required to combine the components of the spray mixture uniformly and, for some formulations, to keep the pesticide in suspension. If agitation is inadequate, the application rate of the pesticide may vary as the tank is emptied. The two common types of agitation are hydraulic and mechanical.

The quantity of flow required for agitation depends on the chemical used. Little agitation is needed for solutions and emulsions, but intense agitation is required for wettable powders. For jet agitators, a flow of 6 gallons per minute for each 100 gallons of tank capacity is adequate. The jet should be submerged to prevent foaming. Wettable powder suspensions can wear the inside of the tank if the jet stream passes through less than 12 inches of liquid before hitting the tank wall.

A mechanical agitator consists of a shaft with paddles and is located near the bottom of the tank. The shaft is driven by an electric motor or some other device powered by the tractor. This system is more costly than jet agitation. Mechanical agitators should operate at 100 to 200 rpm. Foaming will result at higher speeds.

- **Pumps**

The pump must deliver the necessary flow to all nozzles at the desired pressure to ensure uniform distribution. Pump flow capacity should be 20 percent greater than the largest flow required by the nozzles.

When selecting a pump, consider resistance to corrosive damage from pesticides, ease of priming, and power source availability. The materials in the pump housing and seals should be resistant to chemicals, including organic solvents.

Pesticide sprayers commonly use roller, piston, diaphragm, and centrifugal pumps. Each has unique characteristics that make it well adapted for particular situations. Choose a pump that best fits your pesticide application program

- **Strainers**

Proper filtering of the spray mixture not only protects the working parts of the spray system but also avoids misapplication due to nozzle tip clogging. Three types of strainers commonly used on sprayers are tank filler strainers, line strainers, and nozzle strainers. As the mixture moves through the system, strainer openings should be progressively smaller. Strainer mesh size is determined by the number of openings per linear inch; a high strainer size number indicates smaller openings. Strainers need to be checked for clogs and rinsed frequently.

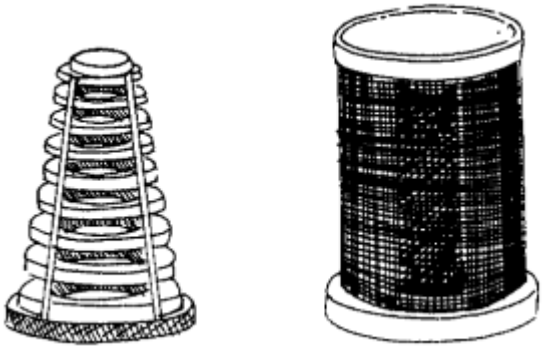

Fig.1. Strainer

- **Hoses**

Use synthetic rubber or plastic hoses that have burst strength greater than peak operating pressures, resist oil and solvents present in pesticides, and are weather resistant.

Sprayer lines must be properly sized for the system. The suction line, often the cause of pressure problems, must be airtight, non-collapsible, and as short as possible, and have an inside diameter as large as the pump intake.

- **Pressure regulators**

A pressure regulator is one of the most important parts of a sprayer. It controls the pressure and therefore the quantity of spray material delivered by the nozzles. It protects pump seals, hoses, and other sprayer parts from damage due to excessive pressure, and it bypasses excess spray material back to the tank.

There are two types of pressure regulators simple relief valves and pressure unloaders. Relief valves are simple bypass valves that require the pump and engine to keep working just as though you were spraying. Pressure unloaders maintain working pressure on the discharge end of the system but move the overflow back into the tank at lower pressure, thus reducing strain on the engine and the pump.

Be certain that the flow capacity of the pressure regulator matches that of the pump being used.

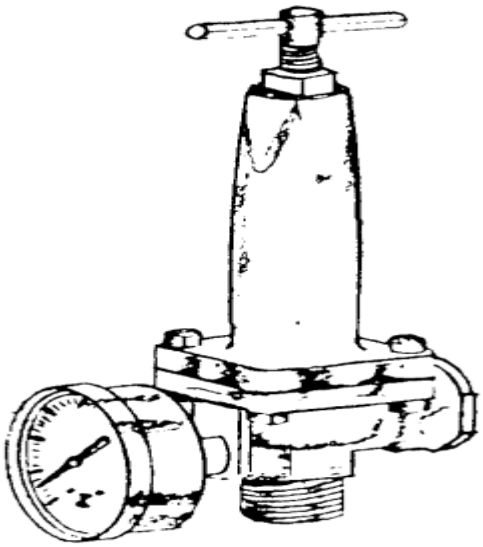

Fig.2. Pressure regulator

- **Pressure gauge**

A pressure gauge is essential to every sprayer system to correctly indicate the pressure at the nozzle. Pressure directly affects the application rate and spray distribution. Pressure gauges often wear out because they become clogged with solid particles of spray material. A glycerine loaded diaphragm gauge is more expensive but will last indefinitely

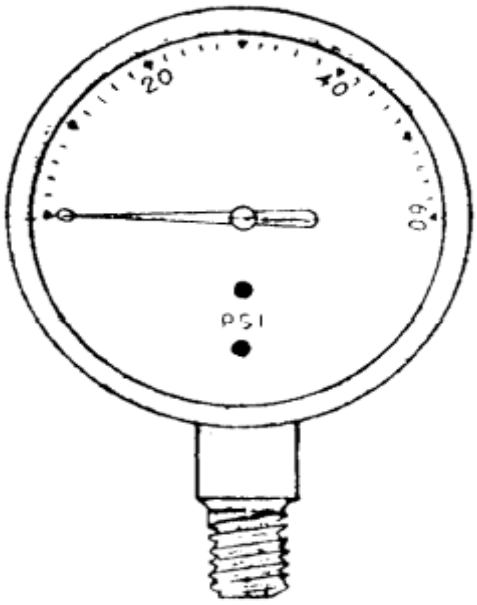

Fig.3. Pressure gauge

- **Nozzles**

Nozzles are important to control the volume of pesticide applied, the uniformity of application, the completeness of coverage, and the degree of drift. Many types of nozzles are available, each one designed for a specific type of application. Regular flat-fan, flood, and whirl chamber nozzles are preferred for weed control. For minimum drift, flood and raindrop nozzles are preferred because they produce large droplets.

