This training course on Responsible Use of Pesticides has been prepared by CropLife International. It consists of 20 sessions that can be given altogether in seven days or, spread over a longer time as needed:

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REMEMBER - GOOD PREPARATION WILL TAKE YOU MORE THAN HALF WAY TO ACHIEVING A SUCCESSFUL COURSE.
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<tr>
<th>Training Session:</th>
<th>Name</th>
<th>Organisation</th>
<th>Location</th>
<th>Telephone Number</th>
<th>Assessment Mark</th>
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INTRODUCTION
Objectives of the Course

The overall objective of this course is to enable participants to understand the underlying concepts and principles of the Responsible Use of Pesticides. The course is designed to be used in any area or region. In developing Responsible Use knowledge among the participants, course activities do not use crop examples from specific areas, but rather call on participants to select their own crops and situations as a basis for the activity. To help the Facilitators, some examples are given as background and as supporting material.

The main target groups of the course are advisors, farm personal, extensions and any other professionals involved in pesticide management.

There will be different levels of knowledge among the participants. However, it is assumed that many will have only a vague idea of what Responsible Use is. Because practical and effective Responsible Use can have many interacting factors, the course is designed to take participants slowly through the explanations of Responsible Use principles and concepts. For this reason, several interacting topics may be introduced in a basic way in one session, and then further developed as individual topics in later sessions.

Course Duration and Location

The full course takes 7 days (at 4 training hours per day). Many participants may find it difficult to attend for this length of time. In this case, the course can be spread over a longer period of time, such as one or two sessions in a morning, afternoon or evening over several weeks. This will need to be decided based on the needs of the participants prior to the course. If this schedule is followed, the introductory activity of each session will be important as a reminder of the results and conclusions of the previous session.

A suitable venue should be selected for the course. The facilities available at the venue will partly depend on how the course is to be held in terms of timing of the sessions. More facilities in terms of refreshments, and perhaps accommodation, will be needed if the full course is to be held in one instance.

Training Method

The training method is participatory, and the role of the facilitator is to create the conditions within the sessions that assist this type of learning. For the course to be effective it is essential that the facilitator has the necessary participatory training skills and experience.

Since the training is participatory, not more than 30 farmers should attend each session, otherwise applying effective adult learning methodology will prove difficult.

Facilitator and session activities are specified during each session plan. This is deliberate, and does not question the skills or experience of the facilitator. Activities are specified in this way so as to take course participants step-by-step through course topics. Facilitators are free to adjust activities to a certain extent depending on their knowledge and experience, and of local circumstances.

The training room should be laid out either with individual participant chairs or tables in a U-shape, or with 3-4 tables in a semi-circle around the main flipchart, with 4-5 participants per table. The room should be large enough for participant groups to work separately and without disturbing each other in group activities; otherwise an additional room will be needed.
Course Participant Evaluation

The facilitator can apply the assessment questions at the end of each session to assess their knowledge after receiving the training. Alternatively, the facilitator can leave these questions at the very end of the course. In this case, it is recommended to apply a pre-course evaluation to measure the participant knowledge prior the course that consists of at least 25 questions selected from the assessment questions given in each sessions. These same 25 questions should be given to the participants as a post-course evaluation so the facilitator can see how the participant knowledge has change.

Preparation of Training Notes, Visual Aids and Training Equipment

After the facilitators have met together and agreed on “who does what”, individual facilitators can begin preparation of their training sessions, referring to the Trainers Manual, the handouts included with each session, and any other material as needed.

Flipcharts should be prepared of the objectives of each session, to be used in the session introduction, and referred to at the end of the session. Also, where presentations are made it is useful to pre-prepare flipcharts with the main points that can be referred to during the presentation.

Activity Times

The times given for each activity of a session are indicative, and are given to help the Facilitators when planning and running the session. However, they are not fixed, and it may be found that with a more knowledgeable group of participants some of the activities may be completed in less than the indicated time. Conversely, on occasion more time must be allowed in order for participants to thoroughly cover the topic.

Participants

Participants should be notified at least four weeks before the start of the course. At this time they should receive detailed joining instructions:

• The course location and venue
• The dates of the course, and the date/time when they should arrive at the venue
• An outline of the course and its objectives
• Information on accommodation, if this is to be provided.
• Any costs they may have to bear.

Participant Details

At the end of the Course Introduction, a Handout is distributed for participants to fill out their contact details. These should be returned to the facilitator as soon as possible. The facilitators should prepare a single list of the information, and make sufficient copies to be distributed to all participants on the last day of the course.

This contact list is intended both for the facilitator’s record of participant attendance, and for networking between Trainers and participants following the course.
Checklist of Training Materials Required

1. Trainers manual and notes
2. Handbook on the Principles of IPM
3. Flipcharts
4. Marker pens
5. Masking tape
6. Cards
7. Glue sticks
8. Block notes
9. Pens/Pencils
10. File covers
11. Selection of pesticide containers/different types of formulations of each hazard classification
12. Selection of labels of each hazard classification
13. Selection of pesticide data sheets/technical leaflets
14. Rubber gloves and other personal protective equipment (PPE)
15. Soap/water
16. Examples of different types of hand sprayers
17. Examples of different types of nozzles
18. Selection of illustrations of major insect pests, beneficial insects, diseases, weeds
19. Pest management leaflets/booklets/recommendations
20. Any other suitable leaflets/booklets/recommendations available, e.g. from pesticide companies
21. Scouting booklets, etc.
1. PESTS AND INTEGRATED PEST MANAGEMENT (IPM)
Introduction to the course

Overview of the session
The overall objective of this course is to enable participants to understand the underlying concepts and principles of the Responsible Use of Pesticides. The course is designed to be used in any area or region. In developing Responsible Use knowledge among the participants, course activities do not use crop examples from specific areas, but rather call on participants to select their own crops and situations as a basis for the activity. To help the Facilitators, some examples are given as background and as supporting material.

The main target groups of the course are advisors, farm personal, extensions and any other professionals involved in pesticide management.

There will be different levels of knowledge among the participants. However, it is assumed that many will have only a vague idea of what Responsible Use is. Because practical and effective Responsible Use can have many interacting factors, the course is designed to take participants slowly through the explanations of Responsible Use principles and concepts. For this reason, several interacting topics may be introduced in a basic way in one session, and then further developed as individual topics in later sessions.

Session Objectives
By the end of the session, participants will be able to:
• Describe the overall goals of the training course, including what will be expected of them in completing the course.
• Define what is responsible use of pesticides.

Introduction to the Training Program

OBJECTIVE OF THE PROCEDURE:
• To establish a friendly atmosphere between the participants, and between the participants and the trainers.

Welcome participants to the first session of the training program. Introduce yourself. Allow the participants a few minutes for each person to introduce him/herself as follows:
• Name and occupation
• Place and description of occupation
• Number of years working in this occupation/place
• Their expectations from the course
Overall Training Program Goals and Schedule

OBJECTIVES OF THE PROCEDURE:
To ensure that participants are aware of the objectives of the course, the structure, the schedule, the training methods to be used, and the commitments required from participants.

Refer participants to the overall program goals (bullet 3 below). Say that:
• The course will explain the concepts and principles of Responsible Use of Pesticides relevant to all crops.
• After the course, participants will:
  • Understand the underlying principles and concepts of the Responsible Use of pesticides.
  • Be better prepared should they attend other courses on production of specific crops, and be better able to understand the Responsible Use of pesticides practices implemented in these crops.
  • Be able to discuss and explain Responsible Use of pesticides principles and practices with farmers, and to give practical advice relevant to a farmer’s situation.

Pre-course Evaluation

OBJECTIVES OF THE PROCEDURE:
To evaluate participant’s knowledge of Responsible Use of Pesticides prior to the start of the course.

Explain that before we start the main part of the course, an evaluation of participant knowledge of responsible use of pesticides is useful, both for the trainers to help them conduct the course, and also for the participants to be able to assess their development as a result of the course. Explain also that they will complete a similar evaluation at the end of the course. The papers and results will be returned then.

Previously the facilitator would have been selected 25 questions from the assessment questions (see Course Participant Evaluation) which will distribute to the participants now as a hand out.

The evaluation consists of 25 multiple choice questions. Ask the participants to put a tick or cross in the box next to what they think is the correct answer to the question.

Allow 20 minutes for the participants to complete the evaluation, then collect the papers. Make sure that the participants have written their names on the papers.

Mark the papers as soon as you have some free time. Enter the participant names and test results into the table, ready for the post-course evaluation in
Lesson Plan

**Materials needed:**
- Flipchart stand with paper.
- Flipchart paper.
- Markers (4 colours).
- Coloured cards.
- Glue stick or blue tack.
- Masking tape.
- Pin board and pins.

**Time needed:**
70 minutes (if less time, adjust each section accordingly)

**Intended audience:**
Farmers and crop protection product dealers (resellers)

**Preparation:**
- Flipchart on flipchart stand with the title “Pests and Integrated Pest Management (IPM)”, and the Lesson Objectives.
- Print off sufficient Fact Sheets for participants.
- Print off sufficient Assessment question sheets.
- Print off sufficient Attendance Record sheets.
- Organise venue and seating arrangements.

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.

TRAINER NOTE: DO NOT GIVE THE EVALUATION RESULTS, GIVE THE PAPERS BACK, OR TELL PARTICIPANTS WHICH QUESTIONS THEY GOT RIGHT OR WRONG, AS THEY WILL SIT THE SAME TEST AT THE END OF THE COURSE.

PARTICIPANTS WILL RECEIVE THEIR RESULTS AND BOTH SETS OF PAPERS AFTER THE POST-COURSE EVALUATION IN SESSION 11 AT THE END OF THE COURSE
## Pests and Integrated Pest Management (IPM)

**Set up/Introduction**  
5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
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</table>
| **Attention:** | Ask if anyone has had any trouble or damage caused by pests. Allow several participants to answer.  
Explain that in farming much of our time, effort and money are spent controlling pests. The more we know about them, they better we can control them. |
| **Title:**    | Refer to the Title Flipchart and tell participants that this training session will cover *Pests and Integrated Pest Management (IPM).* |
| **Credibility:** | Relate some of your experience with pest control. |
| **Objectives:** | Refer to the Title flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to describe:  
the different types of pests;  
the damage pests cause;  
the techniques for controlling pests;  
the concept of integrated pest management. |
| **Benefits:**  | Understanding pests and the techniques for their control can result in better pest management, reduced losses, and better profits. |
| **Direction:** | During this session we will focus on the different types of pests and how we might control them. |
## Delivery (80-90% of total time)

### Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> 5 minutes</td>
<td><strong>Brainstorming – What is a Pest</strong></td>
</tr>
<tr>
<td>Say</td>
<td>that we need to have a common understanding of what we mean by a pest.</td>
</tr>
<tr>
<td>Ask</td>
<td>participants what do they think is meant by the term ‘pest’?</td>
</tr>
<tr>
<td>Take answers from different participants.</td>
<td></td>
</tr>
<tr>
<td><strong>Summarise</strong> by telling participants that a pest is anything that competes with human beings, their animals or crops for food, water, shelter, or air.</td>
<td></td>
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<tr>
<td><strong>2.</strong> 5 minutes</td>
<td><strong>Brainstorming – Types of Pests</strong></td>
</tr>
<tr>
<td>Say</td>
<td>that pests can be grouped into different categories or types.</td>
</tr>
<tr>
<td>Ask</td>
<td>if they can tell you any of these different pest types.</td>
</tr>
<tr>
<td><strong>List</strong> the answers on the flipchart, (e.g. weeds, insects, molluscs, rodents, etc.). Use <em>Types of Pests</em> in the Fact Sheet as a checklist.</td>
<td>Leave space to write answers from the next activity against each pest type.</td>
</tr>
<tr>
<td><strong>3.</strong> 5 minutes</td>
<td><strong>Brainstorming – Common Pests and Damage Caused by these Pests</strong></td>
</tr>
<tr>
<td>Say</td>
<td>that now we have a list of different pest types, can participants name some common pests from each group</td>
</tr>
<tr>
<td><strong>List</strong> the answers of common pests on the flipchart against the relevant pest type.</td>
<td></td>
</tr>
<tr>
<td>Ask</td>
<td>what damage do these common pests cause?</td>
</tr>
<tr>
<td><strong>4.</strong> 10 minutes</td>
<td><strong>Discussion – Monitoring Pest Populations</strong></td>
</tr>
<tr>
<td>Ask</td>
<td>participants if they have noticed that in the same crop or situation there are different pests at different times and that their numbers change.</td>
</tr>
<tr>
<td>Ask</td>
<td>participants to give examples from their own experience.</td>
</tr>
<tr>
<td>Ask</td>
<td>how this could be important to pest management.</td>
</tr>
<tr>
<td><strong>Take</strong> answers from participants, and then</td>
<td></td>
</tr>
<tr>
<td><strong>Explain:</strong></td>
<td></td>
</tr>
<tr>
<td>• how pest populations and numbers change,</td>
<td></td>
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<tr>
<td>• that if we monitor pest populations and numbers we will have information to help us manage pest levels,</td>
<td></td>
</tr>
<tr>
<td>• with this information we can take action to minimise pest numbers before they become too high.</td>
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<tr>
<td>5. Work Groups – Methods of Pest Management</td>
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<tr>
<td>15 minutes</td>
<td></td>
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</tbody>
</table>
|  | **Work group task:**  
|  | • List all the ways they know to control pests or manage pest numbers.  
|  | • Write each example on a card.  
|  | Allow 5 minutes for the work group task, and then collect all the cards from each group.  
|  | **Stick** the cards on one or more flipcharts, in vertical groupings of the different control techniques. Use *Ways to Control Pests* in the Fact Sheet as a checklist.  
|  | **Ask** participants:  
|  | • Why they think you have grouped the cards in this way.  
|  | • If they can see similarities between the methods on the cards in each vertical grouping.  
|  | • Based on these similarities, what headings could we put over each grouping.  
|  | As participants give their answers, write the headings over each vertical grouping e.g. Quarantine; Biological; Managerial etc.  

| 6. Discussion – IPM |  
| 10 minutes |  
|  | **Ask** participants:  
|  | • What do they think the term ‘Integrated Pest Management’ or ‘IPM’ actually means.  
|  | • What methods or techniques are used or not used in IPM.  
|  | **List** answers on the flipchart.  
|  | **Summarise** the answers by saying that:  
|  | • There are many different practices that can be included in an IPM programme.  
|  | • Those which are actually used will depend on the crop and pest situation, and also to a certain extent on the farmer’s resources.  
|  | • Pesticides are one of many available methods.  
|  | • IPM uses all available techniques in an overall crop/pest management strategy that minimises the adverse effects of a pest or pests.  

**IPM is the combination of all appropriate practices into a single plan for crop and pest management that optimises input use to reduce pests and damage to an acceptable level, maximise yield, and minimise negative effects.**  

Also  
**IPM principles and practices were used by farmers to manage pests long before synthetic pesticides were available.**  

**Refer** participants to the IPM Circle, which shows all the factors involved in IPM.
## Finish

(10% of time)

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<tr>
<th>Module/Time</th>
<th>Activity</th>
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</table>
| **Summary:** 2 minutes | **Review:**  
- what pests are,  
- the different types of pest groups,  
- the techniques that might be used to control them,  
- the concept of IPM. |
| **Questions:** 1 minute | Ask if everyone understands or if there are any additional questions.  
Answer these questions provided they are relevant. |
| **Evaluation:** 10 minutes | Ask what damage might be caused by weeds, or insects, or plant pathogens, or animal pathogens etc.  
**Hand out** the Assessment Sheet and ask participants to complete two of the questions.  
**Collect** the Assessment Sheets for later marking and entering the marks on the Attendance Record. |
| **Next step:** 1 minute | Inform the group that future sessions will look at how to use crop protection products correctly as part of an IPM programme.  
**Hand out** the Fact Sheet to participants. |
Assessment Questions

Answer TWO (2) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers.
All questions are the same value (5 marks).

**Question 1:** Describe what a pest is.

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**Question 2:** Give five problems that pests might cause.

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**Question 3:** Give five principles of control.

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**Question 4:** Give five components of integrated pest management (IPM).

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**FACT SHEET**

**WHAT IS A PEST?**
A pest is any living thing that:
- Competes with humans, domestic animals or crops for food and water.
- Injures or damages humans, domestic animals, crops or structures.
- Spreads disease to humans, domestic animals or crops.

Most living things are NOT pests. Many are beneficial. An organism only becomes a pest when the harm it causes becomes unacceptable. This may be due to the type of damage caused, or because pest numbers are so large that massive damage results. For most organisms, natural controls keep numbers in balance and there is no problem. In ideal conditions pests will, like all living things, multiply and increase in numbers.

**TYPES OF PESTS**
Pest organisms can be grouped together:

<table>
<thead>
<tr>
<th>Insects and organisms related to insects:</th>
<th>![Image]</th>
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</thead>
<tbody>
<tr>
<td>These include: Ants, Caterpillars, Beetles, Grasshoppers, Locusts; Flies; Wasps; Lice; Fleas; Ticks; Spiders; Mites; Bugs; Termites; Mosquitoes; Weevils; Borers; Fruit flies, etc. These pests can cause problems for people, crops, animals, stored produce, and structures. They can eat plants, transfer diseases, damage fruit, destroy buildings, and bite people and animals.</td>
<td>![Image]</td>
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<table>
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<tr>
<th>Plant Pathogens:</th>
<th>![Image]</th>
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<tbody>
<tr>
<td>Fungi, Bacteria, and Viruses cause disease in plants. They are also called the silent killer because they cannot be seen, only seen is the damage caused by disruption of the normal internal processes of the plant. Fungi cause most plant diseases in crops. Bacteria and fungi can cause fruit and vegetables to rot after harvest. These pathogens can be spread by insects, people, equipment, wind, rain water, etc.</td>
<td>![Image]</td>
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<table>
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<tr>
<th>Animal Pathogens:</th>
<th>![Image]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungi, Bacteria, Viruses and internal parasites can cause diseases of animals.</td>
<td>![Image]</td>
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</table>

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<tr>
<th>Weeds:</th>
<th>![Image]</th>
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<tr>
<td>Grass and broadleaf weeds can cause many problems, including reducing crop production by competing with crops for nutrients and water; reducing animal production because weeds have low food value; poisoning of animals if the weed is poisonous; block waterways and irrigation canals; etc.</td>
<td>![Image]</td>
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</tbody>
</table>
**Vertebrates:**
Vertebrates are any living organisms with a spinal cord or backbone. Rodents (mice and rats) and birds can do much harm to crops and stored produce. Wild dogs can kill animals.

**Molluscs:**
Snails and slugs can cause damage to crops by eating them.

**Nematodes:**
Nematodes are tiny worm-like organisms that live in the gut of animals (internal parasites), or in the soil and feed on plant roots. They are so small they are very difficult to see by eye.

**IN GENERAL THE HARM THAT PESTS CAN CAUSE INCLUDES:**
- Reduced yields of crops and livestock
- Reduced quality of saleable produce
- Destruction of stored produce
- Increases in cost of production
- Adverse effects on environment
- Adverse effects on community activities
- Adverse effects on the health and welfare of people
- Adverse effects on the health and welfare of animals
- Destruction of infrastructure

**WHEN SHOULD WE CONTROL PESTS?**

Pests can be controlled, but prevention is much better than trying to control pests after they have become a problem. For example, vaccinating animals will prevent diseases, while putting stored grain in sealed containers will prevent damage from insects or rodents.

Crops and animals should always be regularly examined for the presence of pests. The best time to control the pest will depend on what the pest is, where it is, the most susceptible stage of the pest life cycle, the value of the crop or animal, and the cost of control.
HOW SHOULD WE CONTROL PESTS?

- Prevention is better than cure – prevent pest problems from occurring in the first place.
- Know as much as you can about the pests - how they behave, their life cycles, how numbers build up, and so on.
- Control pests only if economic damage occurs or is likely to occur.
- In most cases we just need to reduce pest numbers to levels where they are no longer a problem. We do not need to try to eradicate them (kill every single one).
- Take a long term approach. Before you plant a crop, think about what pest problems there might be and how they might be prevented.