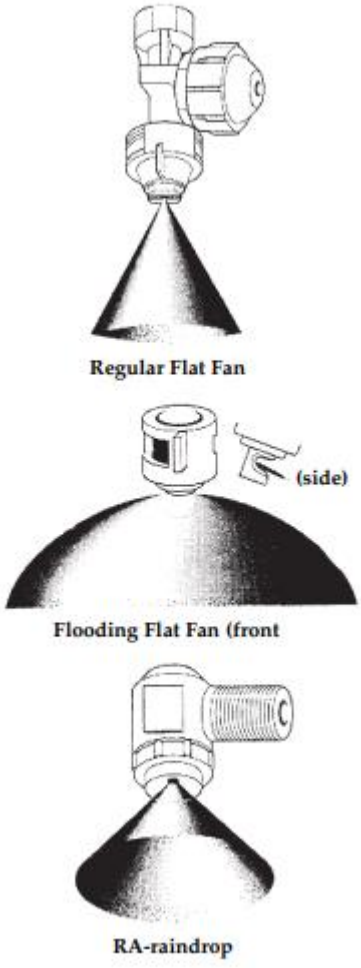

Fig.4. types of Nozzle

- **Regular flat-fan nozzle**

Regular flat-fan nozzles are designed for broadcast applications and are sometimes used on high-clearance and pickup sprayers. They are typically used for foliar applications and require a 30 to 50 percent pattern overlap to obtain uniform coverage. Flat-fan nozzles are recommended for herbicides and insecticides where foliage penetration and complete coverage are not necessary.

Regular flat-fan nozzles produce a narrow oval pattern and medium droplets at pressures of 15 to 20 psi; drift potential increases at pressures above 30 psi.

- **Flooding Flat-fan Nozzle**

Flooding flat-fans are the most commonly used nozzles. They produce a wide-angle pattern that varies with pressure. At high pressure, the pattern is heavier in the center

and tapers off toward the edges; at low pressures, they produce a uniform pattern. Pressure also affects droplet size. Flooding flat-fan nozzles produce large spray droplets at low pressure and small droplets at high pressure. To control drift, flooding nozzles should be operated at between 8 and 25 psi.

- **Hollow-cone whirl chamber nozzle**

The hollow-cone nozzle is used primarily to penetrate foliage for effective pest control when drift is not a concern. These nozzles produce small droplets at pressures of 40 to 80 psi that penetrate plant canopies and cover the undersides of leaves more effectively than spray from other nozzles.

Whirl chamber nozzles have two pieces. The first part is the whirl chamber, which squirts the material as it moves through the second piece, a disk. This results in a circular hollow-cone spray pattern.

- **Raindrop Nozzle**

Raindrop nozzles are designed to reduce drift. This nozzle produces large droplets in a hollow-cone pattern when operated between 20 and 50 psi. The large droplets aid in drift control but may result in poor coverage by some foliar pesticides.

Nozzles are available in a variety of materials. Brass nozzles are inexpensive but wear rapidly. Stainless steel, nylon, and other plastic nozzles are wear resistant when used with corrosive or abrasive materials. Nozzles made of hardened stainless steel are the most wear resistant and expensive.

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. List types of nozzles.
2. Write sprayer types?
3. _____nozzles are designed for broadcast applications and are sometimes used on high-clearance and pickup sprayers.
4. _____nozzles are designed to reduce drift.

Test II: say true or false

1. Low-pressure sprayers normally deliver low to moderate volumes at low pressure
2. Raindrop nozzles are designed to reduce drift.
3. Nozzles are available in a variety of materials.
4. Whirl chamber nozzles have two pieces.
5. Brass nozzles are inexpensive but wear rapidly.
6. Stainless steel, nylon, and other plastic nozzles are wear resistant when used with corrosive or abrasive materials.
7. Nozzles made of hardened stainless steel are the most wear resistant and expensive.
8. Flooding flat-fans are the most commonly used nozzles.

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

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

Information Sheet 3- Implementing calibration of equipment

3.1. Introduction

Sprayer calibration is accomplished by determining the effective spray width, using a test area to test the sprayer's output and time needed to cover the test area, and summing these values to determine the sprayer output per acre.

The amount of chemical solution applied per acre depends on forward speed, system pressure, size of nozzle, and nozzle spacing on the boom. A change in any one of these will change the application rate

3.2. Calibration of spraying equipment

To achieve good results from spraying, the sprayer must be clean and in working condition. It must be calibrated before every major spraying operation so that the exact quantity of spray is delivered on the target, which may be plants in the case of insecticide application or soil in the case of herbicides.

The forward speed and pressure must be adjusted correctly to set the sprayer for any given rate per acre. The nozzle size should be changed to make a large change in application rates, and all nozzles should discharge an equal amount of spray. If any of these adjustments are incorrect, poor results will be obtained.

The first thing to do with sprayer calibration is select the type and size nozzle for your spraying job. Once you've selected the type of nozzle, the next step is to calculate the nozzle size

- **Calibration of knapsack sprayers**
  a. Rinse and clean the sprayer.
  b. Determine nozzle discharge (by selecting a nozzle) in L min-1 at known pressure (V).
  c. Calculate the walking speed of the operator (starting point, end point) in M min-1(L).
  d. Determine the width of the spray swath in meters (W).
  e. Calculate the area sprayed in one minute (W x L) M2 min-1
     Area sprayed min-1 = Swath width of spray x Forward speed min-1

f. The application rate for any given area:

Volume of spray in L unit-1 area = Nozzle discharge (L min-1) x Area

Area sprayed min-1

Lha-1 = V x 10000

L x W

g. Calculate the number of spray loads ha-1

Loads ha-1 = Rate of application ha-1

Tank capacity of sprayer

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Write calibration process.
2. _____ is application of a chemical to a specific area such as a plant canopy, a row or at the base of the plants.

Test II: say true or false

1. Sprayer calibration is accomplished by determining the effective spray width
2. To achieve good results from spraying, the sprayer must be clan.
3. A change in forward speed will change the application rate.
4. An accurate speed is essential for good sprayer operation.
5. Tractor or pick-up speedometers may not give accurate readings so they need to be checked.
6. The first thing to do with sprayer calibration is select the type and size nozzle for your spraying job.
7. The forward speed and pressure must be adjusted correctly to set the sprayer for any given rate per acre.
8. Band application is applying a chemical in parallel bands, leaving the area between bands free of chemical.

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

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

Information Sheet 4- Implementing pre-operative checks and maintenance procedures

4.1. Introduction

The pre-operational check covers a number of key components of the machine and helps to identify maintenance issues and repairs that may be required. It is important to assess the conditions observed during your inspection to determine the action required.

4.2. Pre-operative checks

Before operating the sprayer and each time thereafter, the following areas should be checked off:

1. Lubricate the machine per the schedule outlined in the “Maintenance Section”.
2. Use only a tractor of adequate power and weight to operate the Sprayer.
3. Ensure that the machine is properly attached to the tractor. Be sure that a mechanical retainer is installed through the drawbar pin and the safety chain is attached to the drawbar cage. Jack is properly stowed on bottom side of the tongue.
4. Check the hydraulic system. Ensure that the hydraulic reservoir in the tractor is filled to the required specifications.
5. Inspect all hydraulic lines, hoses, fittings and couplers for tightness. Use a clean cloth to wipe any accumulated dirt from the couplers before connecting to the hydraulic system of the tractor.
6. Check the tires and ensure that they are inflated to the specified pressure.
7. Calibrate the sprayer if it is the start of the season or a new chemical is being used. Calibrate as specified in rate control manual.
8. Check the condition and routing of all chemical hoses and lines. Replace any that are damaged. Re-route those that are rubbing pinched or crimped.
9. Check the spray pattern of each nozzle. Remove and clean or replace any that have an unusual pattern.
10. Remove the steel mesh line filters and wash with clean water. Reinstall.
11. Check that all connections in the electrical system are connected and tight.
12. Remove delivery bolt on breakaway clamp and ensure wing breaks away freely and returns to locked position. (Delivery bolt should not be reinstalled, for delivery safety only)

13. Before unfolding boom remove transport wing lock pins and tower cylinder Transport stop reinstall lock pins and tower stop before parking sprayer.
14. Consult tractor manufacturer's manual for hydraulic operation system. (open or closed center system) For closed center systems, leave hydraulic boom operation block located on the center of boom as factory installed. For open center hydraulic systems, the by-pass (dump) valve needs to be put back in th place of the by-pass (dump) plug.

Self-Check – 4	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Discuss checking of PPE.

Test II: say true or false

1. Check that all connections in the electrical system are connected and tight..
2. Lubricate the machine per the schedule outlined in the “Maintenance Section”.
3. Use only a tractor of adequate power and weight to operate the Sprayer.
4. Ensure that the machine is properly attached to the tractor.
5. Be sure that a mechanical retainer is installed through the drawbar pin.
6. Jack is properly stowed on bottom side of the tongue.
7. Check the spray pattern of each nozzle.
8. Consult tractor manufacturers manual for hydraulic operation system.(
9. Check the condition and routing of all chemical hoses and lines.
10. Remove the steel mesh line filters and wash with clean water.

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

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

Information Sheet 5- Assessing meteorological conditions

5.1. Introduction

Weather conditions such as wind, temperature, relative humidity and precipitation influence the effectiveness of spray applications and the potential for wastage by run-off and drift. This Factsheet describes the impact of weather conditions on spray applications and how to change application methods to match weather conditions, improve accuracy and reduce wastage. It also describes how to use simple tools to measure and monitor weather conditions and provides information on where to purchase these tools.

5.2. Meteorological conditions/ weather conditions

Measure weather conditions when planning to spray, or during spraying if a change in conditions is suspected. Limitations on application temperature and wind speed may be on the pesticide label. Weather Innovations Incorporated (WIN) now offers an online spray advisory forecast for boom sprayers in Ontario at www.weathercentral.ca. This information is a prediction based on wind speed and is therefore only one factor in the decision to spray or not to spray.

It is the responsibility of all applicators to monitor and record local conditions using a combination of weather forecasts, a standard compass or windsock, and a fixed or handheld weather station.

1. Wind

Wind direction determines whether droplets travel toward the target or toward unintended downwind areas such as open water, sensitive crops or areas of human activity. Wind speed affects the distance a droplet will travel before it is deposited on the target.

- Spray only when wind direction is consistent and between 2–15 km/h, or as indicated on the product label.
- The impact of wind is particularly significant when performing directed (e.g. air blast) spraying, so spray with a crosswind and always orient nozzles and deflectors to direct the spray into canopies, not over them.

Spray can be applied at the high end of this scale by using:

- Drift-mitigating nozzles
- Larger droplets
- Slower forward speeds

- Shrouds or deflectors and/or
- By reducing the distance to the target.

2. Temperature and Relative Humidity

Spray when temperatures are low and relative humidity is high. In general, do not spray when relative humidity is less than 40 per cent and air temperature is above 25°C. This reduces the chance of drift due to temperature inversions or evaporation. It also increases target deposition and coverage.

Hot and dry conditions increase drift because droplets rapidly evaporate and become fine droplets, vapor or particles of concentrated pesticide. Few countries specify optimal temperature or relative humidity because several other factors affect drift and on-target deposition. These factors include formulation, spray method, and droplet size.

Optimum spraying conditions are early mornings following overcast nights. However, the best time to spray to avoid disrupting bee activity is evening or at night.

Table1. Wind Conditions and Spraying Recommendation

Wind Condition	**Description**	**Wind Speed / Beaufort at Boom-height**	**Visible Signs**	**Spraying**
Still	May lead to vapor drift where finer droplets remain suspended in the air, prone to evaporation and drift long after spraying is completed	0–2 km/h	Still	May lead to vapour drift where finer droplets remain suspended in the air, prone to evaporation and drift long after spraying is completed
Gusty	These conditions make wind direction unpredictable and may indicate an inversion	Not applicable	Direction keeps changing	Do not spray
Light air	Suitable conditions	2–3.2 km/h	Light air	Suitable conditions

Light to gentle breeze	Ideal conditions	3.2–9.6 km/h	Light to gentle breeze	Ideal conditions
High	Higher wind speeds pose the most obvious risk of drift through, around or over target	9.6–14.5 km/h	High	Higher wind speeds pose the most obvious risk of drift through, around or over target

3. Precipitation

Rain can have both a positive or negative effect on spraying. Some products work best when rain water carries them into the soil after application, but not far enough to enter the water table before they do their work and break down. Depending on the rain-fastness of the product, rain soon after application may also wash the product from leaves and reduce the level of protection. While rain can also redistribute certain products over the target, do not rely on this for distribution.