WAYS TO CONTROL PESTS

The techniques we can use to control pests can be grouped into the following:

| Quarantine, hygiene and exclusion | • Keep pests out if you do not have them.  
| | • Countries or regions may have quarantine blocks at points of entry. Many overseas countries have strict quarantine to keep pests out.  
| | • Don't spread pests from one area to the other.  |
| Biological control | • Using living organisms to control pests. For example; insects or diseases may be used to control weeds. Parasitic insects and diseases may be used to control pest insects. Pathogenic diseases can be used to control vertebrate pests.  |
| Cultural and managerial control | • Changing the environment so it has an adverse effect on pests.  
| | • Crop and animal management.  
| | • For example, time of planting or harvest to avoid pests. Use drip irrigation rather than sprinklers.  
| | • Using mulch can reduce weeds, and cold storage will reduce post harvest diseases.  
| | • Making sure crops and animals are well fed, watered and looked after will help them withstand pests.  |
| Physical control | • Burning, pulling, cutting, digging or mowing weeds.  
| | • Trapping insects or rodents.  |
| Genetic control | • Growing crops or animals which are not affected by pests. These are called resistant varieties.  |
| Chemical control | Chemical controls include:  
| | • Crop protection products  
| | • Animal health products/stock medicines  
| | • Vaccines  
| | • Hormones, vitamins and minerals  |
| May be backed up by legal requirements | Sometimes, a country may have a legal requirement for people to control a pest if it is on their property. |
INTEGRATED PEST MANAGEMENT

When controlling pests, we should not rely on just one method of control but use all appropriate control techniques together. This approach is called “Integrated Pest Management (IPM)”.

Best results are achieved when all the non-chemical control techniques are used first to suppress pest numbers (this is what organic farmers do), and to back these up with chemical controls (crop protection products) as and when required.

Do not rely on just one technique because this will not give good long term results and will lead to problems.

When we use crop protection products, we MUST use them correctly and safely.

In IPM, there are many things to consider as well as the different control techniques. For example:

• What resources do you have available?
• How severe is the pest problem?
• What are the costs of the different controls, the value of the produce or the cost of doing nothing?
• What external factors do we have to consider? For example: government regulations, requirements of those purchasing produce, community concerns, safety for the environment and people.

IPM IS THE COMBINATION OF ALL APPROPRIATE PRACTICES INTO A SINGLE PLAN FOR CROP AND PEST MANAGEMENT THAT OPTIMISES INPUT USE TO REDUCE PESTS AND DAMAGE TO AN ACCEPTABLE LEVEL, MAXIMISE YIELD, AND MINIMISE NEGATIVE EFFECTS.

Also

IPM PRINCIPLES AND PRACTICES WERE USED BY FARMERS TO MANAGE PESTS LONG BEFORE SYNTHETIC PESTICIDES WERE AVAILABLE.

As part our IPM program, we should regularly check the crop or animals to see how effective our controls are in reducing pest numbers, and to be able to prevent pests from returning after we control them.
The IPM Circle

The IPM Circle shows all the components which make up an IPM programme:

- **Mechanical** or physical control methods
- **Cultural** and managerial controls
- **Sanitation** – Quarantine, hygiene and exclusion
- **Biological** and genetic control methods
- **Chemical** Control methods
- **Application** of chemical control (usually by spraying)
- **External** Factors – Weather and other climatic conditions, legal requirements, etc.
- **Economics** and Decision Making
1. Pests and Integrated Pest Management (IPM)
2. PESTICIDE RESISTANCE MANAGEMENT
Lesson Plan

<table>
<thead>
<tr>
<th>Materials needed:</th>
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<tbody>
<tr>
<td>☑ Flipchart stands.</td>
</tr>
<tr>
<td>☑ Flipchart paper.</td>
</tr>
<tr>
<td>☑ Markers (4 colours).</td>
</tr>
<tr>
<td>☑ Notebooks, pens, and file covers for participants who have forgotten to bring them.</td>
</tr>
<tr>
<td>☑ Coloured cards.</td>
</tr>
<tr>
<td>☑ Glue stick or blue tack.</td>
</tr>
<tr>
<td>☑ Masking tape.</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Time needed:</td>
</tr>
<tr>
<td>Intended audience:</td>
</tr>
<tr>
<td>Preparation:</td>
</tr>
<tr>
<td>☑ Flipchart with the session title “Pesticide Resistance Management” and the Session Objectives.</td>
</tr>
<tr>
<td>☑ Flipchart with definitions of Pesticide Resistance.</td>
</tr>
<tr>
<td>☑ Sufficient copies of “How Resistance Develops in a Population” for all participants.</td>
</tr>
<tr>
<td>☑ Three blank flipcharts with a vertical dividing line down the middle.</td>
</tr>
<tr>
<td>☑ Print off sufficient Attendance Record sheets.</td>
</tr>
<tr>
<td>☑ Print off sufficient Assessment question sheets.</td>
</tr>
<tr>
<td>☑ Print off sufficient Fact Sheets for participants.</td>
</tr>
<tr>
<td>☑ Organise venue and seating arrangements.</td>
</tr>
</tbody>
</table>

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction 5 minutes

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
</table>
| Attention:      | Welcome the participants to the session.  

Say: Puppies are one of the most common pets in the world.  

They are all nice and soft and playful, but will inevitably grow and show inherited characteristics of their parents – hair color, size, strength, aptitudes - which can be desirable or not in the pet owner’s eyes.  

Ask:  
• Why should this be?  

Take several responses.  

Inherited traits in puppies, like in any other living organism, such as hair color and size, pass from generation to generation with minimal external pressure or interventions. In the same way, resistance traits in pests are inherited, and could be passed on the offspring of resistant individuals.

<table>
<thead>
<tr>
<th>Title:</th>
<th>Refer to the Title Flipchart and tell participants that this training session will cover Pesticide Resistance Management.</th>
</tr>
</thead>
</table>
| Credibility:    | Say that pesticide resistance has caused major problems to farmers in all parts of the world. This has meant that certain pesticides can no longer be used against the pest.  

In some instances this effect has been so severe that production of a crop has had to be abandoned, and farmers have lost a major part, or all, of their livelihood.  

| Objectives:     | Refer to the Title Flipchart with the Lesson Objectives.  

By the end of the session, participants will be able to:  
• State clearly what is pesticide resistance, and how it develops in a pest population.  
• Outline the different types of pesticide resistance mechanisms.  
• Describe the factors which promote pesticide resistance.  
• Explain the practices which can be used to avoid or manage pesticide resistance.  

| Benefits:       | Knowing the factors which promote pesticide resistance, and the practices which can avoid the development of resistance, ensures that development of pesticide resistance is prevented, a full range of pesticides remains available to manage pests, and farmers can continue to economically produce crops. |
Direction:

• The session starts with an interactive discussion exploring what is meant by pesticide resistance.
• The Facilitator then gives a presentation on how resistance develops in a population, together with brief presentations on resistance mechanisms and cross resistance.
• The remainder of the session is taken up with a work group activity looking at the factors which promote the development of resistance, and the corresponding practices which can prevent or avoid the development of resistance.

Delivery

Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/ Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 5 minutes</td>
<td>Interactive Discussion – What Is Meant By Pesticide Resistance</td>
</tr>
</tbody>
</table>

Say that in the introduction we noted that people from tropical areas of the world have darker coloured skin than people from temperate areas, as this gives them protection from skin cancer and so they have an advantage in the strong sunlight over people with lighter coloured skin. Even so, in both populations there are people who are born with no skin or hair colouration at all due to genetic variation.

Ask

• How can we apply this concept of genetic variation and genetic advantage to the use of pesticides?

Guide the discussion, and write participant comments on the flipchart when these are appropriate to the definition of Pesticide Resistance below.

Put up the “Definition of Pesticide Resistance” flipchart, and explain the definitions, referring to the responses on the participant comments flipchart.

The definition of pesticide resistance used by FAO and IRAC (the Insecticide Action Committee) is:

“A heritable change in the sensitivity of a pest population that is reflected in the repeated failure (more than one instance) of a product to achieve the expected level of control when used according to the label recommendation for that pest species and where problems of product storage, application and unusual climatic or environmental conditions can be eliminated as causes of the failure.” (Text in italics is additional in the FAO definition)

Put simply, a pest population is resistant to a pesticide when:

“There is repeated failure of the pesticide to achieve the expected level of control when used according to the label recommendation.”
### 2. Pesticide Resistance Management

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 minutes</td>
<td><strong>Presentation – How Resistance Develops in a Pest Population, the Different Resistance Mechanisms, and Cross Resistance</strong></td>
</tr>
</tbody>
</table>

**Distribute** the “How Pesticide Resistance Develops in a Population” diagram.

**Explain** how resistance develops with repeated use of the same pesticide.
- Every population has a low number of naturally resistant individuals.
- When a pesticide is applied, these resistant individuals survive, together with some susceptible individuals.
- The proportion of resistant individuals in the remaining population is higher than before the pesticide was applied.
- When the survivors reproduce, there is more chance of resistant individuals mating with another resistant individual, so the next generation has a higher proportion of resistant individuals than the previous population.
- This process is repeated each time the same pesticide is used.

This effect is also described as “natural selection” or “survival of the fittest”.

**Point out** that for example purposes the diagram shows only three generations, but that resistance is unlikely to develop this quickly.

**Emphasise** that resistance can develop in **any** pest organism – insects, mites, weeds, diseases, etc.

**Say** now that we understand what resistance actually is, we now need to understand what are the different resistance mechanisms – how an individual is able to prevent being killed by a pesticide.

**Explain** that we will not go into these different methods in detail, but it is important to be aware of them as this knowledge can be useful in the prevention or avoidance of pesticide resistance.

**Briefly present** “Resistance Mechanisms” and “Cross Resistance” from the Fact Sheet.
<table>
<thead>
<tr>
<th>Work Groups – Factors Which Promote the Development of Pesticide Resistance, and Practices to Prevent / Avoid the Development of Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work Group Task:</strong></td>
</tr>
<tr>
<td>• Agree amongst yourselves the different factors which could promote the development of pesticide resistance. Write these on the left of the flipchart (right in Arabic speaking countries).</td>
</tr>
<tr>
<td>• Against each of the factors which promote the development of resistance, write the corresponding practices which would prevent / avoid the development of pesticide resistance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work Group Reports – Factors Which Promote the Development of Pesticide Resistance and Practices to Prevent / Avoid the Development of Resistance</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
<tr>
<td>• Against each of the factors which promote the development of resistance, write the corresponding practices which would prevent / avoid the development of pesticide resistance.</td>
</tr>
</tbody>
</table>

Participants should get up, look at the flipcharts from the other two groups, and make notes of any comments they may have or points they would disagree with.

Allow 10 minutes for the walk round, and then participants should take their seats again.

Ask participants if they have any comments to make regarding the other group’s flipcharts, or disagree with any of the points.

Review the flipcharts, using “Factors Which Promote the Development of Pesticide Resistance” and “Practices Which Prevent or Avoid the Development of Pesticide Resistance” as a checklist to ensure that all points are covered, adding where points are not included on the group flipcharts.

Point out that the prevention or avoidance of pesticide resistance is largely concerned with avoiding the practices which promote resistance.

Describe Resistance Management Strategies and Mode/Site of Action in detail, including rotation of MoA. Discuss how to find out MoA. If relevant describe resistance management for biotech crops. Concentrate on Bt-crops – point out this is a similar approach to #6 for chemical pesticides (preservation of susceptible insects).
## 2. Pesticide Resistance Management

### Finish

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> 1 minute</td>
<td><strong>Include</strong> as major messages:</td>
</tr>
<tr>
<td></td>
<td>• The definition of pesticide resistance, particularly the simple definition</td>
</tr>
<tr>
<td></td>
<td>• How pesticide resistance develops in a population</td>
</tr>
<tr>
<td></td>
<td>• That pesticide resistance can occur in any pest population – insects, mites, weeds, diseases, etc.</td>
</tr>
<tr>
<td></td>
<td>• Factors which promote the development of pesticide resistance, and the consequent corresponding practices to prevent or avoid resistance.</td>
</tr>
<tr>
<td></td>
<td>• Resistance management strategies.</td>
</tr>
<tr>
<td><strong>Questions:</strong> 1 minute</td>
<td><strong>Ask</strong> if everyone understands or if there are any additional questions. Answer these provided they are relevant.</td>
</tr>
<tr>
<td><strong>Evaluation:</strong> 12 minutes</td>
<td><strong>Hand out</strong> the Assessment Sheet and ask participants to complete two of the questions.</td>
</tr>
<tr>
<td></td>
<td><strong>Collect</strong> the Assessment Sheet for later marking and entering the marks on the Attendance Record.</td>
</tr>
<tr>
<td><strong>Next step:</strong> 1 minute</td>
<td><strong>Say</strong> participants are now able to provide appropriate advice about pesticide resistance to farmers and other pesticide users, which will help to prevent or avoid the development of resistance, and so protect their livelihoods.</td>
</tr>
<tr>
<td></td>
<td><strong>Hand out</strong> the Fact Sheet to participants.</td>
</tr>
</tbody>
</table>
How Insecticide Resistance Develops in a Population

Susceptible individual  Resistant individual

Pesticide applied

70% Control

Survivors reproduce

Pesticide applied

50% Control

Survivors reproduce
How Fungicide Resistance Develops in a Population

Susceptible individual

Survivors reproduce

Resistant individual

Pesticide applied

70% Control

Pesticide applied

50% Control

Survivors reproduce
How Herbicide Resistance Develops in a Population

Susceptible individual  Resistant individual

Pesticide applied

70% Control

Survivors reproduce

Pesticide applied

50% Control

Survivors reproduce
2. Pesticide Resistance Management

Assessment Questions

Name: ..................................................  Date: ..................  Mark: 

Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

**Question 1:** Give the simple definition of pesticide resistance.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 2:** The effect of pesticide resistance developing in a pest population is also known as? Give one of the two possible terms.
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**Question 3:** Give three factors which promote the development of pesticide resistance.
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**Question 4:** For your three answers in Question 3, give the corresponding practices which will prevent or avoid the development of pesticide resistance.
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**Question 5 (optional):** How do you manage resistance development in a Bt-crop?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

DEFINITION OF PESTICIDE RESISTANCE

Both FAO and IRAC (Insecticide Resistance Action Committee) use the following definition:

“A heritable change in the sensitivity of a pest population that is reflected in the repeated failure (more than one instance) of a product to achieve the expected level of control when used according to the label recommendation for that pest species and where problems of product storage, application and unusual climatic or environmental conditions can be eliminated as causes of the failure.” (Text in italics is additional in the FAO definition)

Put simply, a pest population is resistant to a pesticide when:

“There is repeated failure of the pesticide to achieve the expected level of control when used according to the label recommendation.”

RESISTANCE MECHANISMS

Metabolic / Detoxification

• Most commonly found in insects, less common in diseases, becoming more common in weeds.
• Based on systems insects have developed to detoxify natural occurring toxins in their host plants or other food sources.
• Resistant individuals can detoxify the pesticide at a faster rate than susceptible individuals, and before the pesticide can kill the individual.
• Level of resistance can range from low to high, and from pesticide to pesticide.

Reduced Target Site Sensitivity

• The binding site of the pesticide in the organism is changed so that the pesticide cannot bind to the site, reducing the effectiveness of the pesticide.
• The most common known mechanism in weeds and fungi, and is also common in insects.

Reduced Penetration

• Slows the penetration of the pesticide through the cuticle of resistant insects.
• On its own, this mechanism only produces low levels of resistance, but can greatly increase the effect of other resistance mechanisms when combined with these.

Sequestration (separation or isolation)

• In plants the pesticide is removed from sensitive parts to a tolerant site, such as a vacuole.

1 Some or all of these can be used as handouts to participants depending on requirements
**Behavioural Resistance**

- Occurs only in insects, mites, and rodents.
- Individuals change their behaviour so that they do not come into contact with the pesticide.
- Insects may stop feeding if they come across the pesticide, or leave the sprayed area (for example move to the underside of a leaf, move deeper into the crop canopy, or fly out of the sprayed area).

**CROSS RESISTANCE**

Cross resistance is when resistance to one pesticide also results in resistance to another pesticide, even when the pest has not been exposed to the second pesticide. It occurs when the different pesticides have the same resistance mechanism in the organism.

Cross resistance most commonly develops with pesticides that have the same mode or site of action, and are usually, but not always, from the same chemical group.

Some resistance mechanisms can affect pesticides from different chemical groups. This usually occurs when resistance is caused by metabolism.
<table>
<thead>
<tr>
<th>Factors Which Promote the Development of Pesticide Resistance</th>
<th>Practices Which Prevent or Avoid the Development of Pesticide Resistance</th>
</tr>
</thead>
</table>
| • Reliance on pesticides as the main tool of pest management, and ignoring non-pesticide management methods. | • Use non-pesticide crop and pest management practices for all types of pests – insects, mites, weeds, diseases, etc.:  
  • Optimal crop management practices.  
  • Cultural pest management.  
  • Mechanical pest management.  
  • Biological pest management.  
  • Only use pesticides when necessary (weeds with high fecundity rates might require preventive applications also)  
  • Scout the crop to determine pest and beneficial levels before applying a pesticide.  
  • Crop rotation and soil cultivation practices are often particularly important strategies for weed control. |
| • Continual and frequent use of the same pesticide on a pest population, particularly populations with short generation times. | • Avoid repeated use of the same pesticide, or pesticides with the same mode of action.  
  • Rotate pesticides with different mode/site of action. |
| • Treatment of both larval and adult stages at the same time with a single pesticide. | • Pesticide applications should target early pest developmental stages, or the most susceptible stages. |
| • Use of broad spectrum pesticides. These are likely to be used more in an area as they control more pest species, and so the selection pressure on all pest species is increased. | • Use selective pesticides, avoid broad spectrum pesticides. This is not necessary true for weeds. |
| • The use of application rates which are below or above those recommended on the label | • Apply pesticides according to the dose rates on the label. |
| • Poor coverage of the area being treated. This includes both cover of the whole target area (eg a field), and also within the target area (eg poor underleaf coverage, or crop penetration). It also includes areas of over- and/or under-dosing in the target area. | • Ensure even and adequate coverage of the target area. |
| • Use of counterfeit/illegal pesticides that may have unknown active ingredient and/or unknown concentration | • Use of genuine products. |
| • Areas where there is little or no immigration of susceptible individuals from outside. | • If pesticide mixtures are used (tank or pre-mixtures), the following **must** be considered:  
• The individual insecticides must be highly effective, and applied at the individually recommended rates.  
• Mixtures of pesticides with the same mode of action should not be used.  
• Known or potential cross resistance problems between the individual pesticides.  
• The individual pesticides should have similar persistence periods. This is not necessary true for herbicides. |
How Resistance Develops in a Population

Susceptible individual

Resistant individual

Pesticide applied

70% Control

Survivors reproduce

Pesticide applied

50% Control

Survivors reproduce

Note: Although this example uses insects, resistance can develop in any pest population – insects, mites, weeds, diseases, etc.
MANAGING RESISTANCE

Resistance development can be delayed by adopting a number of different practices that rely on pest management and pesticide use strategies:

1. **Integrated Pest Management (IPM):** Adoption of IPM, which includes cultural practices such as crop rotation, possible use of pest-resistant varieties and maintenance of naturally-occurring predators and parasites and other beneficial organisms, help keep pests populations low and therefore avoids the need to use control measures. If pest control is needed a range of practices can be used including mechanical control e.g., hand-picking of diseased leaves, biological pesticides, chemical deterrents and chemical pesticides. The net result is chemical pesticides are only used when necessary and not continuously. **Chemical pesticide should always be used within an IPM strategy.**

2. **Using the correct pesticide dose:** Using less than the recommendation dose results in greater survival of the pest and promotes the build-up of resistance. High doses select for the most resistant individuals and also can be damaging to the environment and unsafe. **Always use the dose recommended on the pesticide label.**

3. **Calibrate and maintain the application equipment:** Poorly calibrated and maintained equipment results in leakage and uneven coverage of the crop and/or target with resulting under- or over-dosing. **Always calibrate application equipment before use and keep it properly maintained.**

4. **Good application practices:** A pesticide needs to be applied effectively to the target – this is achieved by directing to the target location e.g. undersurface of leaves, by ensuring the right droplet size (with liquid sprays) etc., correct volume of water (to avoid run-off), do not spray in windy conditions and, in hot climates, during the hottest time of the day. Incorrect application results in under- or overdosing. **Always used recommended application techniques e.g. direct spray to target, correct nozzles (droplet size), correct volume of water etc.**

5. **Double-hit strategy:** If the pest survives the pesticide application, consider the option of applying a different pesticide or a different control technique to kill survivors. This is a useful strategy for surviving weeds. In small plots single surviving weeds can be removed by hand; this or other control technique should be done before seeding. Avoid resorting to applying increased doses of the original pesticides. **Consider controlling survivors from a pesticide application with a different pesticide or control technique.**

6. **Preservation of susceptible insects:** A few programmes preserve susceptible pests through leaving unsprayed areas or promoting attractive habitats with the cropping area that facilitate immigration of the pest so that susceptible and resistant individual mix and mate, diluting the resistant individuals. This is exclusively done with insect pests.