Monitor weather forecasts and understand the impact on the product being applied.

Avoid spraying when foliage is still wet from rain or dew unless indicated by the label. A leaf can retain only a limited volume of spray, and therefore a limited amount of product.

Once wetted, deposition will not increase beyond the tank concentration and the surplus will run off to the lower leaves and onto the soil.

Self-Check – 5	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Write temperature effects on chemical application.
2. List metrological condition of chemical application?
3. Hot and dry conditions increase drift why?

Test II: say true or false

1. Rain can have both a positive or negative effect on spraying.
2. Products work best when rain water carries them into the soil after application.
3. Depending on the rain-fastness of the product, rain soon after application may also wash the product from leaves and reduce the level of protection.
4. Rain can also redistribute certain products over the target.
5. Monitor weather forecasts and understand the impact on the product being applied.
6. Wind direction determines whether droplets travel toward the target.
7. Spray only when wind direction is consistent and between 2–15 km/h.
8. Avoid spraying when foliage is still wet from rain or dew unless indicated by the label.

Note*:* Satisfactory rating - 20 points Unsatisfactory - below 20 points

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

Information Sheet 6- Conducting chemical application

6.1 introduction

Pesticide application refers to the practical way in which pesticides (including herbicides, fungicides, insecticides, or nematode control agents) are delivered to their biological targets (e.g. pest organism, crop or other plant).

6.2 pesticide Application Techniques

The e methods used to apply agricultural chemicals on crops and herbicides on weed s or on soil are known as application techniques.

Appropriate dosage and even distribution of spray droplets on a target area are of paramount importance.

Chemicals are used in doses ranging from 100 g or less to as high as a few land kg ha-1. Carriers or diluents are mixed with chemicals to ensure even distribution. The most important diluent-carrier is water.

When used as a pesticide carrier, its volume should be varied with the method of application.

The efficacy of a pesticide in any application technique is mainly influenced by the following three factors:

- Mean level of deposit (dosage): This refers to the total amount of toxicant (active ingredient) used in treating a unit of the target area;
- Distribution of deposit: The surface of the leaf may be completely covered by a chemical (active ingredient) deposit in the case of runoff (high volume) spray, but the deposit may be unevenly distributed; and
- Wetting agents tend to decrease droplet size and increase spreads, and low-volatility carriers help prevent the evaporation of small droplets (low and ultra-low volumes) and ensure better distribution

6.3 Pesticide Selection

The most important step in pesticide safety is its proper selection. First of all, the pest problem must be correctly identified. Control measures need not be taken if the pest is not of economic importance. Once economic damage due to a pest has been established, the appropriate pesticide and method of treatment can be chosen. Buying an excess of pesticide should be avoided.

6.4 Handling and Mixing

The following safety guidelines should be followed while handling pesticides:

- Read the label on the pesticide container and leaflet carefully and follow the instructions therein.
- Make the calculations required for dilution.
- Obtain the application equipment required, including personal protective devices.
- Never work alone when handling highly toxic pesticides.
- Never leave pesticides unattended; children or animals may be affected.
- Mix chemicals in the open or in a well ventilated area.
- Measure and mix quantities accurately.
- Never eat drink, smoke, rub eyes or face while working with pesticides.
- Do not use the mouth to siphon a pesticide from the container

6.5 Spraying chemicals

- **Spraying procedures**

To avoid contact with the spray, the drift operator must walk progressively up-wind across the field through non treated crops. The sprayer is held either with the handle across the front of the operator's body or over his shoulder, with the disc above the crop pointing downwind. The spinning disc is normally held 1 m above the crop. It may be necessary to hold it lower while spraying the first swath along the leeward side of a field in order to reduce the chemical's drift outside the treated area.

- **Safety during application**

This reduces risk and prevents pollution. It also ensures safety to animals, which may be nearby.

The following precautions may be taken while applying pesticides

- Wear clothing and use equipment that is protective.
- Spraying should be done in the windward direction, taking care to see that there are no animals, people, or animal feed nearby.
- Apply the correct dosage. Do not use higher dosages than recommended.
- Do not blow, suck or apply the mouth to any sprayer nozzle or other spraying equipment.

- Check the sprayer and spraying equipment for leaks before use. Use properly maintained and functioning equipment.
- If any irregular symptoms are noticed during application, medical attention should be sought immediately

Self-Check – 6	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Write correct use of chemicals.
2. List chemical spraying procedures.

Test II: say true or false

1. Apply the correct dosage.
2. Wear clothing and use equipment that is protective.
3. Spraying should be done in the windward direction.
4. Taking care to see that there are no animals, people, or animal feed nearby.
5. Do not use higher dosages than recommended.
6. Do not blow, suck or apply the mouth to any sprayer nozzle
7. Check the sprayer and spraying equipment.
8. Operator must walk progressively up-wind across the field through non treated crops.
9. Make the calculations required for dilution.

Note*:* Satisfactory rating - 20 points Unsatisfactory - below 20 points

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

Information Sheet 7- Dealing Chemical spills or accidents

7.1 Introduction

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.

A spill is defined as an uncontrolled release of a chemical.

7.2 Types of spill

Spills can be categorized into two types:

1. Major spills

2. Minor spills

- Major spills meet these criteria:
  - ✓ There is fire or potential for fire or explosion.
  - ✓ The spill poses an immediate danger to life or health.
  - ✓ There are injuries requiring medical attention.
  - ✓ You do not know the properties or hazards of the spilled material
  - ✓ Major spills require an external emergency response, i.e. Winnipeg.
- Minor spills are spills that do not meet the criteria of a major spill and can normally be dealt with by University personnel. Environmental Health and Safety (EHS) can provide technical advice or onsite assistance.

If a spill occurs:

- Don’t panic.
- Assess the situation. Staff involved in a spill will need to use their best judgment in determining whether the spill is major or minor.

7.3 Manage spills

Manage spills by applying the following the three Cs

1. CONTROL the spill

2. CONTAIN the spill

3. CLEAN UP the spill.

- CONTROL the spill

Controlling the spill involves two primary activities:

1. **Isolate the spill**. This involves protecting people and animals in the immediate spill area and could include the following:
   - ✓ wear PPE and work up-wind of the spill
   - ✓ evacuate non-essential persons from the immediate area of the spillage, keep bystanders away (for example, rope off the area)
   - ✓ ensure that the spill site is not left unattended
   - ✓ Notify relevant supervisors and/or authorities (for example, police if spill is on a public road)
   - ✓ Keep flames away from spill area.
2. Take immediate steps to control the flow or spill at its source. This could include the following:
   - ✓ Close valves and turn off pump
   - ✓ Manage leaking containers by either positioning container to minimize further spillage or decant leaking containers into suitable temporary container.

- CONTAIN the spill

Containing the spill involves minimizing the spread of spill any further environmental contamination. This could include the following:

- ✓ blocking drains with plastic, sand dykes.
- ✓ using absorbent material or soil to stop further flow.
- ✓ Using a shovel or other equipment to dig a temporary containment trench (especially if waterways are threatened).

- CLEAN-UP the spill

Cleaning up the spill involves two primary activities:

1. Removing the spilled product from the site. This could involve the following steps:
   - ✓ in the case of liquids, using absorbent material to soak up excess spillage
   - ✓ in the case of dry chemical spill, minimizing dust drift by slightly wetting (if appropriate) or covering with plastic sheeting
   - ✓ shoveling contaminated material into drums or heavy duty plastic bag (whichever is appropriate)
   - ✓ Disposing of contaminated materials at an approved site.
2. Decontamination of the site. This can include:

- ✓ Decontamination of the spill site using appropriate neutralizing agents. It may be necessary in some cases to either remove soil or dilute traces of concentrates if appropriate
- ✓ Decontamination of cleanup equipment. Any absorbent materials such as rags and mops should be disposed in the same manner as the spillage material
- ✓ Decontamination of PPE and persons involved in the clean-up.

7.4 Spill report/investigation

Major spills require an incident investigation to be conducted by the supervisor. Major spills meet the Province's criteria for a "Serious Incident" and the local area safety and health committee (LASHC) co-chairs or their designate are required to investigate. EHS staff will be available to assist in the investigation.

Minor spills must be reported in writing to EHS within one working day of the occurrence. This report must contain the date, time, location, names of persons involved, material spilled and volume, as well as a detailed description of the incident and any corrective actions taken.

Self-Check – 7	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Write importance of spill control.
2. Write three Cs.

Test II: say true or false

1. Spill is difficult to control.
2. Minor spills must be reported in writing to EHS.
3. Report must contain the date, time, location, names of persons involved, material spilled and volume.
4. Major spills require an incident investigation to be conducted by the supervisor.
5. Decontamination of the spill site using appropriate neutralizing agents.
6. Decontamination of cleanup equipment.
7. Decontamination of PPE and persons involved in the clean-up.
8. Disposing of contaminated materials at an approved site.
9. shoveling contaminated material into drums or heavy duty plastic bag

Note*:* Satisfactory rating - 20 points Unsatisfactory - below 20 points

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

Operation sheet 1– Calibration of knapsack sprayers

Materials, tools and equipment's

- String
- Stop watch
- Bucket
- Sprayer

Procedures

a. Rinse and clean the sprayer.

b. Determine nozzle discharge (by selecting a nozzle) in L min-1 at known pressure (V).

c. Calculate the walking speed of the operator (starting point, end point) in M min-1(L).

d. Determine the width of the spray swath in meters (W).

e. Calculate the area sprayed in one minute (W x L) M2 min-1

Area sprayed min-1 = Swath width of spray x Forward speed min-1

f. The application rate for any given area:

Lap Test	Demonstration

Name……. ID……..

Date…….

Time started: _____ Time finished: _____

Instructions: perform calibration.

LG #54	LO # 6 - Ensure personnel are adequately trained in chemical use
Instruction sheet	

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

- Providing training to personnel handling or using chemicals
- Organizing external training and assessment opportunities

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

- Training is provided to personnel who handling or using chemicals.
- External training and assessment opportunities organise for staff involved in using chemicals.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Providing training

1.1. Introduction

A written pesticide safety training program is required for training employees who handle pesticides and fieldworkers who enter treated fields. The training program must be presented by a qualified individual annually to pesticide handlers and fieldworkers.

Training the staff on the safe and effective use of pesticides is one of the market requirements. It's a requirement by regulatory bodies around the world. For example, in Kenya, exporters of horticultural produce cannot be issued with an export license unless they demonstrate that, they have trained their staff on the safe use of pesticides.

1.2. Pesticide safety training

- A written pesticide safety training program is required for training employees that handle (mix, load, apply, etc.) pesticides and for fieldworkers who may enter treated fields.
- For pesticide handlers, the pesticide safety training program must meet the requirements set. When pesticides are used for research or commercial production of an agricultural plant commodity, a qualified trainer must provide the training.
- For fieldworkers, the pesticide safety training program must meet the requirements set. A qualified trainer must provide the training for fieldworkers.
- A trainer is qualified to provide pesticide safety training.
- Chemical applications.
- Health and safety issues, employment conditions, reporting structure, maintenance of spray equipment
- Conducting and recording environmental risk assessment.
- Pesticide application techniques for different pest control situations,
- Safe use of pesticides

Self-Check – 1	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. List pesticide training criteria's.

Test II: say true or false

1. A written pesticide safety training program is required for training employees who handle pesticides.
2. A trainer is qualified to provide pesticide safety training.
3. A written pesticide safety training program is required for training employees
4. For pesticide handlers, the pesticide safety training program must meet the requirements set.
5. When pesticides are used for research or commercial production of an agricultural plant commodity, a qualified trainer must provide the training.
6. For field workers, the pesticide safety training program must meet the requirements set.
7. A Conducting and recording environmental risk assessment.
8. Qualified trainer must provide the training for fieldworkers.
9. Conducting and recording environmental risk assessment.