7. **Use good quality, genuine pesticides:** Use of illegal or counterfeit pesticides can result in applications of unknown amounts of the active ingredient (or a different active ingredient), which results in under-, over, or incorrect dosing and undermines resistance strategies. **Never use illegal or counterfeit pesticides.**

8. **Mode/Site of Action (MoA) rotation:** There are hundreds of active pesticide substances, many of which act in different ways – referred to as a different mode or site of action (MoA). A key element of effective resistance management is the use of rotations (alternations, sequences) of different insecticide MoA classes. Users should avoid by repeated use within the crop cycle, or year after year, of the same insecticide or related products in the same MoA class. MoA classes can be determined by labelling on the pesticide bottle (in a few countries) or looking up the active ingredient against lists (see hand-out Rotation of Mode of Action). In some cases the result can be obtained through applying mixtures with different MoAs e.g. some fungicides and many herbicides, if recommended (note: if mixtures are used the full dose recommended for each pesticide should be used). Generally, however, mixtures are not recommended for resistance management for insecticides. **If repeated applications of chemical pesticides are necessary, the MoA should be rotated.**
BIOTECH-DERIVED CROPS

1. **Herbicide-tolerant**: Resistance management in herbicide-tolerant crops follows the same strategy as conventional crops, outlined above.

2. **Bt-crops**: Management of resistance in Bt-crops is achieved through planting of a refuge. This is an area or percentage of the crop that is planted to conventional seed or planted to a crop that is equally attractive to the pest insect. Surviving resistant insects from the Bt-crop plants mix and are diluted by susceptible insects from the refuge (see hand-out of resistance management in Bt-crops). The amount (%) of refuge for each product should be stated on the label. Some products consist of a mixture of Bt and conventional seed at the required percentage. Refuge should be employed from initial planting of Bt-crops.

MODE/SITE OF ACTION

There are hundreds of active pesticide substances, many of which act in different ways - referred to as a different mode or site of action (MoA). This is illustrated in the picture below that shows where different pesticides may affect and insect.

![Mode of Action Diagram](image-url)

Although the picture illustrates MoA for insects, many different herbicides and fungicides also have different MoA. Continued use of products with the same MoA will result in development of resistance, normally in the target pest, but this could also be more broadly e.g. several weed species to a broad spectrum herbicide that is repeatedly used.
MODE/SITE OF ACTION ROTATION

There are hundreds of different pesticides, many of which have different modes/sites of action (mechanism or site of activity, MoA). Resistance can develop to a specific MoA and can be delayed through avoiding the same MoA all the time by rotating MoA over time. This is illustrated by two examples below:

This requires that the MoA of a product is easily known. This is the case where the label of the product has a letter or number code that gives the MoA: each different MoA has a different code, so a user just needs to choose products with different code numbers and rotate as shown above. In the absence of a MoA labelling, the user needs to take note of the active ingredient that is listed on product label and look up the MoA on the lists/posters shown on CropLife International Resistance Action Committees’ websites:

- the Fungicide Resistance Action Committee (FRAC: www.frac.info)
- the Insecticide Resistance Action Committee (IRAC: www.irac-online.org)
- the Herbicide Resistance Action Committee (HRAC: www.hracglobal.com)

A good retailer should have access to the lists/posters and keep up-to-date. Local pesticide company representatives should be able to help. If only some products have MoA labelling it may be easier to preferentially choose those.
On the basis of this information MoA rotation can be included as part of an IPM strategy and adapted for specific crops, for example:
Resistance Management in a Bt Crop: Use of Refuge

Susceptible individual

Resistant individual

Bt-trait

Refuge

Mating: $R \times R \quad R \times S \quad S \times S$
See also:


Resistance Management for Sustainable Agriculture and Improved Public Health (IRAC)
http://www.irac-online.org/documents/irac-croplife-irm-booklet/?ext=pdf

Overview of an Insect Resistance Management (IRM) Plan for Plant Protection Insecticides (IRAC)
http://www.irac-online.org/documents/key-components-of-an-irm-plan/?ext=pdf

General Principles of Insecticide Resistance Management from IRAC
http://www.irac-online.org/documents/principles-of-irm/?ext=pdf

Herbicide Resistance Action Committee website
http://www.hracglobal.com/

Fungicide Resistance Action Committee website
http://www.frac.info/

Rodenticide Resistance Action Committee website
http://www.rrac.info/
2. Pesticide Resistance Management
3. CLASSIFICATION OF CROP PROTECTION PRODUCTS (CPP’S)

Before attempting this module, participants should have completed the module on *Pests and Integrated Pest Management*
Lesson Plan

| Materials needed:                                      | ☑ Flipchart stand with paper. |
|                                                     | ☑ Flipchart paper.             |
|                                                     | ☑ Markers (4 colours).         |
|                                                     | ☑ Coloured cards.              |
|                                                     | ☑ Glue stick or blue tack.     |
|                                                     | ☑ Masking tape.                |
|                                                     | ☑ Pin board and pins.          |
|                                                     | ☑ Sample containers or labels.  |

| Time needed:                                          | 85 minutes (if less time, adjust each section accordingly) |
| Intended audience:                                    | Farmers and crop protection product dealers (resellers)    |

| Preparation:                                         | ☑ Flipchart on flipchart stand with the title “Types of Crop Protection Products”, and the Lesson Objectives. |
|                                                     | ☑ Flipchart with Module 2 Table.                           |
|                                                     | ☑ Print off 5-6 copies of Module 2 Table (provided at the end of the Lesson Plan). |
|                                                     | ☑ Coloured cards with names of types of crop protection products and cards with names of types of pests controlled. |
|                                                     | ☑ Print off sufficient Fact Sheets for participants.       |
|                                                     | ☑ Print off sufficient Assessment question sheets.         |
|                                                     | ☑ Print off sufficient Attendance Record sheets.           |
|                                                     | ☑ Organise venue and seating arrangements.                 |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction 5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
</table>
| Attention: | Ask participants if they know the different types of crop protection products, and how they are differentiated:  
  • Insecticides for insects;  
  • Herbicides for weeds;  
  • Fungicides for diseases; etc.  
  Record their answers on a flipchart. |
| Title:     | Refer to the Title Flipchart and tell participants that this training session will cover *Types of Crop Protection Products*. |
| Credibility: | Tell participants your own story about using incorrect crop protection products. |
| Objectives: | Refer to the Title Flipchart with the Lesson Objectives.  
  By the end of the lesson, participants will be able to explain and describe the different ways in which crop protection products are classified. |
| Benefits:  | Understanding the differences between types of crop protection products can assist the farmer in selecting the best crop protection product for a problem. |
| Direction: | During this session, we will focus on the different types of crop protection products that farmers use. |

Delivery (80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| 1. 2 minutes | **Brainstorming – The Right Product for the Pest**  
  Ask participants if they have a headache, can they take cough syrup to treat it?  
  They should answer “No”.  
  Ask participants: What do you need to treat a headache?  
  They should answer that a painkiller is needed for a headache.  
  Explain that the same applies to pests and crop protection products - different pests need different crop protection products. |
2. **Brainstorming – Pest Types**
   - **Remind** participants that in Lesson 1 we discussed the different groups of pest types.
   - **Ask** participants how we grouped the different pest types.
   - **List** the answers on a flipchart. (Insects, Weeds, Bacteria, Fungi, Viruses, Molluscs, Vertebrates, etc.)

3. **Brainstorming – Definition of a Crop Protection Product**
   - **Ask** participants if they can give a definition of a Crop Protection Product. What is it for, what does it do?
   - **List** answers on a flipchart.
   - **Summarise** by saying that a crop protection product is a chemical which prevents or reduces loss or damage caused by pests, and not all products kill pests, some repel or inhibit the growth of pests.
   - **Emphasise** that crop protection products are just one of the tools used in IPM.

4. **Work Groups – Advantages and Disadvantages of Crop Protection Products**
   - **Divide** participants into four groups, and the four groups into two pairs.
   - **Say** that crop protection products have advantages and disadvantages in use.
   - **Work Group task:**
     - Pair 1: List advantages of using crop protection products
     - Pair 2: List disadvantages of using crop protection products

5. **Work Group Reports – Advantages and Disadvantages of Crop Protection Products**
   - **Ask** Pair 1 in turn for an advantage of using pesticides until there are no more responses.
   - **Write** the answers on the flipchart.
   - **Ask** Pair 2 in turn for a disadvantage of using pesticides until there are no more responses.
   - **Write** the answers on the flipchart.
   - **Summarise** the answers on the flipchart, **adding** points as necessary using the Fact Sheet as a checklist.
6. Whole Group Activity – Product Names
5 minutes

**Distribute** the sample Product Labels among the whole group.

**Ask** participants to look at the labels and identify the product name. Are there any other names on the label?

**Explain** that a product has three names:
- The **chemical name** of the *active ingredient* is long and complicated. It may or may not appear on the label.
- The **common name** of the *active ingredient* is an internationally recognised shorter name. It **always** appears on the label.
- The **product** or **trade name** is that given by the manufacturer of the product. It appears in large print on the label.

7. Brainstorming – Crop Protection Product Classification
3 minutes

**Refer** to the flipchart from the Attention activity with pesticides classified by the types of pests they control.

**Ask** participants in what other ways could crop protection products be classified.

**List** answers on the flipchart. Use *Classification of Crop Protection Products* in the Fact Sheet as a checklist.

**Explain** that Formulations, Toxicity, and Chemical Groups are covered in more detail in lessons 3, 4 and 5, and that in the next activity will examine classification by the type of pest controlled.

8. Work Groups – Crop Protection Product Classification by Type of Pest Controlled
10 minutes

**Divide** participants into 3-4 groups depending on numbers.

**Put** up the pre-prepared Table flipchart, and distribute a copy of the table to each group.

**Work group task:**
- Complete the Table with the name of the type of product that controls each of the pest groups – Emphasise that it is the type of product that is needed, not specific products.
- Provide examples of products from each type of product.

9. Work Group Reports
5 minutes

**Ask** group leaders to pin their answer Tables for all to see.

**Allow** participants a short time to look at the answer Tables.

10. Work Group Summary
5 minutes

Referring to the work group answers, **complete** the Table flipchart, **explain** the complete table, and **provide** suitable examples/experiences.

**Use** the *Type of Pest Controlled* table in the Fact Sheet as a checklist.
<table>
<thead>
<tr>
<th>11.</th>
<th>Brainstorming – Selecting the Right Crop Protection Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 minutes</td>
<td>Say that we have discussed ways of classification, and the advantages and disadvantages of crop protection products.</td>
</tr>
<tr>
<td></td>
<td>Ask how can we use this information to help select the right crop protection product.</td>
</tr>
<tr>
<td></td>
<td>Write answers on the flipchart.</td>
</tr>
<tr>
<td></td>
<td>Add as necessary using the list in the Fact Sheet as a checklist.</td>
</tr>
<tr>
<td></td>
<td>Say that in the Fact Sheet is an 18 step list to Best Practice Crop Protection Product Use. We will not discuss this now, but participants should note the points and consider them during future sessions.</td>
</tr>
</tbody>
</table>

### Finish (10% of time)

**Module/Time** | **Activity** |
--- | --- |
Summary: 1 minute | Review how crop protection products are named and classified. |
| Give a summary of types using the table. |
| Remind participants to ensure that they use the appropriate type of crop protection product, and to check the label that it is appropriate. |
Questions: 1 minute | Ask if everyone understands or if there are any additional questions. |
| Answer these provided they are relevant. |
Evaluation: 12 minutes | On a pinboard, randomly put up the cards with crop protection product types and names of pest types controlled. |
| Ask participants to match the types. |
| Hand out the Assessment Sheet and ask participants to complete two of the questions. |
| Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
Next step: 1 minute | Inform the group that the following lessons will look in more detail at other ways of classifying crop protection products – Formulation, Toxicity, and Chemical Group. |
| Hand out the Fact Sheet to participants. |
## Classification of Crop Production Products

<table>
<thead>
<tr>
<th>Type of Crop Production Product</th>
<th>Type of Pest Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Insects</td>
</tr>
<tr>
<td></td>
<td>Fungi</td>
</tr>
<tr>
<td></td>
<td>Weeds</td>
</tr>
<tr>
<td></td>
<td>Bacteria</td>
</tr>
<tr>
<td></td>
<td>Mites</td>
</tr>
<tr>
<td></td>
<td>Nematodes</td>
</tr>
<tr>
<td></td>
<td>Snails and slugs</td>
</tr>
<tr>
<td></td>
<td>Mice and rats</td>
</tr>
<tr>
<td></td>
<td>Insect eggs</td>
</tr>
<tr>
<td></td>
<td>Other?</td>
</tr>
<tr>
<td></td>
<td>Other?</td>
</tr>
</tbody>
</table>
Assessment Questions

Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

Question 1: What is a crop protection product?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: Give five advantages of using crop protection products.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: Give five potential disadvantages of using crop protection products.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: Give five things to consider when selecting a crop protection product to use.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

PESTS

A pest can be broadly defined as any organism which adversely affects man, his crops, his livestock, stored produce, or anything he considers to be of value, including buildings.

Pests may include: weeds; insects; mites and spiders (these are not insects); molluscs (snails and slugs); pathogens - microorganisms which cause disease (bacteria, viruses, fungi); animals (birds, rodents and so on); molluscs (snails and slugs); internal parasites (round worms, flat worms and tape worms of animals).

CROP PROTECTION PRODUCTS

A crop protection product is defined as: Any substance which is used to prevent or reduce loss or damage caused by pests, either by directly killing the pest, or by inhibiting its growth, or by repelling it.

Pests should be controlled using many different methods as part of an integrated pest management (IPM) program. Crop protection products are only one of the tools.

ADVANTAGES OF USING CROP PROTECTION PRODUCTS

• Can treat large area quickly
• Can provide cost effective control of pests
• Can ensure good quality of harvested produce
• Flexible – there are many types so it is usually easy to choose the right one for a situation.
• Using crop protection products to control pests means that labour resources can be used on other tasks.
• Can be used to protect people, animals and the environment by controlling pests.
• Enable the profitable production of high quality, affordable food and natural fibre.

POTENTIAL DISADVANTAGES OF USING CROP PROTECTION PRODUCTS

(Potential disadvantages mean that crop protection products may or may not cause these problems)
• Crop protection products can be expensive.
• Require skill to use them correctly, safely and effectively.
• May be toxic and harm people if precautions are not taken.
• May harm the environment and non-target organisms, if precautions are not taken.
• Can lead to pollution of water and soil if not used correctly.
• Can result is harmful residues in harvested produce, if not used correctly.
• Application equipment may be expensive.
• Pests can develop resistance to individual crop protection products, if not used correctly.
• Apart from poisoning, crop protection products may cause other health effects, or be flammable or corrosive.
CROP PROTECTION PRODUCT NAMES

• Each active ingredient has a chemical name that describes the actual chemical active ingredient. This name is often long and complicated. It may appear on the label in brackets.
• Each active ingredient is also given an internationally recognised common name that is much easier to use and remember than the chemical name. A specific common name always refers to the same active ingredient, regardless of the manufacturer of the product. Common names are always given on the label.
• Manufacturers give their own product name or trade name to their products containing particular active ingredients. It is the product name which appears in large print on the label. A trade name is usually owned by a company and cannot be used by any other for a crop protection product; this is enforced by international legislation.

For example: Roundup (company’s product name) contains the active ingredient Glyphosate (the common name of the active chemical).

CLASSIFICATION OF CROP PROTECTION PRODUCTS

There are many different types of crop protection products. They can be classified in different ways:
• By the type of pest they control.
• By toxicity and other hazards: for example, how poisonous it is. See Lesson 3: Toxicity and Other Hazards.
• By chemical group and mode of action: this is the way crop protection products work. See Lesson 4: Chemical Groups and Modes of Action of Crop Protection Products.
• By formulation type: this is the physical form of the product (powder, liquid, gas and so on). See Lesson 5: The Main Types of Pesticide Formulation.

UNDERSTANDING THE DIFFERENT TYPES OF CROP PROTECTION PRODUCTS, THEIR HAZARDS, AND THE WAY IN WHICH THEY WORK, IS ESSENTIAL FOR SAFETY, AND EFFECTIVE AND ECONOMIC CONTROL OF PESTS.

SELECT THE RIGHT TYPE OF CROP PROTECTION PRODUCT FOR THE PEST PROBLEM, AND USE IT CORRECTLY.
### Classification by Type of Pest Controlled

<table>
<thead>
<tr>
<th>Type of Crop Production Product</th>
<th>Type of Pest Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insecticides</strong> kill insects</td>
<td>Insects</td>
</tr>
<tr>
<td><strong>Fungicides</strong> kill or prevent plant disease organisms caused by fungi (not bacteria)</td>
<td>Fungi</td>
</tr>
<tr>
<td><strong>Herbicides</strong> kill weeds (grass weeds and broadleaf weeds)</td>
<td>Weeds</td>
</tr>
<tr>
<td><strong>Bactericides</strong> kill plant disease organisms caused by bacteria (germs). Products which control bacterial disease in animals are called Antibiotics</td>
<td>Bacteria</td>
</tr>
<tr>
<td><strong>Acaricides</strong> kill mites and spiders</td>
<td>Mites</td>
</tr>
<tr>
<td><strong>Nematicides</strong> kill nematodes which are tiny worm-like organisms in the soil that attack the plant roots.</td>
<td>Nematodes</td>
</tr>
<tr>
<td><strong>Molluscicides</strong> kill snails and slugs</td>
<td>Snails and slugs</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>------------------</td>
</tr>
<tr>
<td><strong>Rodenticides</strong> kill rats and mice</td>
<td>Mice and rats</td>
</tr>
<tr>
<td><strong>Ovicides</strong> kill insect eggs</td>
<td>Insect eggs</td>
</tr>
<tr>
<td><strong>Drenches</strong> (anthelmintics) are used to control internal parasites in animals</td>
<td></td>
</tr>
</tbody>
</table>

**Important**

- Each crop protection product has its own range of control
- You cannot use a herbicide to control insects
- You cannot use a rodenticide to control fungi
- Know your crop protection products – Read the label – Be wise!
Selecting the Right Crop Protection Product

There are many, many different crop protection products available. When you have a pest problem, it is essential to select the most suitable crop protection product for the job. Points to consider are:

- The type of pest and therefore the type of crop protection product to use.
- Will it be effective? Does it have the right mode of action and use pattern to do the job needed?
- The cost of that crop protection product and the relative value of the produce (crop or animal), and the cost of doing nothing.
- The toxicity of the crop protection product.
- The potential effects on the environment.
- Potential residues. Will those purchasing the produce allow the product to be used?
- Government regulations. Is it legal to use the crop protection product?
- How it is applied? What application equipment is required to apply the crop protection product? Is the equipment available?
- Skill. What level of skill is needed by the person using the crop protection product?
- Are the target pests resistant to the crop protection product?

To maximise advantages and minimise disadvantage follow these steps to BEST PRACTICE

1. Use crop protection products as part of integrated pest management (IPM).
2. Understand your legal responsibilities.
3. Select crop protection products carefully before use.
4. Know how the crop protection product works, its hazards, and how to apply it correctly.
5. Manage risks at every step to avoid harm to people, animals or the environment.
6. Follow the label directions.
7. Make sure crop protection product users are well trained.
8. Only purchase crop protection products from reputable resellers to ensure they work and are not counterfeit or illegal.
9. Transport carefully to avoid spills and accidents.
10. Store safely to protect the crop protection products, people, animal and the environment.
11. Handle crop protection products carefully and safely. Avoid exposure and spills.
12. Use the correct application equipment. Make sure it is adjusted and calibrated correctly, and cleaned up after use.
14. Protect the environment. Prevent spray drift or run-off of crop protection products into waterways.
15. Dispose of waste safely.
16. Keep records of all crop protection products used.
17. Monitor the results after application. Check pest numbers.
18. Plan your crop protection product use and purchases carefully.
4. TOXICITY AND OTHER HAZARDS

Before attempting this module, participants should have completed the module on *Types of Crop Protection Products*
Lesson Plan

| Materials needed: | ☑ Flipchart stand with paper.  
|                  | ☑ Flipchart paper.  
|                  | ☑ Markers (4 colours).  
|                  | ☑ Coloured cards.  
|                  | ☑ Glue stick or blue tack.  
|                  | ☑ Masking tape.  
|                  | ☑ Pin board and pins.  
|                  | ☑ Sample containers or labels. |

| Time needed: | 85 minutes (if less time, adjust each section accordingly) |
| Intended audience: | Farmers and crop protection product dealers (resellers) |

| Preparation: | ☑ Flipchart on flipchart stand with the title “Toxicity and Other Hazards”, and the Lesson Objectives.  
|              | ☑ Print off sufficient Fact Sheets for participants.  
|              | ☑ Print off sufficient Assessment question sheets.  
|              | ☑ Print off sufficient Attendance Record sheets.  
|              | ☑ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### Set up/Introduction

**5 minutes (5-10% of total time)**

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | **Say** that crop protection products can be very useful but also extremely dangerous.  
**Ask** if they know anyone who had been poisoned by crop protection products. |
| **Title:** | **Refer** to the Title Flipchart and tell participants that this training session will cover *Toxicity and Other Hazards*. |
| **Credibility:** | **Briefly** describe any cases of poisoning or environmental damage from crop protection products. |
| **Objectives:** | **Refer** to the Title flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to explain:  
• the different hazards that crop protection products can cause to humans, animals, and the environment; |
| **Benefits:** | Knowing the different types of hazards caused by crop protection products will help you protect yourself, your family and others. |
| **Direction:** | During this session, we will focus on the types of hazards caused by crop protection products. We will not discuss protective equipment or first aid in case of poisoning by crop protection products as these are discussed in another lesson. |

### Delivery

**80-90% of total time**

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module / Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **1.**  
1 minute | **Presentation – Possible Risks of Crop Protection Products**  
Tell participants that crop protection products are safe if used strictly according to the label by skilled persons who know how to take the necessary precautions.  
However, crop protection products can cause great harm and damage to human beings and the environment if handled carelessly and without taking precautions. |
2. Work Groups – Hazards and Toxicity of Crop Protection Products

10 minutes

- **Divide** the participants into 3-4 groups depending on numbers.
- **Distribute** the sample labels or containers among the groups

**Work Group task:**
Discuss and agree among the group:
- The hazards that might be associated with crop protection products.
- From the product label, can we tell the toxicity of the product.
- From the product label, can we identify the toxicity classification of the product.

**Remind** participants that hazards are things that may cause harm, injury, or danger to humans, animals or the environment, and that toxicity is a measure of how poisonous a substance is.

3. Work Group Reports - Hazards and Toxicity of Crop Protection Products

10 minutes

- **Ask** the first group for a response to the first question on hazards. Write the answer on the flipchart.
- **Ask** the second group for another response to the first question. Repeat by going round all the groups until there are no more answers.
- **Repeat** for questions 2 and 3.
- **Summarise** the group results on the flipchart, using as a checklist the Fact Sheet sections on *Hazards and Toxicity*.
- **Add** to the participant answers as necessary. Refer also to the relevant information on the product labels.
- **Explain** the WHO classification of toxicity.

4. Brainstorming – Routes of Entry into the Body and Reasons for Contamination

10 minutes

- **Say** that we will start our examination of hazards and contamination with humans.
- **Ask** participants how crop protection products can enter the body.
- **List** answers on the flipchart. Leave space between the three routes of entry (dermal, oral, respiratory) for the answers to the next question.
- **Ask** participants how this can happen.
- **List** answers in key words against the relevant route of entry. Use the table in the Fact Sheet as a checklist.
|4. Toxicity and Other Hazards |
|---|---|
|**5.** | **Brainstorming – How to Avoid Contamination** |
| 4 minutes | **Ask** participants how users of crop protection products can prevent or avoid contamination. |
| | **List** answers on the flipchart. Use the table in the Fact Sheet as a checklist. |
| | **Tell** participants that in another session we will discuss how we can protect ourselves with protective equipment. |
|**6.** | **Brainstorming – Environmental Contamination** |
| 15 minutes | **Say** that we will now continue with the environment, and that we will focus on water sources, cultivated land with crops, and uncultivated land with plants and animals. |
| | **Ask** participants how water, crops, and plants and animals can become contaminated by crop protection products. |
| | **List** answers on the flipchart, using the table in the Fact Sheet as a checklist. |
| | **Ask** next what the consequences of this contamination are. |
| | **List** answers on the flipchart, again using the table in the Fact Sheet as a checklist. |
| | **Ask** finally how we can avoid contamination of the environment. |
| | **List** answers on the flipchart, again using the table in the Fact Sheet as a checklist. |
|**7.** | **Brainstorming – Protection From Other Hazards** |
| 5 minutes | **Refer** to group answers from module 3 on the hazards that might be associated with crop protection products. |
| | **Ask** how these other hazards could be avoided or minimised. |
| | Use the relevant sections of the Fact Sheet as a checklist. |
|**8.** | **Brainstorming – Residues** |
| 10 minutes | **Ask** what is meant by residues of crop protection products in produce and foods. |
| | **Summarise** the answers and **explain** what is meant by residues. |
| | **Ask** how residues might get on produce and foods. What harm might result? |
| | **Briefly explain:** |
| | • Maximum Residue Levels (MRLs), |
| | • their regulation, |
| | • how to ensure MRLs are not exceeded. |
| | **Refer** to the relevant information on the sample product labels. |
### Summary:

1 minute

**Say:**
- If handled incorrectly, crop protection products can enter the body through the skin, orally, or by inhalation.
- Crop protection products can also damage crops, water sources, and nature if not handled with care.

### Questions:

1 minute

**Ask** if everyone understands or if there are any additional questions.

Answer these provided they are relevant.

### Evaluation:

12 minutes

**Ask** how crop protection products can enter the body.

**Ask** how crop protection products can damage the environment.

**Hand out** the Assessment Sheet and ask participants to complete two of the questions.

**Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record.

### Next step:

1 minute

**Say** in this session, we learned about the types of hazard caused by crop protection products. In other sessions, we will discuss the consequences of contamination for people, protective equipment, and also first aid.

**Hand out** the Fact Sheet.
Assessment Questions

Name: ................................. Date: .................. Mark: ............................

Answer TWO (2) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers.
All questions are the same value (5 marks).

Question 1: Give five potential hazards with crop protection products:
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: What are the different levels or classes of toxicity?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: Give five ways oral poisoning (crop protection products entering the body through the mouth) can be prevented:
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: Give five ways crop protection product damage to the environment can be prevented:
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

A hazard is something that may cause injury or harm to people, animals or the environment.

There are a number of potential hazards associated with crop protection products. A crop protection product may or may not be hazardous. A crop protection product may also have more than one hazard, and the severity or level of hazard may vary. Hazards may cause risks during use, storage or transport of the crop protection product.

Potential hazards include:
• Toxicity – it is poisonous or not?
• Environmental hazards – will it cause harm to non-target organisms like honey bees, frogs, fish, earth worms, birds and so on?
• Flammability – will it easily catch fire?
• Corrosiveness – will it corrode equipment, or cause burns to your skin?
• Harmful residues in produce making the produce unfit for sale or use.

Those who are selling, transporting or using crop protection products must ensure that risks are minimised so that harm is not caused to people or the environment. Crop protection products must be used strictly according to the label by experienced persons who know how to take the necessary precautions.

The precautions should match the level of hazard. If the crop protection product is very toxic, more precautions will need to be taken than with a crop protection product of low toxicity. The golden rule is to treat all crop protection products with great care and precaution, because they can cause harm to people and the environment.

TOXICITY

Toxicity is a measure of how poisonous a crop protection product is to man. High toxicity to man does not necessarily mean that the crop protection product is highly toxic to the pest. Also, crop protection products that are highly toxic to pests may or may not be highly toxic to people. Formulations are usually less toxic than the pure active ingredient. The following WHO classification of formulation toxicity is most commonly used, although there are others such as national systems:

Class Ia: “Extremely Hazardous”
Class Ib: “Highly Hazardous”
Class II: “Moderately Hazardous”
Class III: “Slightly Hazardous”
[no class] “Unlikely to Cause Hazard in Normal Use”
The toxicity warning on the crop protection product label refers to the formulation, not the active ingredient. The more toxic the crop protection product, the higher the level of hazard. The classification is used to determine the warnings that on the label, the protective clothing that users should wear, and other precautions that need to be taken.

**CROP PROTECTION PRODUCTS AND THE HUMAN BODY (FAO)**

Crop protection products can enter the body through three major routes:
- Through the skin and eyes – Dermal
- Through the mouth - Oral
- Through breathing - Inhalation of vapour or sprays
- Products may also enter the body through injection, for example accidentally sticking a needle into yourself when vaccinating animals.

**ROUTES OF ENTRY INTO THE BODY, REASONS FOR CONTAMINATION, AND WAYS TO PREVENT CONTAMINATION**

<table>
<thead>
<tr>
<th>Route into body</th>
<th>Reasons for contamination</th>
<th>Prevention</th>
</tr>
</thead>
</table>
| Dermal and eyes | • Not wearing proper protection.  
                  • Applying crop protection products in windy conditions.  
                  • Wearing contaminated clothes.  
                  • Rubbing eyes or forehead with contaminated gloves or hands  
                  • Splashing crop protection product in the eyes and not wearing goggles  
                  • Splashing or spilling crop protection product on the skin  
                  • Leaking sprayers  
                  • Touching treated plants, livestock or soil | • Read the label.  
                                                                 • Wear proper protective clothing.  
                                                                 • Be a responsible operator when applying crop protection products.  
                                                                 • Always wash hands after handling a crop protection product.  
                                                                 • Start each day with clean clothes and protective equipment. |
| Oral            | • Storing crop protection product in food containers or drink bottles  
                  • Eating, drinking, or smoking while working with crop protection products.  
                  • Not washing hands before eating, drinking or smoking  
                  • No mouth protection when working with crop protection products.  
                  • Accidentally applying crop protection product to food or eating food with crop protection product residues  
                  • Drinking water contaminated with crop protection product | • Read the label.  
                                                                 • Do not reuse empty containers.  
                                                                 • Never put crop protection products into food or drink containers.  
                                                                 • Never eat, drink, or smoke while handling crop protection products; first wash properly.  
                                                                 • Always wear protective clothing when working with crop protection products.  
                                                                 • Do not eat food which has been treated with crop protection product until after the time stated on the label (Withholding Period) |
| Respiratory | • Not wearing proper protection.  
• Working carelessly with powder crop protection product formulations.  
• Handling crop protection products in confined or poorly ventilated areas  
• Using an inadequate or poorly fitting respirator  
• Being exposed to crop protection product drift | • Read the label.  
• Always wear protective clothing when working with crop protection products.  
• Work with volatile chemicals in a well-ventilated area and use the right protection. |

### ENVIRONMENTAL HAZARDS

Everything around us makes up the environment, including animals. Certain areas of the environment are more easily damaged by crop protection product contamination than others:

- Wells, ponds, lakes, rivers and underground water.
- Cultivated land with crops.
- Uncultivated land that supports wild plants and animals.
4. Toxicity and Other Hazards

The following table explains the dangers that can occur in the environment:

<table>
<thead>
<tr>
<th>Area</th>
<th>Reasons for contamination</th>
<th>Consequences of contamination</th>
<th>Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water sources</td>
<td>• Improper disposal of empty containers.</td>
<td>• Polluted water that can:</td>
<td>• Read the label.</td>
</tr>
<tr>
<td></td>
<td>• Careless disposal of leftover crop protection product mixes.</td>
<td>• Make humans and animals sick after drinking or using it.</td>
<td>• Dispose of empty containers and leftovers away from all water sources.</td>
</tr>
<tr>
<td></td>
<td>• Spills and leaking containers.</td>
<td>• Harm fish or plants in the water or at the waterside.</td>
<td>• Attend to spills and accidents quickly.</td>
</tr>
<tr>
<td></td>
<td>• Spray drift.</td>
<td></td>
<td>• Never apply crop protection products in strong winds.</td>
</tr>
<tr>
<td></td>
<td>• Runoff from treated areas</td>
<td></td>
<td>• Do not apply crop protection product just before or during rain.</td>
</tr>
<tr>
<td>Cultivated lands with crops</td>
<td>• Mixing crop protection products stronger than indicated on the label.</td>
<td>• Damage or destroy crops.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Over applying crop protection products to the target area.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncultivated land that</td>
<td>• Improper disposal of empty containers.</td>
<td>• Damage to plants.</td>
<td></td>
</tr>
<tr>
<td>supports wild plants and</td>
<td>• Careless disposal of leftover crop protection product mixes.</td>
<td>• Make animals sick.</td>
<td></td>
</tr>
<tr>
<td>animals</td>
<td>• Spills and leaking containers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Application of spray drift.</td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
FLAMMABILITY AND CORROSIVENESS

Some crop protection product concentrates will burn if exposed to flames, and others will eat away at metal equipment or your skin. When you are storing, transporting or using crop protection product concentrates, it is important that:

• You do not smoke.
• You wear protective clothing and wash it after use.
• You keep crop protection product concentrates away from flames.
• You thoroughly wash application equipment after use.
• You carefully store and transport crop protection product (keep different chemical types apart, and make sure containers cannot be damaged).
• You wash yourself after handling or using crop protection products.
4. Toxicity and Other Hazards
5. CHEMICAL GROUPS AND MODES OF ACTION OF CROP PROTECTION PRODUCTS

Before attempting this module, participants should have completed the module on *Types of Crop Protection Products*
Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper.  
|                  | ✓ Flipchart paper.  
|                  | ✓ Markers (4 colours).  
|                  | ✓ Coloured cards.  
|                  | ✓ Glue stick or blue tack.  
|                  | ✓ Pin board and pins.  
|                  | ✓ Masking tape.  
|                  | ✓ Sample containers or labels which state the mode of action of the product.  
| Time needed:     | 70 minutes (if less time, adjust each section accordingly)  
| Intended audience: | Farmers and crop protection product dealers (resellers)  
| Preparation:     | ✓ Flipchart on flipchart stand with the title “Chemical Groups and Modes of Action”, and the Lesson Objectives.  
|                  | ✓ Flipchart with general modes of action listed down one side and room allowed to write in definitions.  
|                  | ✓ Coloured cards with general modes of action (e.g. Broad spectrum, Narrow spectrum, Short term, Residual, etc).  
|                  | ✓ Print off sufficient Fact Sheets for participants.  
|                  | ✓ Print off sufficient Assessment question sheets.  
|                  | ✓ Print off sufficient Attendance Record sheets.  
|                  | ✓ Organise venue and seating arrangements.  

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### Set up/Introduction

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention:</td>
<td>Say that so far we have examined the classification of crop protection products in terms of type of pest controlled and of toxicity.</td>
</tr>
<tr>
<td></td>
<td>In this session we will look at two other methods of classification – Chemical Group and Mode of Action.</td>
</tr>
<tr>
<td>Title:</td>
<td>Refer to the Title Flipchart and tell participants that in this training session we will cover two other ways of classification - <em>Chemical Groups and Modes of Action</em>.</td>
</tr>
<tr>
<td>Credibility:</td>
<td>Explain your own experiences in crop protection products.</td>
</tr>
<tr>
<td>Objectives:</td>
<td>Refer to the Title Flipchart with the Lesson Objectives.</td>
</tr>
<tr>
<td></td>
<td>By the end of the lesson, participants will be able to explain and describe:</td>
</tr>
<tr>
<td></td>
<td>• Two additional ways of classifying crop protection products - Chemical Group and Mode of Action</td>
</tr>
<tr>
<td></td>
<td>• The importance of Mode of Action in product selection and the management if resistance.</td>
</tr>
<tr>
<td>Benefits:</td>
<td>The mode of action is important when selecting a crop protection product. When you are aware of the different modes of action, you can choose the crop protection product with the mode of action that is best for the job. Knowing the mode of action can also enable you to prevent the development of resistance to crop protection products.</td>
</tr>
<tr>
<td>Direction:</td>
<td>During this session, we will not discuss recommendations of crop protection products for specific crops. We will focus on the mode of action in general.</td>
</tr>
</tbody>
</table>

### Delivery

(80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 3 minutes</td>
<td><strong>Brainstorming – Different Types of Chemicals</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> what different types of chemicals there might be.</td>
</tr>
<tr>
<td></td>
<td><strong>Guide</strong> them to inorganic, organic, botanical and biological.</td>
</tr>
<tr>
<td></td>
<td><strong>Explain</strong> the differences between these types.</td>
</tr>
</tbody>
</table>
### Brainstorming – Mode of Action

**Ask** what participants think is meant by ‘Mode of Action’.

**Guide** them to an answer containing the following:
*The mode of action of a crop protection product is the way it works to control a pest.*

There are two aspects to the mode of action:
- The **general** mode of action (or use pattern)
- The **specific biochemical** mode of action (how it works to control the pest).

### Work Groups – Mode of Action

Divide the participants into 3-4 groups depending on numbers.

Give each group a crop protection product label.

**Work Group task:**
Identify the general mode of action (or use pattern) from the label.

Allow the groups a short time to examine the label.

**Ask** each group read the mode of action aloud e.g. residual, contact etc.

**Say** that we will look now into the differences between general modes of action.

**Hand out** the cards (one or two each for each group) with the general modes of action: Broad spectrum, narrow spectrum etc

**Workgroup task:**
- Each participant should discuss explain their definition with the other group members.
- Agree on a group definition of each term

### Work Group Results – Mode of Action

**Put up** the flipchart with the list of general modes of action terms.

**Ask** each group to give its definitions of the terms.

**Write** against each term the definition the participants provide. Modify each to match the definitions from the Fact Sheet.

**Ensure** the differences between general modes of action are discussed.
### Discussion – Mode of Action and Crop Protection Product Types

**Say** that we will now link the modes of action to the main types of crop protection products.

**Ask** for each mode of action term if it relates to insecticides, herbicides, fungicides or other crop protection product types.

**Write** the correct answers after the definitions on the flipchart.

**Ask** for each term if participants can name a crop protection product they use which works in that way.

**Ask** why the same type of crop protection product classification (e.g. insecticides, or herbicides) may have products with different modes of action.

**Guide** participants to the following answer: 
*There are a variety of different pest species that fall under the same broad type of pest. These different pest species may need to be controlled in different ways or at different times. Because of this, crop protection products come with different modes of action to suit different situations.*

### Brainstorming – Different Chemical Groups

**Say** that earlier in this session we divided crop protection chemicals into groups – inorganic, organic, botanical and biological.