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

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

Information Sheet 2- Organizing external training and assessment opportunities

2.1 Introductions

External training includes: 'open' programs, where one or more of your staff attend training that has been advertised. Closed programs, where you commission training to be delivered specifically for your staff.

2.2 External training

If your staff need formal training (e.g. for work that requires a licence or certificate), but you don't have the time or resources to offer the training yourself, you may consider using an external training provider.

External training should be run through a registered training organization. Training is typically at the organization's premises in a classroom setting. You can also hire external training providers to conduct in-house training at your business, or offer your staff online training through an external organization.

External training includes:

1. Introduction to chemical safety and chemicals used in the workplace.
2. Relevant chemical legislation and duties of key participants.
3. Global Harmonized System (GHS) classification and labelling system.
4. The potential risks associated with each hazard class.
5. Routes of exposure.
6. Signs and symptoms of exposure to chemicals.
7. The current controls in place to protect the health and safety of employees i.e. engineering controls.
8. Segregation and storage of chemicals.
9. Use of personal protective equipment and other safety equipment such as ventilations systems.
10. Identifying key information from the safety data sheets. Safety data sheets are a useful tool to use during Chemical Safety training as they cover hazards, information on safe handling and emergency procedures.

11. Procedures to be followed in the event of an accident or an incident. Including, accident and incident reporting procedures.

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. List external training facilities.

Test II: say true or false

1. External training includes: 'open' programs, where one or more of your staff attend training that has been advertised.
2. Identifying key information from the safety data sheets.
3. Safety data sheets are a useful tool to use during Chemical Safety training.
4. The current controls in place to protect the health and safety of employees.
5. External training should be run through a registered training organization.
6. Training is typically at the organization's premises in a classroom setting.
7. External training providers to conduct in-house training at your business.

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

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

LG #55	**LO #7 - Implement recording systems for chemical storage and use**

Instruction sheet

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

- Complying chemical use records
- Reordering risk assessment and control strategies
- Implementing Clean up procedures

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

- Records comply with legislation and regulations surrounding chemical use.
- Risk assessment and control strategies recorded in accordance with requirements.
- Clean up procedures implemented following chemical applications..

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the “Information Sheets”. Try to understand what are being discussed. Ask your trainer for assistance if you have hard time understanding them.
4. Accomplish the “Self-checks” which are placed following all information sheets.
5. Ask from your trainer the key to correction (key answers) or you can request your trainer to correct your work. (You are to get the key answer only after you finished answering the Self-checks).
6. If you earned a satisfactory evaluation proceed to “Operation sheets
7. Perform “the Learning activity performance test” which is placed following “Operation sheets” ,
8. If your performance is satisfactory proceed to the next learning guide,
9. If your performance is unsatisfactory, see your trainer for further instructions or go back to “Operation sheets”.

Information Sheet 1- Complying chemical use records

1.1 Introduction

By law, the use of agricultural or veterinary chemical products must be recorded.

Accurate records are important because they provide a level of protection if something goes wrong. Records can show that, before applying the chemical, you:

1. Assessed the risks
2. knew the application rates
3. checked the wind speed
4. understood the withholding periods

Chemical use records can also improve your operation, and save you time and money. Previous records can be used to inform resistance management, the quantity of chemical product needed for future applications, and overall effectiveness of your chemical use practices

1.2 Agricultural chemical use records

The following records must be made within 48 hours of using an agricultural chemical product:

- Product trade name
- Date the product was used
- Application rate of the product, or enough information to calculate application rate
- Crop or commodity that was treated or the situation in which the product was applied
- Specific location where the product was used
- Wind speed and direction at the time and location of application (if spraying outdoors)
- Name and contact details of the applicator
- Name and contact details of the supervisor (if applicable)
- Name and contact details of person for whom the application was carried out (if applicable).

You must keep these records for two years from the date of use.

You don't need records of use for the following products and uses:

- household or home garden products available from retail outlets that are applied by hand or via a hand-operated device

- agricultural chemical products used to clean a swimming pool or a spa
- Licensed pest controllers who use agricultural chemical products in non-agricultural situations.

Self-Check – 1	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. List chemical recording details

Test II: say true or false

1. Chemical use records can also improve your operation, and save you time and money.
2. Chemical use records can improve your operation.
3. Agricultural chemical products used to clean a swimming pool or a spa.
4. Licensed pest controllers who use agricultural chemical products in non-agricultural situations.

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

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

Information Sheet 2- Reordering risk assessment and control strategies

2.1. Introduction

There is as much risk associated with the use of agrochemicals as the benefits. First and foremost is the harm they cause to humans and the environment. Use of pesticides in agriculture is inevitable as discussed previously. However, their non-judicious use is posing a great risk to human health as well as the environment. The pesticide molecules are inherently toxic. And most of them are broad-spectrum in nature resulting in the emergence of resistant species. Hence it is essential to develop molecules with selective toxicity. Instead, their biological counterparts need to be discovered and applied to alleviate the toxic effects. Farmers need to be educated on the need-based application of agrochemicals to promote discriminate use of these chemicals.

2.2. Assessing risk

A risk assessment is based on information supplied on the label and/or MSDS, and involves an inspection of the actual work location and work practices. In some situations it may be necessary to obtain specialist advice.

This code will help you examine the work practices related to storage, handling and use and then estimate the risk to employees and other persons, property and the environment.

Review risk assessments when:

- Work practices change
- A new chemical is introduced
- When an updated MSDS is produced by the supplier
- Need is indicated by adverse results of health surveillance or monitoring
- Five years has elapsed since the last assessment (check that you have the latest MSDS)

2.3. Risk control strategies

Four basic strategies:

1. Apply safeguards that eliminate the remaining uncontrolled risks for the vulnerability [Avoidance]
2. Transfer the risk to other areas (or) to outside entities[transference]
3. Reduce the impact should the vulnerability be exploited[Mitigation]

4. Understand the consequences and accept the risk without control or mitigation[Acceptance]

1. Avoidance

It is the risk control strategy that attempts to prevent the exploitation of the vulnerability, and is accomplished by means of

- countering threats
- Removing Vulnerabilities in assets
- Limiting access to assets
- Adding protective safeguards.