**Ask** if participants can name any different chemical groups within these.

**List** any correct ones they name on the flipchart, using the chemical groups in the Fact Sheet as a checklist.

**Ask** what is the difference between them.

**Explain** that crop protection products in each group are similar and related (like a family).

### Work Groups – Biochemical Mode of Action of Chemical Groups

**Work Group task:**
- Discuss why the fact that crop protection products in each chemical group are similar might be important.

**Ask** each work group to report to the full group.

**Guide** the answers to the conclusion that each chemical group has a particular biochemical mode of action (i.e. how the chemical actually works to control the pest).

**Ask** the full group if they have seen different chemicals working in different ways.
### 8. Discussion - Resistance to Crop Protection Products

**5 minutes**

Ask if participants have heard of the term “resistance” in relation to crop protection products.

Ask what they understand ‘resistance’ to mean.

Guide participants to an explanation as described in the Fact Sheet.

---

### 9. Demonstration - Resistance

**5 minutes**

Ask everyone to stand up and divide themselves into two groups – tall people and short people.

Ask the short group if their parents were short or if their children are short.

Ask the tall group if their parents were tall or if their children are tall.

Don't embarrass anyone.

**Explain** that characteristics like height are inherited.

Ask the tall people to sit down.

Ask what would happen if over a number of generations if tall people never had children, and only short people had children.

Say everyone would be short and there would be no tall people.

**Explain** that

- The development of resistance by pests to a particular mode of action of crop protection product works the same way.
- To avoid resistance developing, pesticides from the same chemical group should not be repeatedly used.
### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong></td>
<td><strong>Review:</strong> General modes of action, Chemical groups and biochemical modes of action, Why this is important for resistance management.</td>
</tr>
</tbody>
</table>
| **2 minutes** | **Emphasise:** • Choosing the correct crop protection product type for the job  
|             | • Not using the same mode of action crop protection product all the time.  
|             | • Use IPM and do not rely on crop protection products only.  
|             | • The more participants know about the crop protection products they use, the better the results they will get. |
| **Questions:** | **Ask** if everyone understands or if there are any additional questions.  
| **1 minute** | Answer these provided they are relevant. |
| **Evaluation:** | **Ask** participants to define:  
| **12 minutes** | • Some of the Mode of Action terms,  
|             | • What chemical groups are,  
|             | • What the importance of mode of action is,  
|             | • What resistance is and how to prevent it.  
|             | **Hand out** the Assessment Sheet and ask participants to complete two of the questions.  
|             | **Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** | **Say** that now participants know the modes of action of crop protection products they can select the correct product for the pest and situation.  
| **1 minute** | **Hand out** the Fact Sheet to participants. |
Answer FIVE (5) only of the following questions. 
You may write your answers on this question sheet or tell your trainer the answers. 
All questions are the same value (2 marks).

Question: Explain any five of the following terms (2 marks each)

Mode of action

Broad spectrum (non-selective)

Narrow spectrum (selective)

Residual crop protection product

Contact crop protection product

Systemic insecticide

Translocated herbicide

Fumigant

Pre-emergence herbicide

Post emergence herbicide

Protectant fungicide

Resistance
FACT SHEET

In order to be able to choose the best crop protection product to use and to get the best results from the product, it is necessary to have some understanding of the chemical groups of crop protection products and how they work.

TYPES OF CROP PROTECTION PRODUCTS

There are a number of different crop protection product types targeting different pest types:
- Insecticides
- Herbicides
- Fungicides
- Molluscicides
- and so on

CHEMICAL TYPES

Broadly, these crop protection products may be one of the following chemical types:
- Inorganic: These are based on naturally occurring chemicals like arsenic, copper, mercury, sulphur, tin or zinc. Many of these compounds are now banned or have severely limited uses because they are general poisons and very hazardous.
- Organic: These are synthetic in that they have been developed by man. They are the most common crop protection products and there are many different chemical groups.
- Botanical: These are obtained from plant extracts.
- Biological/Microbial: These contain bacteria, viruses, protozoa, or fungi and therefore are not “chemicals”. The microorganisms control the target pest through infection causing a disease.

MODE OF ACTION

Crop protection products kill or disrupt a pest’s functions. This is called the mode of action. In other words: the mode of action is the way the crop protection product works or acts on the pest. This may be described as:
- The general mode of action (or use pattern);
- The specific biochemical mode of action (how it works to control the pest)

GENERAL MODES OF ACTION OR USE PATTERNS

Some important terms are:
- Broad spectrum (or non-selective): Broad spectrum crop protection products control a wide range of pests. For example, non-selective herbicides kill all plants. Broad spectrum insecticides, fungicides or animal drenches kill a wide range of target pests.
- Narrow spectrum (or selective): Narrow spectrum crop protection products control only certain specific pests. Selective herbicides may kill only broadleaf weeds, or only grass weeds. Narrow spectrum insecticides or animal drenches will kill only some pest types.
- Short-term control: Short-term effect means the pests are controlled quickly after application but there is limited or no long term control.
- Residual: Residual effect has a longer period of control after the application, usually because a residue of crop protection product remains. Herbicides, insecticides and fungicides may be residual.
- Contact: Contact insecticides and herbicides only kill a target pest when they come into direct contact with the crop protection product. They provide short-term control.
- Systemic insecticides and fungicides: Systemic insecticides are absorbed and move
within a plant, and kill the pest when it feeds on the plant. Systemic fungicides are absorbed and move within a plant to control fungal disease after infection. These are also called eradicants or curatives. Systemics usually give longer term control.

- **Stomach poisons**: A crop protection product that must be eaten by the insect pest to kill it. These crop protection products are more effective against pests which move around a lot.

- **Translocated herbicides**: The herbicide moves from the point of application to where it acts within the plant. It simply enters the plant, goes into the system, and disrupts the plant’s internal processes, killing it. Herbicides may move from leaves to the roots or from the roots to the leaves.

- **Pre-emergence herbicides**: Are applied to soil before weed seeds germinate.

- **Post-emergence herbicides**: Are applied to the growing weed. Post emergence herbicides may be contact or translocated.

- **Protectant fungicides**: Are applied to plant leaves before fungal spores infect the plant.

- **Eradicant (Curative or therapeutant) fungicides**: Are used to cure a fungal disease after infection has occurred – they are systemic and control from within the plant.

- **Fumigant**: An insecticide in vapour or gas form in the air which the pest breathes in. These crop protection products can only be used in enclosed spaces, such as greenhouses and warehouses. Some insecticides applied in the field may also have some fumigant action.

- **Insect Growth Regulators**: These crop protection products only affect a certain part of a pest’s life cycle or are used at a certain time. For example: disrupt the growth and development of insect life stages.

### TYPES OF CROP PROTECTION PRODUCTS AND GENERAL MODES OF ACTION

The table below shows the most commonly used crop protection products and their modes of action.

<table>
<thead>
<tr>
<th>Type of crop protection product</th>
<th>General mode of action</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Insecticides</strong></td>
<td>Short term or residual: Usually insecticides used in the pest control industry, or Contact or systemic: Usually crop protection insecticides, or Life-stage affected: Specialist insecticides used in the agricultural as well as pest control industries, or Fumigant, or A combination of the modes of action listed above.</td>
</tr>
<tr>
<td><strong>Fungicides</strong></td>
<td>Narrow or broad spectrum. Control mostly by contact, but systemic fungicides also exist. Protectants are applied to form a layer of fungicide on the plant and protect the plant from fungal infection. Eradicant (Curative or therapeutant) fungicides are systemic and can control fungal infections after a disease occurs.</td>
</tr>
<tr>
<td><strong>Herbicides</strong></td>
<td>Selective (either grasses only or broadleaf weeds only), or Non-selective action (kills every growing plant). May be contact or translocated through plant. May be residual or non-residual, short term or long term.</td>
</tr>
<tr>
<td><strong>Miticides</strong></td>
<td>Short term or residual, or Contact or systemic, or Life-stage affected: Specialist insecticides used in the agricultural as well as pest control industries, or A combination of the modes of action listed above.</td>
</tr>
</tbody>
</table>
5. Chemical Groups and Modes of Action of Crop Protection Products

<table>
<thead>
<tr>
<th>Chemical Groups</th>
<th>Mode of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nematicides</td>
<td>Contact (soil fumigants).</td>
</tr>
<tr>
<td>Molluscicides</td>
<td>Target pests ingest the crop protection product (usually as bait).</td>
</tr>
<tr>
<td>Rodenticides</td>
<td>Target pests ingest the crop protection product (usually as bait).</td>
</tr>
</tbody>
</table>

The same type of crop protection product (e.g. insecticides, herbicides, etc) can have different general modes of action. Also, under the same broad type of pest (insects, weeds, etc) there are a variety of different pest species. These different insect species must be controlled in different ways. Because of this, insecticides come with different modes of action in order to control different species of insects. Also, pests may need to be controlled at different times. For example, weeds may need to be controlled before the weed seed germinates, or fungal disease may need to be prevented before infection occurs, which require different general modes of action.

**CHEMICAL GROUP**

Within each crop protection product type and chemical type, there are many different chemical groups or chemical ‘families’. For example:

- Organochlorines
- Carbamates
- Organophosphates
- Pyrethroids
- Bipyridyls

Crop protection products within each of these have similar characteristics and biochemical modes of action.

**BIOCHEMICAL MODES OF ACTION**

As examples:

An insecticide may

- Disrupt the nervous system of an insect, or
- Break down the waxy outer covering (cuticle), or
- Disrupt feeding, or
- Disrupt the development of the insect through its life stages from egg to adult (these are insect growth regulators).

Herbicides may

- Disrupt a specific part of the photosynthesis mechanism, or
- Break down plant cell walls.

The biochemical mode of action of a product depends on the chemical family to which it belongs. All crop protection products in the same chemical family have the same biochemical mode of action.
IMPORTANCE OF MODE OF ACTION WHEN SELECTING A CROP PROTECTION PRODUCT

The mode of action plays an important role in selecting crop protection products for a specific pest. The mode of action:

- Tells the operator if the crop protection product is suitable for application to the targeted pest. Selecting the correct mode of action will give the best result in controlling the target pest.
- The general mode of action (use pattern) may determine the timing of application and the way in which it is applied. For example, protectant fungicides must be applied before there is any disease infection. Pre-emergence herbicides must be applied to soil before weed seeds germinate.
- Helps to prevent the development of resistance. Resistance is the ability of a pest to survive a dose of crop protection product that would normally kill it. This resistance can be passed from one generation of pests to the next – it is genetic and inherited. Resistance occurs in all pest types: insects, weeds, fungi, bacteria, animal parasites, mites, rodents and so on.
- By taking the mode of action into consideration, the possibility of applying an incorrect crop protection product is reduced.

RESISTANCE

Resistance develops when crop protection products with a specific biochemical mode of action are used repeatedly over many years. Most individual pests are susceptible and killed, but some survive because they are naturally not affected by the chemical. They reproduce, and gradually over many generations the number of resistant individuals increases until there are so many that crop protection products with that mode of action are no longer effective. Resistance can be passed from one generation of pests to the next – it is genetic and inherited.

To prevent resistance, do not continually use for year after year, crop protection products with the same biochemical mode of action. Also use other non-chemical controls as part of integrated pest management.

| Make sure you purchase and use the correct crop protection product |
|-------------------------| |
| Read the label for the mode of action of the product. Will it do what you want it to do? How and when should you apply it to control the pest? |

Source: FAO
6. THE MAIN TYPES OF PESTICIDE FORMULATIONS
Lesson Plan

<table>
<thead>
<tr>
<th>Materials needed:</th>
<th>Flipchart stand with paper.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flipchart paper.</td>
</tr>
<tr>
<td></td>
<td>Markers (4 colours).</td>
</tr>
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<td>Coloured cards.</td>
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<td>Glue stick or blue tack.</td>
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<td>Masking tape.</td>
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<td></td>
<td>Pin board and pins.</td>
</tr>
<tr>
<td></td>
<td>Sample containers or labels which state the mode of action of the product.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time needed:</th>
<th>60 minutes (if less time, adjust each section accordingly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intended audience:</td>
<td>Farmers and crop protection product dealers (resellers)</td>
</tr>
</tbody>
</table>

| Preparation:       | Flipchart on flipchart stand with the title “The Main Types of Pesticide Formulations”, and the Lesson Objectives. |
|                    | Small transparent plastic sachets:                   |
|                    | • 4 of cocoa powder or something resembling powder     |
|                    | • 4 of coffee, sugar, or something resembling granules |
|                    | • 4 of baby powder, or something resembling dust       |
|                    | 4 bottles of water or any other liquid                |
|                    | Coloured cards with the words:                        |
|                    | • LIQUIDS                                            |
|                    | • SOLID/DRY                                          |
|                    | • Dusts                                              |
|                    | • Granules                                           |
|                    | • Powders                                            |
|                    | Coloured cards with the words:                        |
|                    | • Emulsifiable Concentrate (EC)                      |
|                    | • Suspension Concentrate (SC)                        |
|                    | • Ultra Low Volume Concentrate (ULV)                 |
|                    | • Dusts                                              |
|                    | • Granules (G)                                       |
|                    | • Wettable Powder (WP)                               |
|                    | • Water dispersible granules (WG)                    |
|                    | Print off sufficient Fact Sheets for participants.   |
|                    | Print off sufficient Assessment question sheets.     |
|                    | Print off sufficient Attendance Record sheets.       |
|                    | Organise venue and seating arrangements.              |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction 5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention:</td>
<td>Ask participants what form medicines come in. They should answer: pills, liquids, powders, etc. Ask them why they come in those forms. Why can’t we just take the pure ingredients that are in the pills or powders? This is because sometimes the ingredients are too strong to take without mixing them with something. Also, the formulations help the medicine to be ingested in the right doses in the right places. Tell participants that it is exactly the same with pesticides. Pesticides also come in a form that makes them easier to apply and ensures that the correct doses are applied in the correct places.</td>
</tr>
<tr>
<td>Title:</td>
<td>Refer to the Title Flipchart and tell participants that in this training session we will cover The Main Types of Pesticide Formulations.</td>
</tr>
<tr>
<td>Credibility:</td>
<td>Explain your own experiences in crop protection products.</td>
</tr>
<tr>
<td>Objectives:</td>
<td>Refer to the Title Flipchart with the Lesson Objectives. By the end of the lesson, participants will be able to explain and describe: • The main types of pesticide formulations • The advantages and disadvantages of the formulation types</td>
</tr>
<tr>
<td>Benefits:</td>
<td>Understanding the different types of pesticide formulations will enable participants to select the correct formulation for a specific problem.</td>
</tr>
<tr>
<td>Direction:</td>
<td>During this session, we will focus on seven main pesticide formulations used in crop protection, not the whole range of pesticide formulations.</td>
</tr>
</tbody>
</table>
# Delivery (80-90% of total time)

## Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| 1. 5 minutes | Brainstorming – What is a Formulation?  
Ask: What is a formulation?  
Write in black the word ‘FORMULATION’ on the flipchart.  
Allow participants to offer some answers.  
Use the red marker to draw a square around “FORM” in FORMULATION.  
Ask: What is a formulation?  
Guide their answer to the form in which a pesticide is manufactured.  
Remind participants of the discussion about the form that medicines come in.  
Say that the active ingredients in pesticides cannot be applied directly on the crops, because they are either too concentrated, too toxic, or would not spread or stick properly to the plant surface. Therefore, manufacturers develop a formulation to make the pesticide more effective, safer, and easier to apply, handle, and store. The formulation helps to get the right doses in the right places. |
| 2. 5 minutes | Workgroups - Formulations  
Divide participants into 4 groups.  
Say that there are several types of formulations.  
Give each group a powder sachet, a granule sachet, a dust sachet, and a bottle of liquid.  
Tell the groups that you have given them four types of pesticide formulations.  
Work group task:  
• Discuss and agree which types of formulation they have.  
• Write their answers in their notebooks.  
Allow a few minutes for the groups to discuss. |
<table>
<thead>
<tr>
<th>3.</th>
<th><strong>Work Group Results - Formulations</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10 minutes</strong></td>
<td><strong>Ask</strong> the first group to hold up one of the formulations and tell the others what it is.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> if the other groups agree.</td>
</tr>
<tr>
<td></td>
<td>If they agree, <strong>paste</strong> the card with the corresponding name on the wall (you can paste the sachet next to it).</td>
</tr>
<tr>
<td></td>
<td><strong>Continue</strong> with the next group and ask them for another formulation.</td>
</tr>
<tr>
<td></td>
<td><strong>Continue</strong> until all formulations are discussed and their names are pasted on the wall next to each other.</td>
</tr>
<tr>
<td></td>
<td>(Make sure that the cards with the words Granules, Powder, and Dust are placed beside each other.)</td>
</tr>
<tr>
<td></td>
<td><strong>Explain</strong> that the formulations can be categorized into two groups:</td>
</tr>
<tr>
<td></td>
<td>• Liquid</td>
</tr>
<tr>
<td></td>
<td>• Solid (or dry)</td>
</tr>
<tr>
<td></td>
<td><strong>Paste</strong> the card with the words Solid/Dry above Granules, Powder, and Dust and explain that these are all solid or dry pesticides.</td>
</tr>
</tbody>
</table>
4. Discussion – Formulation Types

20 minutes

Explain that each category contains several formulations, using the solid/dry formulations from the previous activity as an example.

Start with the liquids. Paste the card with the word Liquids on the flipchart.

Ask if someone knows a formulation type of liquid pesticides (not a brand).

Tell participants you will only mention the main three most common types of liquid formulations (paste the coloured card when you mention the formulation):
- Emulsifiable Concentrates (EC)
- Suspension Concentrates (SC)
- Ultra Low Volume Concentrates (ULV)

Discuss for every formulation:
- The level of concentration
- How it is mixed
- The advantages and disadvantages

Involve participants by asking them questions.

Do not go into too much detail. Tell participants that this information is in the Fact Sheet.

Continue with the solid/dry pesticides:
- Dusts
- Granules (GR)
- Water Dispersible Granules (WG)
- Wettable Powders (WP)

Discuss for every formulation:
- The level of concentration
- How it is mixed
- The advantages and disadvantages

Ask where to find the formulation of pesticides on the label.
(It will be listed on the centre panel in the form of an abbreviation.)
### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Summary:** 1 minute | **Using** the cards on the flipchart, review:  
  • Reasons for pesticide formulations  
  • Liquid and dry formulations  
  • Examples of liquid and dry formulations |
| **Questions:** 1 minute | **Ask** if everyone understands or if there are any additional questions.  
  Answer these provided they are relevant. |
| **Evaluation:** 12 minutes | **Ask** participants:  
  • To describe a formulation.  
  • Why we need formulations of pesticides.  
  • To name two examples of dry formulations and two examples of liquid formulations.  
  • To name the disadvantages of a dusting powder.  
  **Hand out** the Assessment Sheet and ask participants to complete two of the questions.  
  **Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** 1 minute | **Say** in this session, we learned about the different pesticide formulations. In the next session, we will discuss the different types of pesticides.  
  **Hand out** the Fact Sheet. |
Answer THREE (3) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers.
All questions are the same value (5 marks).

Question 1: Why do we need to have pesticide formulations?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: Give two advantages of an emulsifiable concentrate formulation.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: Describe two types of liquid formulations and two types of solid formulations.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: Where on the label is the information regarding the type of formulation?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 5: What criteria are used when selecting for use a pesticide which has different formulations?
...........................................................................................................................................................................................
The pesticide formulation describes the form in which a pesticide is manufactured.

**WHY DO WE NEED FORMULATIONS?**

Pesticide chemicals cannot be used in their original active ingredient form. The active ingredient must be diluted with water, oil, air, or inactive solids to enable the user to apply the pesticide evenly over the application surface.

**PESTICIDE FORMULATIONS**

Pesticides can be divided into two main formulation types:
- Liquid
- Solid/Dry

**LIQUID FORMULATIONS**

Liquid formulations consist of emulsifiable concentrates, Ultra Low Volume concentrates, Solutions, aerosols and gas.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Concentrate</th>
<th>Mixing</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsifiable Concentrate (EC)</td>
<td>Very high</td>
<td>Usually mix with water</td>
<td>• High concentrate</td>
<td>• Higher possibility of poisoning</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Cost effective</td>
<td>• Corrosive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Easy to handle</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Need little agitation</td>
<td></td>
</tr>
<tr>
<td>Suspension Concentrate (SC)</td>
<td>Moderate</td>
<td>Usually mix with water</td>
<td>• Safer to use</td>
<td>• Need more agitation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Easy to handle</td>
<td>• May leave a visible residue</td>
</tr>
<tr>
<td>Ultra Low Volume Concentrate (ULV)</td>
<td>Moderate</td>
<td>Usually already mixed</td>
<td>• Effective for vector and locust control</td>
<td>• Need special equipment to apply</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with oil and ready for application</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**SOLID/DRY FORMULATIONS**

Solid or dry formulations consist of dusts, granules, and powders.

The most commonly used solid formulations of pesticides are:
### Formulations

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Concentrate</th>
<th>Mixing</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
</table>
| Dusts                        | Low         | Ready to use  | • Require simple equipment  
• Easy to apply  
• No mixing  | • Easily drift off target  
• Difficult to apply evenly  
• High possibility of inhalation |
| Granules (GR)                | Low         | Ready to use  | • Simple application.  
• No drift  
• Safe to use  
• No mixing  | • May need water to activate  
• Non-selective |
| Water Dispersible Granules (WG) | Moderate to low | Mix with water | • Easy to handle  
• Easy to mix and measure  | • Visible residue  
• Abrasive to spray equipment  
• Can easily clog nozzles |
| Wettable Powders (WP)        | Moderate to low | Mix with water | • Easy to handle  
• Easy to mix and measure  | • Inhalation hazard during handling  
• Visible residue  
• Abrasive to spray equipment.  
• Can easily clog nozzles |

**OTHER FORMULATIONS ARE:**

**Liquids**
- Flowables (FC)

**Solid/Dry**
- Soluble Powders (SP)
- Water Dispersible Powders (WS)
- Dusting Powders (DP)

**ADJUVANTS**

Sometimes a substance must be added to improve the effect of the pesticide. This is called an adjuvant. An adjuvant is added to the pesticide mixture, separate from the pesticide formulation, to improve the performance of the pesticide.

The most commonly used adjuvants are:
- **Wetter/spreaders/stickers:** Help the pesticide to spread and cling to the target surface.
- **Foam retardants:** Prevents the pesticide mix from becoming too foamy.
- **Drift retardants:** Clings to the small drops and lessens the possibility of drift.
6. The Main Types of Pesticide Formulations
7.1 HOW TO READ A PESTICIDE LABEL
Lesson Plan

Materials needed:
- Flipchart stand with paper.
- Flipchart paper.
- Markers (4 colours).
- Coloured cards.
- Glue stick or blue tack.
- Masking Tape.
- Pin board and pins.

Time needed: 45 minutes (if less time, adjust each section accordingly)

Intended audience: Farmers and crop protection product dealers (resellers)

Preparation:
- Flipchart on flipchart stand with the title “How to Read a Pesticide Label”, and the Lesson Objectives.
- 1 empty bottle of water.
- Sufficient copies of one of Visuals 1 to 5, depending on local language (if possible, better to have identical real labels).
- Coloured cards with label information headings:
  - Product Name
  - Active ingredient
  - Concentration of active ingredient and inert material
  - Crops and pests for which pesticide is registered
  - Dose rates
  - Toxicity and hazard warnings
  - Safety precautions
  - Pre-harvest interval
  - Pictograms
  - Expiry date
  - Registration number
  - Name of manufacturer
  - Note to the physician
  - First aid
- Flipchart paper with a large drawing of a label. Make sure that everything listed as basic information is present on the label (see example poster at the end of the lesson plan)
- Print off sufficient Fact Sheets for participants.
- Print off sufficient Assessment question sheets.
- Print off sufficient Attendance Record sheets.
- Organise venue and seating arrangements.

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
## 7.1 How to Read a Pesticide Label

### Set up/Introduction

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | **Show** participants the empty bottle of water and **ask** them what it is.  
The answer should be: An empty bottle of water.  
**Ask** them to tell you the brand name of the water.  
The answer should be: The brand name of the water on the label.  
**Ask** how they know the brand name.  
The answer should be: It is written on the label.  
**Tell** participants that the brand name of the water is written on the label and tells what is inside the bottle. Every pesticide container also has a label that tells what is inside the container. |
| **Title:** | **Refer** to the Title Flipchart and tell participants that this training session will cover *How to Read a Pesticide Label* |
| **Credibility:** | **Tell** participants your own story about using incorrect crop protection products. |
| **Objectives:** | **Refer** to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to:  
• Describe the different parts of a pesticide label and the types of information provided  
• Explain the information provided on the label and what it means |
| **Benefits:** | All information found on the label can help you provide better advice to customers. |
| **Direction:** | During this session, we will focus on the label, but will not discuss the Colour band. |
## Delivery

*(80-90% of total time)*

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. 15 minutes</strong></td>
<td><strong>Full Group Activity – Information on the Label</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Paste</strong> the label poster on the wall so it is visible to all participants, and <strong>ask</strong> them to join you in the front.</td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong> that this is a pesticide label and that it contains a lot of information about the plant protection product.</td>
</tr>
<tr>
<td></td>
<td><strong>Hand</strong> the coloured cards with label information headings to the participants. If possible, give each participant one card. Otherwise let two persons look at one card.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> them to think about the purpose of the information under that heading on the card each has received. Allow a short time for them to think and discuss.</td>
</tr>
<tr>
<td></td>
<td><strong>Call out</strong> one by one the information headings on the coloured cards.</td>
</tr>
<tr>
<td></td>
<td>The person who has that coloured card should:</td>
</tr>
<tr>
<td></td>
<td>• Come to the front,</td>
</tr>
<tr>
<td></td>
<td>• Identify the location of the information on the label poster,</td>
</tr>
<tr>
<td></td>
<td>• Stick the card next to the information on the poster, and</td>
</tr>
<tr>
<td></td>
<td>• Tell the other participants the purpose of this information.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> the other participants if they agree with this. If they do not, to explain why.</td>
</tr>
<tr>
<td></td>
<td><strong>Repeat</strong> for all the cards.</td>
</tr>
<tr>
<td></td>
<td>When all cards have been stuck in the poster in the correct place, ask everyone to go back to their seats.</td>
</tr>
<tr>
<td><strong>2. 10 minutes</strong></td>
<td><strong>Participant Pairs – Information on the Pesticide Label</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Divide</strong> participants into pairs.</td>
</tr>
<tr>
<td></td>
<td><strong>Give</strong> each pair a copy of a real pesticide label or the visual in the local language.</td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong> that all the information indicated on the label poster and cards is also printed on the label they were given.</td>
</tr>
<tr>
<td></td>
<td><strong>Go through</strong> all the information headings/cards on the poster one by one and ask the participants find the information on their label.</td>
</tr>
<tr>
<td></td>
<td><strong>Walk</strong> around to check that all pairs have identified the information.</td>
</tr>
<tr>
<td></td>
<td><strong>Repeat</strong> for each of the information headings/cards until all information is identified.</td>
</tr>
<tr>
<td></td>
<td>If you did not use the visuals in your exercise, show them to participants and tell them that every label is different.</td>
</tr>
</tbody>
</table>
## 7.1 How to Read a Pesticide Label

### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/ Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> 1 minute</td>
<td><strong>Review</strong> the information headings and cards on the label poster.</td>
</tr>
<tr>
<td><strong>Questions:</strong> 1 minute</td>
<td><strong>Ask</strong> if everyone understands or if there are any additional questions. Answer these provided they are relevant.</td>
</tr>
<tr>
<td><strong>Evaluation:</strong> 12 minutes</td>
<td><strong>Ask</strong> participants to describe the information about the product under several of the cards on the label poster. <strong>Hand out</strong> the Assessment Sheet and ask participants to complete two of the questions. <strong>Collect</strong> the Assessment Sheet for later marking and entering the marks on the Attendance Record.</td>
</tr>
<tr>
<td><strong>Next step:</strong> 1 minute</td>
<td><strong>Inform</strong> the group that the following lessons will look at the colour/pictogram band in detail <strong>Hand out</strong> the Fact Sheet to participants.</td>
</tr>
</tbody>
</table>
**Example Label**

<table>
<thead>
<tr>
<th>ERASE SC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Directions for Use</strong>  &lt;br&gt; Mix 12ml per 10 litres of water.  &lt;br&gt; Apply when young plants show shothole damage.  &lt;br&gt; Apply to maize funnel.  &lt;br&gt; Repeat after 14 days</td>
</tr>
<tr>
<td><strong>Pre-Harvest Interval</strong>  &lt;br&gt; Maize can be eaten 14 days after last treatment</td>
</tr>
<tr>
<td><strong>Symptoms of Poisoning</strong>  &lt;br&gt; • Salivation  &lt;br&gt; • Skin irritation</td>
</tr>
<tr>
<td><strong>First Aid</strong>  &lt;br&gt; • Remove patient from source of poisoning  &lt;br&gt; • Keep patient calm, and warm and comfortable</td>
</tr>
<tr>
<td><strong>Advice to Physician</strong>  &lt;br&gt; • Treat symptomatically  &lt;br&gt; • No known antidote</td>
</tr>
</tbody>
</table>

**1 litre**

**Caution**
7.1 How to Read a Pesticide Label

[Image of a pesticide label]

- **Precautions**: Wear protective clothing and gloves when using. Do not eat, drink, or smoke when applying pesticides. Wash hands thoroughly before eating, drinking, or smoking. Do not contaminate drinking water, food, or utensils. Keep out of reach of children.

- **Directions for Use**: Apply as a morning and evening spray. Do not allow pets or livestock to enter treated areas until the residue has dried. Store in a cool place away from children and pets.

- **Emergency Information**: In case of poisoning, seek immediate medical attention. Call your local poison control center or emergency services. Do not induce vomiting unless instructed by a medical professional. If swallowed, give 2-4 cups of water. If on skin, wash with soap and water. If in eyes, rinse with plenty of water for 15 minutes. If on clothing, remove immediately.

- **Technical Information**: Active Ingredient: difenoxurox. Use only as directed. Store in a cool, dry place.
**FONGICIDE SYSTEMIQUE**

Homologation : 132/00/FO/HOMO/CNHPA/CAM

(550 g/l de chlorothalonil + 100 g/l de carbendazime)

- **Spécial maraîché** -

**BANKO PLUS** est un fongicide systémique très performant grâce à sa composition double assurant une action préventive (empêchant l’installation du champignon) et curative (limitant son développement et inhibant sa sporulation).

**BANKO PLUS** se caractérise également par une longue rémanence (efficace durant 2 semaines) permettant de réduire et économiser la fréquence des traitements fongicides traditionnels. Il permet enfin de gérer les risques de résistance aux fongicides.

**Bien lire l’étiquette avant emploi**

**Volume net : 1 litre**

**CONSEILS DE PREPARATION**

Bien agiter l’emballage avant l’emploi.

Verser la quantité nécessaire de **BANKO PLUS** dans le pulvérisateur rempli d’eau aux 3/4. Agiter et compléter en eau. **BANKO PLUS** est compatible avec de nombreuses spécialités phytosanitaires. Toutefois, toute association doit faire l’objet d’un essai préalable et ne saurait engager la responsabilité du fournisseur. Par ailleurs, les mélanges avec les engrais liquides sont déconseillés.

**MESURES DE SECURITE**

- Irritant pour les yeux et la peau
- Conserver hors de portée des enfants
- Conserver à l’écart des aliments et boissons
- Ne pas fumer, manger ou boire pendant l’utilisation
- En cas de contact avec les yeux, laver immédiatement abondamment avec de l’eau et consulter un médecin
- Le chlorothalonil est toxique pour les poissons. Ne pas déverser dans les cours d’eau, mares, etc...

**Fabriqué par :**

**Distribuée au Cameroun par :**

FIMEX International BP 3224 DOUALA

**SECMBKPO**

**3CM00023**
7.1 How to Read a Pesticide Label
DOMINEX 100DT est un ectoparasiticide à large spectre d’activité pour la lutte contre les insectes et les tiques du bétail. Le produit allie un effet de choc et une longue action résiduelle sur les parasites du bétail à une faible toxicité vis-à-vis des mammifères.

RECOMMANDATIONS D’UTILISATION:
En tunnel, par pulvérisation manuelle ou en bain déticueur (en première charge): diluer 1 litre de Dominex 100DT par 2000 litres d’eau. Pour recharger l’équipement de pulvérisation ou ajuster le niveau du bain déticueur: diluer 1/2 litre de Dominex 100DT par 2000 litres d’eau ajoutée.

PREMIERS SOINS:
En cas de contact avec la peau: laver à l’eau et au savon.
En cas de contact avec les yeux: rincer à l’eau claire.
En cas d’ingestion: Ne PAS provoquer le vomissement. Appeler un médecin.

Note au Médecin: Ce produit contient des hydrocarbures aromatiques pouvant causer des dommages pulmonaires par aspiration. En cas d’ingestion procéder à un lavage gastrique avec intubation endotrachéenne. Traiter symptomatiquement. Éviter les graisses animales et végétales et l’alcool qui peuvent favoriser l’absorption.

OMS/FAO - Classe II - Modérément dangereux

NOÇIF EN CAS D’INGESTION ET PAR INHALATION
PRÉCAUTIONS:
Éviter tout contact avec les yeux, la peau et les vêtements.
Ne pas manger, boire ou fumer pendant l’utilisation.
Se laver les mains, les bras, le visage et toute autre partie du corps entrée en contact avec le produit à l’eau et au savon.
Éviter de contaminer les sources d’eau avec des emballages vides, des restes de produit ou de bouillie non utilisés ainsi que des eaux de rangement.
Détruire les emballages vides. Ne PAS les réutiliser.
NE PAS MÉLANGER DOMINEX 100DT À D’AUTRES PRODUITS.

STOCKAGE:
Conserver le Dominex 100DT dans son récipient d’origine hermétiquement fermé, dans un endroit aéré et, si possible, frais.
Stocker hors de la portée des enfants et à l’écart des denrées alimentaires et fourrages.

© Dominex et FMC sont des marques déposées de FMC Corporation
Date de production / Numéro de lot: voir emballage
10056881-15087614
7.1 How to Read a Pesticide Label

Visual 5
Assessment Questions

Name:  
Date:  
Mark:  

Answer THREE (3) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers.
All questions are the same value (5 marks).

Question 1: Why is important to read the label before using the product?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: Mention three types of information you can obtain by reading the label.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: What information is provided on the label under ‘Notes to Physician’?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: Where on the label will you find the crops and pests on which the product can be applied?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 5: Where would you find the name of the active ingredient(s) in the product?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

Every pesticide product has a label that contains instructions on how to handle and use the pesticide effectively and safely.

**Farmers and dealers must always read the label before handling a pesticide.**

**THE LABEL PANELS**

Each pesticide label contains several important sections. The label is usually made up of one, two or three panels. In the example below, the label has three panels: one centre panel and two side panels.

The centre panel usually contains:
- product name,
- formulation,
- composition and active ingredient,
- danger warning triangle,
- volume or mass of contents,
- registration number,
- usage declaration, and
- manufacturer’s logo.

The one or two side panels usually contain:
- directions for use,
- warnings,
- precautions,
- symptoms of poisoning,
- first aid instructions,
- notes for physicians,
- compatibility,
- batch number,
- date of manufacture, date of expiry, storage instructions,
- warranty,
- distributor’s details, and
- other notes.
SUBSTITUTIONS

When you are buying a plant protection product, the supplier may substitute one product for another if the active ingredient is the same. This does not necessarily mean that the substitute product is registered for your crop or pest situation. Do not accept a substitution until you have checked that the substitute product may be used on the crops that you wish to treat. If you are not sure, check with the manufacturer.

THE CENTRE PANEL

(Note: The information to be found on the centre panel can vary for each manufacturer. This is just an example.)

- **Product or trade name**: Name given by the manufacturer.
- **Active ingredient**: Chemical name given to the part of the pesticide formulation that controls or kills the target pest.
- **Net volume or mass**: How much is in the container.
- **Product registration number**: Official number issued by the national pesticide registration authority.
- **Formulation**: See session 5
- **Usage declaration**: Explains what the product will control or may be used for.
- **Manufacturers logo**
- **Colour band**: Indicates the level of toxicity and instructs how to safely handle the product. See session 6.2.
### Directions for use:

recommendations by crop and pest.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Pest</th>
<th>Dosage</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomatoes</td>
<td>Semi-looper</td>
<td>100 ml/100 litres water</td>
<td>Apply as a high volume, full cover spray and repeat as required.</td>
</tr>
<tr>
<td>Potatoes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beans</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbages</td>
<td>Diamond-back moth</td>
<td>100 ml/100 litres water</td>
<td>Commence spraying when infestation is noticed and repeat at weekly intervals.</td>
</tr>
<tr>
<td>Lawns</td>
<td>Lawn caterpillar</td>
<td>100 ml/100 litres water</td>
<td>Apply as a high volume, full cover spray. Commence spraying when infestation is noticed and repeat as required.</td>
</tr>
</tbody>
</table>

#### Warnings:

Advice on using the product.

### Shelf life (gives expiry date), date of manufacture, and batch number

**Date of manufacture:**

Batch No.: Bayer AG, Germany

Registered trade mark of Bayer AG, Germany

Code 1008642012958- Printed by TNS Print (01) 89443485A

---

(Note: The information to be found on the centre panel can vary for each manufacturer. This is just an example.)

---

**WARNING**

ALLOW 2 DAYS BETWEEN LAST APPLICATION AND HARVEST ON CABBAGES, TOMATOES AND POTATOES AND 3 DAYS ON BEANS.

TO CAUSE A HAZARD IN THE USE, STORAGE OR DISPOSAL OF THIS SUBSTANCE IS AN OFFENCE.

THIS PRODUCT WHEN STORED IN ITS UNOPENED ORIGINAL CONTAINER AWAY FROM DIRECT SUNLIGHT AND IN A COOL, DRY PLACE WILL BE FIT FOR USE FOR AT LEAST 18 MONTHS.
Precautions:
Precautions to take when using the product.

Symptoms of poisoning:
Description of symptoms that will occur in case of contamination.

First aid:
Description of steps to take in case of contamination.

Note to physicians:
Instructions for physicians on medicine to administer in case of contamination.
Centre Panel

Product or trade name: The name the manufacturer gives the product to distinguish it from other manufacturers’ products. Note that several products may contain the same active ingredient. A trade name is owned by a company and cannot be used by any other company for a pesticide (e.g., Gramoxone, Bravo). This is enforced by national and international legislation.

Active ingredient and composition: The active ingredient is the chemical name given to the part of the pesticide formulation that controls or kills the target pest. It is recognized internationally. The composition indicates how concentrated the product is.

Net volume or mass: How much of the pesticide is in the container.

Product registration number: The official registration number of the pesticide issued by the national pesticide registration authority.

Formulation: The pesticide must be suitably formulated to function properly or to be applied. Many possible formulations are described in Session 5.

Usage declaration: Describes what the product will control or be used for (crops and pests).

Manufacturer’s logo: Sometimes appears on the front and/or on the side panel of the label.

Colour band: Indicates the level of toxicity and instructs how to safely handle the product. The Colour band is described in detail in Session 6.2.

Side Panels

Directions for use: Recommendations on how to use the product, including a list of crops that the product can be applied to, application or dilution rates (such as grams/liter and liter/hectare), methods of application, and harvest intervals.

Warnings, precautions, or safety instructions: Tell the user what precautions to take when using the pesticide.

Expiry date, date of manufacture, and batch number: Important information; expired pesticides must not be used.

First aid instructions: Immediate actions to be taken when a suspected case of poisoning occurs.