Three common methods of risk avoidance are

1. Application of policy
2. Application of Training & Education
3. Application of Technology

2. Transference

Transference is the control approach that attempts to shift the risk to other assets, other processes, or other organizations.

It may be accomplished through rethinking how services are offered, revising deployment models, outsourcing to other organizations, purchasing Insurance, Implementing Service contracts with providers.

3. Mitigation

It is the control approach that attempts to reduce the impact caused by the exploitation of vulnerability through planning & preparation.

Mitigation begins with the early detection that an attack is in progress and the ability of the organization to respond quickly, efficiently and effectively.

Includes 3 types of plans

a. Incident response plan (IRP) - Actions to take while incident is in progress
b. Disaster recovery plan (DRP) - Most common mitigation procedure.

c. Business continuity plan (BCP) - Continuation of business activities if catastrophic event occurs.

4. Acceptance

It is the choice to do nothing to protect a vulnerability and do accept the outcome of its exploitation.

This strategy occurs when the organization has:

- Determined the level of risk.
- Assessed the probability of attack.
- Estimated the potential damage that could occur from attacks.
- Performed a thorough cost benefit analysis.
- Evaluated controls using each appropriate type of feasibility.
- Decided that the particular function, service, information, or asset did not justify the cost of protection.

Self-Check – 2	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. List common methods of risk avoidance

_____

_____

_____

2. List three types of plan

_____

_____

_____

Test II: say true or false

1. A risk assessment is based on information supplied on the label and/or MSDS
2. Acceptance is the choice to do nothing to protect a vulnerability and do accept the outcome of its exploitation.
3. Mitigation is the control approach that attempts to reduce the impact caused by the exploitation of vulnerability through planning & preparation.
4. Transference is the control approach that attempts to shift the risk to other assets, other processes, or other organizations.

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

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

Information Sheet 3- Implementing clean up procedures

3.1. Introduction

Cleaning pesticide application equipment is necessary and worthwhile. The risk from not cleaning your spray equipment is reason enough to take the time to do it right. Even a trace of leftover chemical sprayed on a different crop can cause severe damage**.**

3.2. Cleaning pesticide application equipment

When cleaning spray equipment, it is just as important to protect yourself from pesticide exposure as it is to protect the crops you are spraying. Determining what personal protective equipment (PPE) wearing when cleaning equipment is simple. Read the PPE statement on the label of the product you are cleaning out. At the very least, wear the PPE required by the label. In addition, wear a chemical-resistant apron, eye protection, pesticide-resistant gloves, and any other appropriate PPE.

Places where residues hide

Because sprayer systems are complex, pesticide residues can accumulate in many places. Places in a system that tend to collect the most residues include:

- Spray tanks
- Sumps and pumps
- Around baffles
- Hoses
- Valves
- Booms
- Screens
- End caps
- Nozzles

Cleaning Procedures

The following is a general set of guidelines to clean a sprayer system. If this contradicts label instructions for a given pesticide, always follow the label's instructions instead. The label is the law.

Step1. Clean booms after each use.

Some pesticide formulations can settle inside spray equipment very quickly, which can make cleaning much more difficult. To avoid cleaning difficulties, it is important for handlers to clean out sprayer booms every single day the sprayer is used. This prevents chemicals from penetrating plastic or getting cemented to the inner surfaces of equipment. Never allow the spray solution to remain in the boom lines overnight prior to flushing. Hoses can become contaminated. Use oil-resistant hoses on sprayers. Remove end caps after the nozzles and screens have been flushed to further help clean out the spray booms.

Step 2 Rinse sprayers the first time in the field

Because of the high concentration of residue still in the system during the first rinse, it is wise to perform this first rinse at the original application site. Use 10 percent of the tank's water capacity to rinse. Agitating the rinse water is helpful in freeing any residue. A pressure washer can make this rinsing more effective. Be sure to open all valves to ensure every part of the system is rinsed on the first flush. Run water through the system for at least five minutes. Doing this by boom section makes it easier to check for plugged nozzles.

Apply the contaminated rinse water to the outer rows of the field you treated. Check to make sure that these outer rows are not near susceptible vegetation. It is up to the handler's judgment as to where to clean other parts of the system and dispose of that rinse water. Alternate the places to spread rinse water and avoid having pesticide residues concentrated in one spot. Avoid contaminating other water sources such as lakes and streams.

Rinse can also be used as a diluent for future pesticide mixtures if: the pesticide in the rinse is labeled for use on the target site where the new mixture is to be applied, the rinse is used to dilute a mixture containing the same or a compatible pesticide, and the amount of pesticide in the rinse, plus the amount of pesticide product in the new mixture, does not exceed the label rate for the target site.

The rinse cannot be added to a future pesticide mixture if: the rinse contains strong cleaning agents, such as bleach or ammonia, that might harm the plant, animal, or surface

where the rinse will be applied, or the rinse would alter the pesticide mixture and make it unusable.

Step 3 Clean all screens.

The screens in a sprayer system collect solids and semisolids (e.g., gooey pesticide residue), so clean them to prevent clogs in the line. Dirty screens can negatively affect sprayer performance. Removing and cleaning these screens is a very important step in cleaning the system. Dirty screens can continually re contaminate the rest of the system. Clean with a brush and hot soapy water. Rinse it is also important to clean the filter housings, where residues can also build up. After cleaning, put screens back in the system, except nozzle screens; these should be left off until the end.

Step 4 Clean the end caps and rinse a second time

The space between the last nozzle and the very end of the boom is called an end cap. This is yet another essential part of a sprayer to thoroughly clean. There are two end caps on each section of the boom sprayer. If the sprayer does not have end caps, you need to install them in order to adequately clean the booms. Remove the end caps and scrape the residue off with a brush, using tank cleaner and water. Put one end cap back on each section of the boom to prepare for the second rinse cycle. The rings on end caps break easily, so watch for rings that need replacing.

Circulate water through the system a second time. With one end cap in place on each boom section, flush each section, one at a time, so there is enough water pressure and volume to properly rinse the boom. Once a section is rinsed, put the missing end caps back on and move to the next section. Remove the end caps that were attached previously. Rinse again. After all sections have been rinsed, put all end caps back in place.