Symptoms of poisoning: Describes the symptoms to look for if poisoning occurs, and the first aid measures to carry out.

Notes to physicians: Instructions for physicians on what to administer in case of poisoning.

Container storage: Explains how to store containers.

Compatibility: Describes what the pesticide can and cannot be mixed with.

Warranty: A declaration from the manufacturer or distributor on the contents, or activity of the contents, of the pesticide container.

Other notes: Any other notes from the manufacturer.
7.2 HOW TO READ THE COLOUR BAND
Lesson Plan

Materials needed:
- Flipchart stand with paper.
- Flipchart paper.
- Markers (4 colours).
- Coloured cards.
- Glue stick or blue tack.
- Masking Tape.
- Pin board and pins.
- Sample containers or labels.

Time needed: 75 minutes (if less time, adjust each section accordingly)

Intended audience: Farmers and crop protection product dealers (resellers)

Preparation:
- Flipchart on flipchart stand with the title “How to Read the Colour band”, and the Lesson Objectives.
- Real or copy pesticide label.
- 8 copies of visual 1 (coloured copies).
- 8 copies of visual 2 (these do not have to be coloured copies).
- Flipchart with a large diagram of the Colour band in Visual 2.
- Print off sufficient Fact Sheets for participants.
- Print off sufficient Assessment question sheets.
- Print off sufficient Attendance Record sheets.
- Organise venue and seating arrangements.

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### Set up/Introduction

**5 minutes (5-10% of total time)**

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention:</strong></td>
<td>Ask participants where to find the Colour Band on the label.</td>
</tr>
<tr>
<td></td>
<td>It is at the bottom of the centre panel.</td>
</tr>
<tr>
<td><strong>Title:</strong></td>
<td>Refer to the Title Flipchart and tell participants that this training session will cover <em>How to Read the Colour Band</em>.</td>
</tr>
<tr>
<td><strong>Credibility:</strong></td>
<td>Tell participants your own story about using incorrect crop protection products.</td>
</tr>
<tr>
<td><strong>Objectives:</strong></td>
<td>Refer to the Title Flipchart with the Lesson Objectives.</td>
</tr>
<tr>
<td></td>
<td>By the end of the lesson, participants will be able to:</td>
</tr>
<tr>
<td></td>
<td>• Read a Colour Band.</td>
</tr>
<tr>
<td></td>
<td>• Explain the meanings of the band colour and pictograms.</td>
</tr>
<tr>
<td><strong>Benefits:</strong></td>
<td>The colour band indicates the level of toxicity and instructs how to handle the product safely. This information is important for farmers and dealers to know so that they can avoid accidents.</td>
</tr>
<tr>
<td><strong>Direction:</strong></td>
<td>During this session, we will focus on the colour band and not on the other parts of the label, which were covered in the previous session.</td>
</tr>
</tbody>
</table>

### Delivery

**80-90% of total time**

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 2 minutes</td>
<td><strong>Presentation - The Colour Band</strong></td>
</tr>
<tr>
<td></td>
<td>Show participants the pesticide label and clearly indicate where to find the colour band (you can also ask them to look at the Visual that was handed out during session 6.1).</td>
</tr>
<tr>
<td></td>
<td>Say that there are two important parts of the colour band:</td>
</tr>
<tr>
<td></td>
<td>• The colour band</td>
</tr>
<tr>
<td></td>
<td>• The pictograms.</td>
</tr>
<tr>
<td></td>
<td>Say we will start with the colour band, and then we will discuss the pictograms.</td>
</tr>
<tr>
<td></td>
<td>Say that the colour band indicates the product’s level of hazard. There are five categories in four different colours. The categories and colours are internationally accepted.</td>
</tr>
</tbody>
</table>
2. **Work Groups – The Colour Band**

**Divide** participants into 4 groups.

**Give** each group two coloured copies of Visual 1 (two copies to ensure that every member of the group can clearly see the visual).

**Work group task:**
Agree among the group:
- How many different hazard categories there are.
- How many different colours there are
- The meaning of the different colours

Allow a few minutes for the groups to discuss and agree.

3. **Work Group Results – The Colour Band**

**Ask** the groups in rotation to give their answers to the work group questions.

**Ask** if the other groups agree with the answer.

**Write** the answers on the flipchart in the order:
- Red: Extremely hazardous
- Red: Highly hazardous
- Yellow: Moderately hazardous.
- Blue: Slightly hazardous.
- Green: Unlikely hazardous in normal use.

**Ensure** that participants understand exactly what each colour and hazard level means:

**Ask:**
- If pregnant women are allowed to handle pesticides in any of the hazard levels.
- If children are allowed to handle pesticides in any of the hazard levels.

The answer to both questions is No.
Pregnant women or children are never allowed to handle pesticides or any other inputs (not even green-labelled pesticides).

(Note: An alternative method of presenting these questions is to ask: Who thinks red-labelled products can be handled by pregnant women? Please raise your hand. Then: Who thinks yellow-labelled products can be handled by pregnant women? Please raise your hand, etc.)
### 4. Work Groups – Pictograms

**10 minutes**

**Say** that now we know the colour bands and hazard levels, we will continue with the pictograms on the band.

**Ask** if anyone knows what pictograms are.

Pictograms are small drawings that give advice on how to mix, apply, and store the pesticide. They also contain warnings.

Stick the flipchart with the drawing of Visual 2 on the wall and give two copies of Visual 2 to every group.

**Work Group task:**
- Discuss and agree how to read the colour band. Where do you start, and how do you read the rest?
- What does each of the pictograms mean?
- Select one person to report the results.

Allow 10 minutes for the groups to discuss and agree.

### 5. Work Group Results – Pictograms

**15 minutes**

**Group 1 Results:**

**Ask** the reporter from group 1 to indicate on the flipchart diagram of Visual 2 which part of the Pictogram band to read first.

**Ask** the other groups if they agree.

We start reading in the middle of the band. These pictograms indicate the level of hazard.

**Ask** the reporter from group 1 to say what the pictogram in the middle of the band on the visual means.

The skull and crossbones means that the product is extremely or highly hazardous.

**Ask** the reporter from group 1 which colour band indicates the same.

The answer is the red colour band.

**Show** them Visual 3 and explain that there is another pictogram that indicates the level of hazard: the cross. It indicates that the product is moderately hazardous.

**Ask** which colour band indicates the same level of hazard.

This is the yellow colour band.

**Group 2 Results:**

**Ask** the reporter from group 2 to indicate on the flipchart diagram of Visual 2 which part of the Pictogram band to read second.

**Ask** the other groups if they agree.
After reading the middle pictogram, we go to the left to the block containing four pictograms.

**Ask** the reporter from group 2 what this block indicates.

It shows how to protect ourselves when mixing the pesticide.

**Ask** the reporter from group 2 to indicate on the flipchart how we should read this block.

We start on the right side and then move to the left.

**Ask** the reporter from group 2 the meaning of the pictograms.

The far right pictogram means: When mixing, then…. The other three pictograms in boxes indicate: Wear gloves, face shield, and boots. Do not give more explanation, but continue with the next the next group report.

**Group 3 results**

**Ask** the reporter from group 3 to indicate on the flipchart diagram of Visual 2 which part of the Pictogram band to read third.

**Ask** the other groups if they agree.

We continue with the block on the right to the block containing four pictograms.

**Ask** the reporter from group 3 what this block indicates.

It shows how to protect ourselves when applying the pesticide.

Ask the reporter from group 3 to indicate on the flipchart how we should read this block.

We start on the left side and then go to the right.

**Ask** the reporter from group 3 the meaning of the pictograms.

The far left pictogram means: When applying, then…. The other pictograms indicate: Wear gloves, respirator, and boots.

**Say** that in the next activity will discuss these pictograms in more detail before completing the work group reports from Group 4 in activity 7.
Presentation/Discussion– Pictograms

Show Visual 4.

Explain that these three pictograms are always used in combination with the advice pictograms.

- They mean: When you do this, then you should wear that.
- The pictogram on the left means: When mixing liquids, wear...
- The pictogram in the middle means: When mixing powder or granules, wear...
- The pictogram on the right means: When spraying, wear...

Show Visual 5.

Explain that these pictograms give advice on what personal protective equipment to wear.

Ask in turn for each pictogram if anyone knows what the pictogram means.

Pictogram 1: Wear gloves
Pictogram 2: Wear boots
Pictogram 3: Wear an apron
Pictogram 4: Wear overalls
Pictogram 5: Wear a respirator
Pictogram 6: Wear eye mask
Pictogram 7: Wear face shield

Work Group Results – Pictograms (Continued)

Group 4 Results

Ask the reporter from group 4 to indicate on the flipchart diagram of Visual 2 the last three pictograms and to explain what they mean.

Ask the other groups if they agree.

Show Visual 6.

Explain that these pictograms also give advice.

Pictogram 1: Wash after handling or using plant protection products.
Pictogram 2: Keep pesticides locked away out of reach of children and animals.

Show Visual 7.

Explain that these are warning and other hazard pictograms.
Warning:
Pictogram 1: Dangerous to livestock and poultry
Pictogram 2: Dangerous to fish and water bodies

Hazard:
Pictogram 3: Corrosive
Pictogram 4: Explosive
Pictogram 5: Inflammable.
Finish  
(10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Summary:** 1 minute | **Review** using visual 2.  
• Repeat the 4 colours  
• What they indicate  
• How to read the colour band. |
| **Questions:** 1 minute | Ask if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |
| **Evaluation:** 12 minutes | Ask participants to name the order of hazards for the colour bands.  
Show Visual 2 and ask how to read the pictogram band.  
Indicate some pictograms and ask what they mean.  
Hand out the Assessment Sheet and ask participants to complete two of the questions.  
Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** 1 minute | Inform the participants that they now know how to read the label including the colour band.  
Say they should read labels with customers so that they know how to use the product and how to protect themselves.  
Hand out the Fact Sheet to participants. |
7.2 How to Read the Colour Band

Visual 1

HAZARD CLASSIFICATION

GROUP Ia

GROUP Ib

GROUP II

GROUP III

GROUP IV
Visual 2

Visual 3 - Level of hazard

Visual 4 - When..., Then...
Visual 5 - Advice

![Visual 5 - Advice](image1)

Visual 6 - Advice and storage

![Visual 6 - Advice and storage](image2)
Visual 7: Warning and Other Hazard

1. 
2. 
3. 
4. 
5. 
Assessment Questions

Name: ...........................................  Date: .................  Mark: 

*Answer TWO (2) only of the following questions.*

You may write your answers on this question sheet or tell your trainer the answers.

*All questions are the same value (5 marks).*

**Question 1:** How many colour bands are there?

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**Question 2:** What is indicated by a red colour band?

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...........................................................................................................................................................................................

**Question 3:** What is the correct way to read a toxicological colour band?

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...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 4:** What type of PPE should be worn while using green-labelled pesticides?

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET
The colour band can be found on the centre panel of the pesticide label.

The Colour Band indicates the level of toxicity and instructs how to safely handle the product.

The Colour Band contains two important items:
- The colour of the band
- The pictograms
The Colour Band

The colour of the band indicates the product’s level of hazard. There are 5 categories in 4 different colours. The categories and colours are internationally accepted.

**Colour: Red**
Group: Ia and Ib
Extremely and highly hazardous

**Colour: Yellow**
Group: II
Moderately hazardous

**Colour: Blue**
Group: III
Slightly hazardous

**Colour: Green**
Group: IV
Unlikely hazardous in normal use

The Pictograms

Pictograms are small drawings that give advice on how to mix, apply, and store the pesticide. They also contain warnings. Pictograms should be read in a specific order:
1. Start in the middle where you will find a pictogram with the level of hazard.
2. Go the left side.
3. The pictograms in the box should be read from right to left.
4. Go the right side.
5. The pictograms in the box should be read from left to right.

Each pictogram has its own meaning. The most common are:
Level of hazard

Extremely or highly hazardous (red colour band)

Slightly hazardous (yellow colour band)

Storage

Keep pesticides locked away out of reach of children and animals

Advice

Wash after use

Warning

Hazard

Corrosive

Explosive

Inflammmable

Protection

The following pictograms are always used in combination with the advice pictograms.
For example: **When mixing, then** wear gloves, eye protection, and boots.

- **When mixing liquid, then...**
- **When mixing powder or granules, then...**
- **When spraying, then...**

### ADVICE

- Wear Gloves
- Wear Protection over nose and mouth
- Wear Eye Protection
- Wear Respirator
- Wear Boots
- Wear Overalls
- Wear Apron
- Wash after use
8. PROTECTING THE ENVIRONMENT

Before attempting this module, participants should have completed the module on *Types of Crop Protection Products*
Lesson Plan

| Materials needed: | ☑ Flipchart stand with paper.  
|                  | ☑ Flipchart paper.  
|                  | ☑ Markers (4 colours).  
|                  | ☑ Coloured cards.  
|                  | ☑ Glue stick or blue tack.  
|                  | ☑ Masking Tape.  
|                  | ☑ Pin board and pins.  
|                  | ☑ Sample containers or labels.  
|                  | ☑ A range of different nozzles.  
|                  | ☑ A small sprayer to be able to demonstrate the effect on drift of large and small droplets. |
| Time needed:     | 80 minutes (if less time, adjust each section accordingly) |
| Intended audience: | Farmers and crop protection product dealers (resellers) |
| Preparation:     | ☑ Flipchart on flipchart stand with the title “Protecting the Environment”, and the Lesson Objectives.  
|                  | ☑ Print off sufficient Fact Sheets for participants.  
|                  | ☑ Print off sufficient Assessment question sheets.  
|                  | ☑ Print off sufficient Attendance Record sheets.  
|                  | ☑ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction
5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention</td>
<td>Ask participants if they know of any cases of environmental damage by crop protection products. If none, relate some of your experiences.</td>
</tr>
<tr>
<td>Title</td>
<td>Refer to the Title Flipchart and tell participants that this training session will cover <em>Protecting the Environment</em>.</td>
</tr>
<tr>
<td>Credibility</td>
<td>Explain cases of environmental damage from crop protection products that you know about.</td>
</tr>
<tr>
<td>Objectives</td>
<td>Refer to the Title Flipchart with the Lesson Objectives. By the end of the lesson, participants will be able to: • Describe the potential environmental damage that incorrect use of crop protection products may cause. • Implement procedures to prevent environmental damage.</td>
</tr>
<tr>
<td>Benefits</td>
<td>Environmental contamination by crop protection products can be both expensive and cause many problems. This needs to be prevented.</td>
</tr>
<tr>
<td>Direction</td>
<td>During this session, we will focus the damage caused by environmental pollution, what the causes are, and how it can be prevented.</td>
</tr>
</tbody>
</table>

Delivery
(80-90% of total time)

Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| 1. 5 minutes | **Discussion – What is the Environment and Sensitive Areas**  
Ask participants to explain their understanding of what the environment is.  
Ask them to explain their understanding of sensitive areas – places that are easily harmed by crop protection products.  
List responses in key words on the flipchart. |
| 2. 10 minutes | **Work Groups – How Crop Protection Products Might Pollute the Environment**  
Divide the participants into 3-4 groups depending on numbers.  
Work Group task: • List how crop protection products might pollute the environment.  
Allow a few minutes for the activity.  
Ask each group to present their list, and allow a short time for discussion.  
**Summarise** the answers to a single list on a flipchart with the heading ‘Sources of Contamination’. Use the list in the Fact Sheet as a checklist. |
<table>
<thead>
<tr>
<th>3.</th>
<th><strong>Work Groups – Problems that Contamination Might Cause</strong></th>
</tr>
</thead>
</table>
| **15 minutes** | **Work Group task:**  
  • List the problems this contamination might cause.  
  **Ask** each group to present their list, and allow a short time for discussion.  
  **Summarise** the answers to a single list on a flipchart and place this beside the first chart. Use the list in the Fact Sheet as a checklist.  
  **Emphasise** sensitive areas. |
| 4. | **Work Groups – Prevention of Environmental Pollution** |
| **15 minutes** | **Work Group task:**  
  • Discuss the ways in which environmental pollution may be prevented.  
  **Ask** each group to present their list, and allow a short time for discussion.  
  **List** the answers on a flipchart.  
  • Safe handling  
  • Safe transport  
  • Safe storage  
  • Safe disposal of waste  
  • Safe application  
  **Discuss** each in turn. |
| 5. | **Work Groups – Spray Drift** |
| **15 minutes** | **Say** that spray drift is a common cause of environmental pollution.  
  **Ask** what could cause spray to drift outside the target area.  
  **Write** answers on the flipchart  
  **Work Group task:**  
  • List the ways in which spray drift can be minimised.  
  **Ask** each group to present their list.  
  **Collate** their answers and summarise to a list of the 10 steps on a flipchart. Discuss each one.  
  **Using** a little sprayer, demonstrate the effect of fine and coarse droplets and how each differs with regard to drift. |
## 8. Protecting the Environment

### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
<th>Time</th>
</tr>
</thead>
</table>
| **Summary:** 1 minute | Review and emphasise, using the flipcharts:  
• The importance of minimising environmental contamination  
• The causes of environmental contamination  
• How to avoid environmental contamination |  |
| **Questions:** 1 minute | Ask if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |  |
| **Evaluation:** 12 minutes | Ask  
• What are sensitive areas,  
• What damage can be caused to the environment,  
• How drift might be avoided.  
Hand out the Assessment Sheet and ask participants to complete two of the questions.  
Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record. |  |
| **Next step:** 1 minute | Remind participants that every time spraying is done, they should assess the risks and take steps to minimise environmental contamination.  
Other training sessions will cover the details of transport, storage and application.  
Hand out the Fact Sheet. |  |
Assessment Questions

Name: ..................................................  Date: ..................  Mark: 

Answer TWO (2) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

Question 1: Give five ways crop protection products may enter the environment.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: Give five problems that may be caused by crop protection products entering the environment.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: Give five sensitive areas that may be easily damaged by crop protection products.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: Give five ways to prevent environmental contamination.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 5: Give five ways to prevent spray drift.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
WHAT IS THE ENVIRONMENT

The environment is everything around us. It includes not only the “natural” elements such as soil, water and air, but also people, plants, animals, indoors/outdoors, fields, gardens, houses, offices, etc. We are dependent on the environment for our survival. If crop protection products are used incorrectly or without due consideration, they can affect beneficial insects, birds, fish and domestic animals, they can contaminate sources of drinking and washing water, and they can contaminate our food and living and working areas.

It is the responsibility of everyone to use crop protection products correctly and to follow practices that minimise environmental contamination, such as following the principles of IPM.

In addition, environmental contamination by crop production products should be minimised by:

• Careful transport, storage, handling and application.
• Application based on pest scouting and threshold levels.
• Using the correct dose rates.
• Using application methods that both minimise the amounts used and also ensure that the crop protection product is only applied to the target area.

SOURCES OF ENVIRONMENTAL CONTAMINATION BY CROP PROTECTION PRODUCTS

Common causes of environmental contamination are through atmospheric pollution, water pollution and soil pollution:

• Use at the site of application. Even a correct application puts a crop protection product into the environment.
• Excess application leading to run-off from the plants or other treated surfaces.
• Drift of spray droplets or vapour during application, or application during windy weather.
• Spills and leaks during storage, transport, mixing and use, which are not cleaned up.
• Water used for personal washing, and for cleaning equipment and clothing.
• Improper disposal of excess spray mix.
• Improper disposal of empty crop protection product containers.
• Over dosing during application.
• Fires in crop protection product stores.