Step 5 Add tank cleaner

Commercial tank cleaners neutralize and loosen chemicals that remain in spray equipment; use them only after the first two thorough rinses. Tank cleaners should not be expected to do the bulk of the cleaning, but rather to manage remaining traces of pesticide. Cleaners typically have a high pH level, which counteracts the acidity of many pesticides. There is some doubt about the effectiveness of ammonia or bleach as tank

cleaners. However, some pesticide labels may specify using ammonia or bleach to clean a tank. If so, do not use both at the same time. When bleach and ammonia mix, they generate toxic chloramine vapor. Many pesticide labels offer suggestions on what commercial tank cleaners to use. For more information about specific cleaners to use with specific herbicides, see the “Recommended Cleaning Agents for Selected Herbicides” table in the Guide for Weed, Disease, and Insect Management

Put water in the tank first. Add the cleaner next. The rate of cleaner to be used is usually expressed as pints or quarts per 100 gallons of water and can be found on its label. Once this mixture is in the tank, turn on the agitation and circulate the cleaning solution throughout the system.

Most tank cleaner labels will list an amount of time that the cleaner needs to successfully neutralize the chemicals. The longer the solution is in the system, the better. In fact, letting it sit overnight is perfectly acceptable. Once you decide the cleaner has had ample time to do its job, proceed with Step 6.

Step 6 Perform final system flush

Thoroughly flush out the system with clean water. You can also use a tank mix surfactant or a fertilizer additive to remove residues that commercial cleaners can miss.

Step 7 Wash up

After you are completely finished with the process of cleaning your spray equipment, do not come into contact with other people. Do not eat, drink, chew gum, use tobacco, or use the bathroom until you and your clothing are properly cleaned. Wash gloves thoroughly before removing them. Remove outer clothing outdoors, then immediately shower. Wash the clothes you wore separately from any other clothing. After removing the clothes, run the empty machine with the hottest water available and detergent, on the longest cycle to completely cleanse it. Safely discard any clothing that is heavily contaminated.

Cleaning Backpack Sprayers

Cleaning backpack sprayers is much different from cleaning a field rig. Backpack sprayers are far smaller in size with a lot less plumbing to hide pesticide residues. Thus, they are

much easier to clean. In fact, cleaning a backpack sprayer is a lot like rinsing a pesticide container. Rinse out the tank thoroughly and then spray the rinse from the sprayer onto the site of application. When applying the rinse, do not exceed the legal amount of pesticide that may be applied to a given area. Repeat this procedure for a total of three rinses. For the second rinse, consider using a commercial tank cleaner to make a solution that will more effectively remove residues. See the pesticide label for recommended cleaning agents. Another source is the Guide for Weed, Disease, and Insect Management in Nebraska, EC130. Allow the solution to sit for the amount of time listed on the label of the cleaning product. Rinse a third time with only water. After the third rinse, the sprayer should be sufficiently cleansed to be used with a different product.

Winterizing Sprayers

Tank and Pumps: To begin the process of winterizing the sprayer, add a solution of 50 percent automotive antifreeze and 50 percent water to the empty tank. RV antifreeze is nontoxic but is harder on pumps and seals. If you choose to use RV antifreeze, do not add water. Turn off all the boom sections, turning on the pump and master spray switch. If the sprayer is a backpack sprayer, pump the solution through the system and collect it after it comes out of the nozzle. Likewise, with a field sprayer, run the solution through the entire system for at least five minutes. Do not allow the antifreeze solution to fall on the ground. Drain any and all accessory tanks and lines. Keep in mind that the solution can usually be reused for two years after the first use, a total of three uses. Make sure the antifreeze does not become diluted. Using compressed air, blow any remaining liquid from the sprayer lines. Open, drain, and clean the mixing chambers. Some pumping systems have a drain plug within the pump housing that can be used to drain the pump.

Spray boom: begin by taking the boom feed hoses off of the boom section valves. Thoroughly flush all the boom sections with compressed air through the feeder hose and out the nozzles until dried. Take off the nozzle tube end plugs and blow out any water left in the boom. Once dry, clean out any and all boom section filters. Remove screens and nozzles and store them in a lightweight oil such as vegetable oil, kerosene, or diesel fuel during the winter. Plug any open assemblies. Check to see if the boom is dry. Apply vegetable oil to O-rings and reinstall. All gauges should be removed and stored indoors

upright so they do not freeze. Plug these open assemblies also. This will help the remaining antifreeze prevent any freezing/cracking of boom lines. The stainless steel plungers in solenoid valves come in contact with the spray solution. Apply lithium grease on solenoid switches and relays. This will prevent rust and sticky valves during the winter months. Always store spray equipment indoors when possible.

Self-Check – 3	Written test

Name…… ID…… Date…….

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

Test I: give short answer

1. Write importance of equipment cleaning.
2. _____begin by taking the boom feed hoses off of the boom section valves.

Test II: say true or false

1. Cleaning pesticide application equipment is necessary and worthwhile.
2. To begin the process of winterizing the sprayer, add a solution of 50 percent automotive antifreeze and 50 percent water to the empty tank.
3. The rinse cannot be added to a future pesticide mixture if: the rinse contains strong cleaning agents.
4. Check to see if the boom is dry.
5. All gauges should be removed and stored indoors upright.
6. The stainless steel plungers in solenoid valves come in contact with the spray solution.
7. Apply lithium grease on solenoid switches and relays.
8. Always store spray equipment indoors when possible.

Note*:* Satisfactory rating - 20 points Unsatisfactory - below 20 points

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

Operation sheet 1–Cleaning the sprayer tank

Objectives:

- To clean tanks

Tools and equipment's

- Water
- Detergents
- PPE
- Sprayer etc.

Procedures:

1. Drain the tank and rinse
2. Fill the sprayer tank
3. Add cleaning solution and mix
4. Leave sprayer for 8 hours
5. Clean nozzles, screens, and filters
6. Flush solution through
7. Rinse entire system

Lap Test	Demonstration

Name…… ID……..

Date……

Time started: _____ Time finished: _____

Instructions: perform sprayer tank cleaning

Reference Materials

Book:

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