PROBLEMS CAUSED

• Leaching through the soil into ground water.
• Carried across the field in irrigation water.
• Residues in food stuffs from contaminated food crops or pasture.
• Damage to crops that are affected by spray drift.
• Adverse effects on the health of people, livestock, wildlife, or beneficial organisms.
• Adverse public opinion
• Poisoning hazard to man
• Poisoning hazard to the environment, e.g. to fish and other aquatic organisms.
• Pollution by litter

Some crop protection products breakdown very quickly in the environment, others break down very slowly. Crop protection products which persist or accumulate in the environment for a long period of time cause greater problems. The persistence of a crop protection product is a measure of how long it remains active before being degraded or broken down. A crop protection product with long persistence will remain in the environment for a longer period and have more chance to move from the site where it was applied than a crop protection product with short persistence.
SENSITIVE AREAS

Some areas of the environment are more at risk than others, as people, animals, plants, or other living organisms in such areas are more likely to be injured by a crop protection product. These sensitive areas include:

Indoors:
- Places where people – especially children, pregnant women, the elderly and the sick – live, work, or are cared for.
- Places where food is processed, stored, prepared, or eaten.
- Places where domestic animals are kept, live, and eat.

Outdoors:
- Areas near open or surface water, or where the ground water is close to the surface.
- Areas near schools, playgrounds, hospitals, gardens, or where food or fodder is processed.
- Areas where honey bees are active.
- Areas near food or fodder crops which are not intended to be treated.
- Water Sources for Drinking – Wells, Boreholes, Ponds, Lakes, Dams
- Water courses – streams, rivers
- Water Sources for Irrigation – hazard to other crops
- Cultivated lands
- Existing crops
- Following crops
- Uncultivated lands
- Natural vegetation
- Wild life
- Beneficial (natural enemies, bees)

HOW DO WE PROTECT THE ENVIRONMENT?

Risks can be minimised with care.
- Safe handling
- Safe transport
- Safe disposal
- Safe storage
- Safe application

SAFE HANDLING

- Take care not to spill crop protection product when measuring and mixing.
- Be careful unloading crop protection products from transport vehicles.
- Make sure application equipment is not leaking.
- Put your container washings into the sprayer
- Carefully dispose your sprayer washings
- Any spillages must be dealt with immediately
- Avoid contamination of self and surrounds
- Use protective clothing and safety equipment (PPE)
- Use mechanical handling equipment if available. Avoid use of sharp handling equipment.
- Avoid equipment likely to increase risk of spills
- Place damaged containers in secondary container for later treatment – label
SAFE TRANSPORT

- Separate from passenger cab
- Separate from foods and feedstuffs
- Prevent spills and container damage
- Load safely
- Secure load
- Route selection/vehicle security
- Carry safety and spill handling equipment
- Be aware of Dangerous Goods requirements

SAFE DISPOSAL

- Dispose packaging as instructed
- Spillages must be absorbed, removed, disposed of in a safe place
- Do not spray in strong wind
- Triple rinse containers when empty – put the rinse water into the spray tank.
- Dispose of empty containers correctly.

SAFE STORAGE

- Make sure stores are well designed to contain spills and prevent contamination if there is a fire.

SAFE APPLICATION

- Aim to minimise:
  - Contamination of ground water
  - Contamination of surface water
  - Contamination of nearby people, crops or animals
  - Contamination of soil
  - Drift of spray and vapour

10 STEPS TO MANAGING DRIFT

1. Check the label for any directions on how to minimise drift.
2. Identify sensitive areas that may be harmed. Do a risk assessment.
3. Communicate with those who may be affected by spray drift. Talk to your neighbours.
4. Do not spray in adverse weather conditions. Think about the forecast - what is the weather going to do? Do not spray if the wind is strong or blowing towards a sensitive area. Do not spray in very hot (above 30 degrees C) or very cold (below 10 degrees C) temperatures. In high temperatures, it is uncomfortable for the operator, there is a risk of evaporation, and plants may be stressed. In cold weather, crop protection products do not work very well. In very dry conditions (low humidity) evaporation of spray droplets can be excessive. Be careful of cold air moving down a slope carrying crop protection product drift with it. Record the weather conditions.
5. Do not spray in windy conditions, or when the wind direction is changeable.
6. Control droplet size. Very fine droplets are the ones which drift. Large droplets do not drift but also do not give good coverage of the target. Select nozzles which give medium sized spray droplets. High spray pressures also give fine droplets, so if drift is likely, use a lower pressure if possible. Some adjuvants make droplets larger or reduce evaporation.
7. Be careful how you spray. Do not spray into the wind. Keep the nozzle close to the target. Try to avoid spraying up into the air – make sure spray is directed towards the target. Be extra careful spraying trees.
8. Sprayers may be modified with shields, hoods or covers to trap droplets underneath. This works well if spraying has to be done in windy weather.

9. Try to leave a buffer zone around sensitive areas. If possible do not crop close to waterways or houses. Plant rows of trees or shrubs to protect the sensitive areas.

10. Keep records of all spray application including products used, amounts used, equipment used, and the weather conditions. Good records can help with decision making and is a record of what was done.
8. Protecting the Environment
9.1 GUIDELINES FOR BUYING CROP PROTECTION PRODUCTS
Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper. |
|                  | ✓ Flipchart paper.           |
|                  | ✓ Markers (4 colours).       |
|                  | ✓ Coloured cards.            |
|                  | ✓ Glue stick or blue tack.   |
|                  | ✓ Masking Tape.              |
|                  | ✓ Pin board and pins.        |
|                  | ✓ Sample containers – appropriate and inappropriate. |

| Time needed:     | 65 minutes (if less time, adjust each section accordingly) |
| Intended audience: | Farmers and crop protection product dealers (resellers) |
| Preparation:     | ✓ Flipchart on flipchart stand with the title “Guidelines for Buying Crop Protection Products”, and the Lesson Objectives. |
|                  | ✓ PowerPoint presentation of visuals. |
|                  | ✓ Print off sufficient Fact Sheets for participants. |
|                  | ✓ Print off sufficient Assessment question sheets. |
|                  | ✓ Print off sufficient Attendance Record sheets. |
|                  | ✓ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### Set up/Introduction

5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attention:</td>
<td><strong>Ask</strong> participants about their experiences in buying crop protection products.</td>
</tr>
<tr>
<td></td>
<td><strong>Record</strong> their answers on flipchart.</td>
</tr>
<tr>
<td>Title:</td>
<td><strong>Refer</strong> to the Title Flipchart and tell participants that this training session will cover <em>Guidelines for Buying Crop Protection Products</em>.</td>
</tr>
<tr>
<td>Credibility:</td>
<td><strong>Explain</strong> your own experiences in purchasing crop protection products.</td>
</tr>
<tr>
<td>Objectives:</td>
<td><strong>Refer</strong> to the Title Flipchart with the Lesson Objectives.</td>
</tr>
<tr>
<td></td>
<td>By the end of the lesson, participants will be able to explain and describe the four categories of guidelines:</td>
</tr>
<tr>
<td></td>
<td>• Genuine and registered products</td>
</tr>
<tr>
<td></td>
<td>• Planning</td>
</tr>
<tr>
<td></td>
<td>• Labels and packaging</td>
</tr>
<tr>
<td></td>
<td>• Other issues</td>
</tr>
<tr>
<td>Benefits:</td>
<td>Farmers or dealers who do not buy the correct products in the correct quantity, quality, or at the correct time will lose money, and crop yield, or customers. These guidelines can help you avoid pitfalls when buying or selling crop protection products.</td>
</tr>
<tr>
<td>Direction:</td>
<td>During this session, we will largely focus on the guidelines for farmers who buy crop protection products from dealers, wholesalers, or retailers.</td>
</tr>
</tbody>
</table>

### Delivery

(80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> 10 minutes</td>
<td><strong>Discussion – Correct Buying of Crop Protection Products</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Ask:</strong></td>
</tr>
<tr>
<td></td>
<td>• Why it is important to buy crop protection products correctly?</td>
</tr>
<tr>
<td></td>
<td>• What are the consequences when crop protection products are not bought correctly?</td>
</tr>
<tr>
<td></td>
<td>Let the group offer various answers.</td>
</tr>
<tr>
<td></td>
<td><strong>Write</strong> the answers on the flipchart.</td>
</tr>
<tr>
<td></td>
<td>Possible answers are:</td>
</tr>
<tr>
<td></td>
<td>• Buying the right quantity prevents obsolete stock.</td>
</tr>
<tr>
<td></td>
<td>• Farmers will be satisfied if they can buy the products they need.</td>
</tr>
<tr>
<td></td>
<td>• Buying only genuine and registered products prevents bringing counterfeit and illegal products on the market.</td>
</tr>
<tr>
<td></td>
<td><strong>Add</strong> their other contributions. Give praise for contributions.</td>
</tr>
<tr>
<td>Work Groups – Guidelines for Buying Crop Protection Products</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Divide participants into three groups.</td>
<td></td>
</tr>
<tr>
<td>Say that in this group activity we will examine guidelines for preventing farmers from making mistakes when they buy crop protection products.</td>
<td></td>
</tr>
<tr>
<td>Say that we can categorize the guidelines into four categories:</td>
<td></td>
</tr>
<tr>
<td>• Genuine and registered products</td>
<td></td>
</tr>
<tr>
<td>• Planning</td>
<td></td>
</tr>
<tr>
<td>• Labels and packaging</td>
<td></td>
</tr>
<tr>
<td>• Other issues</td>
<td></td>
</tr>
<tr>
<td>Work Group task:</td>
<td></td>
</tr>
<tr>
<td>• Under each category, list three guidelines for preventing farmers from making mistakes when they buy crop protection products.</td>
<td></td>
</tr>
<tr>
<td>Let the groups work for a few minutes.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work Group Results – Genuine and Registered Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say that we will start with Genuine and Registered Products.</td>
</tr>
<tr>
<td>Ask each group in turn for a guideline that falls under that category.</td>
</tr>
<tr>
<td>• If the guidelines are correct, write them on the flipchart.</td>
</tr>
<tr>
<td>• If a guideline is mentioned that belongs to one of the other categories, say that we will discuss that guideline later.</td>
</tr>
<tr>
<td>• If the guideline is incorrect, ask if other groups agree, and guide them to a correct guideline.</td>
</tr>
<tr>
<td>Do not discuss the results for too long.</td>
</tr>
<tr>
<td>Ensure that the following guidelines are mentioned under Genuine and Registered Products:</td>
</tr>
<tr>
<td>• Buy only from reliable and trusted suppliers. Avoid buying from strangers who suddenly appear in an area selling crop protection products to farmers.</td>
</tr>
<tr>
<td>• Buy products that are registered in the country for the intended use.</td>
</tr>
<tr>
<td>• Buy products that have been manufactured or formulated by reputable companies, both international and local.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Work Group Results – Planning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say that we will now examine the guidelines under Planning.</td>
</tr>
<tr>
<td>Repeat the group results as for the previous activity.</td>
</tr>
<tr>
<td>Ensure that the following guidelines are mentioned under Planning:</td>
</tr>
<tr>
<td>• Order and buy products in a timely manner. Place orders well before the season begins. Take into account delivery and transport delays.</td>
</tr>
<tr>
<td>• Buy the appropriate amount. Do not buy large packs at discount prices. This may seem financially expedient, but could result in the crop protection product not being used before its expiry date.</td>
</tr>
<tr>
<td>• Consider the capacity of your store. Ensure that there is enough space to safely store all products.</td>
</tr>
<tr>
<td>5. Work Group Results - Labels and Packaging</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Say that we will now examine the guidelines under <em>Labels and Packaging</em>.</td>
</tr>
<tr>
<td>Repeat the group results as for the previous activities.</td>
</tr>
<tr>
<td>Ensure that the following guidelines are mentioned under Labels and Packaging:</td>
</tr>
<tr>
<td>• Check that the labels on the packages are intact, written in the official national language of your country, and readable.</td>
</tr>
<tr>
<td>• Read the labels to ensure that it is the correct product.</td>
</tr>
<tr>
<td>• Check that the products have not expired or are not about to expire before they are sold.</td>
</tr>
<tr>
<td>• Buy only products that are in their original containers.</td>
</tr>
<tr>
<td>• Check that the containers are intact and not damaged or leaking.</td>
</tr>
<tr>
<td>• Check that the containers are sealed and that the cap or lid has not been tampered with.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Work Group Results - Other Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Say that we will now examine the guidelines under <em>Other Issues</em>.</td>
</tr>
<tr>
<td>Repeat the group results as for the previous activities.</td>
</tr>
<tr>
<td>• Ensure that the following guidelines are mentioned under Other Issues:</td>
</tr>
<tr>
<td>• Ask for advice if you are in doubt about anything. Extension officers or the national association for crop protection product dealers can give you advice.</td>
</tr>
<tr>
<td>• Always try to buy less toxic crop protection products, which are safer and easier to use.</td>
</tr>
<tr>
<td>• Ensure you have been properly trained by an accredited organisation</td>
</tr>
<tr>
<td>• Do not use used crop protection product containers for storing food or carrying water.</td>
</tr>
<tr>
<td>• Safely transport the crop protection products, away from passengers and food.</td>
</tr>
<tr>
<td>• Safely store the crop protection products, away from people and food.</td>
</tr>
</tbody>
</table>
### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Summary:** 1 minute | **Review** the four guideline categories  
Say that following these guidelines will help them to avoid problems when buying crop protection products. |
| **Questions:** 1 minute | **Ask** if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |
| **Evaluation:** 12 minutes | **Ask:**  
- What are the four guideline categories when buying crop protection products?  
- What are some of the guidelines under each category?  
**Hand out** the Assessment Sheet and ask participants to complete two of the questions.  
**Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** 1 minute | **Say** in this session,  
- We learned about the guidelines for buying crop protection products.  
- Before the next season starts, remember these guidelines and use them when buying crop protection products.  
**Hand out** the fact sheet to participants. |
Answer TWO (2) only of the following questions. 
You may write your answers on this question sheet or tell your trainer the answers. 
All questions are the same value (5 marks).

**Question 1:** What are the different categories of guidelines when buying crop protection products?

...........................................................................................................................................................................................
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...........................................................................................................................................................................................

**Question 2:** When buying crop protection products, why is it important to have an intact label on the container?

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...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 3:** Why is it important to plan ahead for crop protection product purchases?

...........................................................................................................................................................................................
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...........................................................................................................................................................................................

**Question 4:** When seeking advice, to whom should you go to get the correct advice about crop protection products?

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
**FACT SHEET**

Correct buying of crop protection products is an important activity because:

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="source" alt="Image" /></td>
<td>Buying the right quantity prevents obsolete stock</td>
</tr>
<tr>
<td><img src="source" alt="Image" /></td>
<td>Customers will be satisfied if they can buy the products they need.</td>
</tr>
<tr>
<td><img src="source" alt="Image" /></td>
<td>Buying only genuine and registered products prevents bringing counterfeit and illegal products on the market.</td>
</tr>
</tbody>
</table>

### GENUINE AND REGISTERED PRODUCTS

<table>
<thead>
<tr>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="source" alt="Image" /></td>
<td>Buy only from reliable and trusted suppliers. Avoid buying from strangers who suddenly appear in an area selling crop protection products to dealers</td>
</tr>
<tr>
<td><img src="source" alt="Image" /></td>
<td>Buy products that are registered in the country for the intended use.</td>
</tr>
<tr>
<td><img src="source" alt="Image" /></td>
<td>Buy products that have been manufactured or formulated by reputable companies, both international and local.</td>
</tr>
</tbody>
</table>

Source: FAO
### PLANNING

<table>
<thead>
<tr>
<th>Image</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image](73x635 to 222x731)</td>
<td><strong>Order and buy products in a timely manner.</strong> Place orders well before the season begins. Take into account delivery and transport delays.</td>
</tr>
<tr>
<td>![Image](80x527 to 215x623)</td>
<td><strong>Buy the appropriate amount.</strong> Do not buy large packs at discount prices. This may seem financially expedient but could result in the crop protection product not being sold before its expiration date. If you do not buy enough crop protection products, you will lose sales by not supplying your customers.</td>
</tr>
<tr>
<td>![Image](59x431 to 234x520)</td>
<td><strong>Consider the capacity of your store.</strong> Ensure that there is enough space to safely store all products.</td>
</tr>
</tbody>
</table>

*Source: FAO*
### LABELS AND PACKAGING

<table>
<thead>
<tr>
<th>Image</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Ensure that the labels on the packages are intact, written in the official national language of your country, and readable.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Read the label to ensure that it is the correct product.</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Ensure that the products have not expired or are not about to expire before they are sold.</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>Buy only products that are in their original containers.</td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>Ensure that the containers are intact and not damaged or leaking.</td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>Ensure that the containers are sealed and that the cap or lid has not been tampered with.</td>
</tr>
</tbody>
</table>

### OTHER ISSUES

Source: FAO
### Guidelines for Buying Crop Protection Products

<table>
<thead>
<tr>
<th>Advice</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask for advice if you are in doubt about anything.</td>
<td>Extension officers or the national association for crop protection product dealers can give you advice.</td>
</tr>
<tr>
<td>Always try to buy and supply less toxic crop protection products, which are safer and easier to use.</td>
<td></td>
</tr>
<tr>
<td>Ensure you have been properly trained by an accredited organisation</td>
<td></td>
</tr>
<tr>
<td>Do not use used crop protection product containers for storing food or carrying water.</td>
<td></td>
</tr>
<tr>
<td>Safely transport the crop protection products, away from passengers and food.</td>
<td></td>
</tr>
<tr>
<td>Safely store the crop protection products, away from people and food.</td>
<td></td>
</tr>
</tbody>
</table>
9.2 GUIDELINES FOR IDENTIFICATION OF COUNTERFEIT AND ILLEGAL PRODUCTS
Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper.  
|                  | ✓ Flipchart paper.  
|                  | ✓ Markers (4 colours).  
|                  | ✓ Coloured cards.  
|                  | ✓ Glue stick or blue tack.  
|                  | ✓ Masking Tape.  
|                  | ✓ Pin board and pins.  |

| Time needed: | 60 minutes (if less time, adjust each section accordingly)  

| Intended audience: | Farmers and crop protection product dealers (resellers)  

| Preparation: | ✓ Flipchart on flipchart stand with the title “Guidelines for Identification of Counterfeit and Illegal Products”, and the Lesson Objectives.  
|              | ✓ Flipchart with definitions of counterfeit and illegal products (Visual 1).  
|              | ✓ Flipchart with differences between genuine products and counterfeit and illegal products (Visual 2).  
|              | ✓ Pamphlets or handouts with information about counterfeit and illegal products.  
|              | ✓ Print off sufficient Fact Sheets for participants.  
|              | ✓ Print off sufficient Assessment question sheets.  
|              | ✓ Print off sufficient Attendance Record sheets.  
|              | ✓ Organise venue and seating arrangements.  

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### Set up/Introduction

**5 minutes (5-10% of total time)**

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention:</strong></td>
<td><strong>Ask:</strong></td>
</tr>
<tr>
<td></td>
<td>• Why are clothes sold in open and street markets at cheaper rates compared to the clothes sold in licenced shops.</td>
</tr>
<tr>
<td></td>
<td>• How can they be sold at a cheaper price than in licenced shops, even though the clothes look satisfactory?</td>
</tr>
<tr>
<td></td>
<td>Likely answers are:</td>
</tr>
<tr>
<td></td>
<td>• The clothes are not branded,</td>
</tr>
<tr>
<td></td>
<td>• The clothes are substandard</td>
</tr>
<tr>
<td></td>
<td>• No receipt is given</td>
</tr>
<tr>
<td></td>
<td>• The manufacturers are unknown</td>
</tr>
<tr>
<td></td>
<td>• The clothes have been imported illegally.</td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong> that the same applies to crop protection products - Counterfeit and illegal products exist, which are sold at cheaper rates by dishonest dealers and traders.</td>
</tr>
<tr>
<td></td>
<td><strong>Record</strong> their answers on a flipchart.</td>
</tr>
<tr>
<td><strong>Title:</strong></td>
<td><strong>Refer</strong> to the Title Flipchart and tell participants that this training session will cover <em>Guidelines for Identification of Counterfeit and Illegal Products</em>.</td>
</tr>
<tr>
<td><strong>Credibility:</strong></td>
<td><strong>Ask</strong> if anyone, or someone they know, has experienced the adverse effects of using counterfeit or illegal products.</td>
</tr>
<tr>
<td><strong>Objectives:</strong></td>
<td><strong>Refer</strong> to the Title Flipchart with the Lesson Objectives.</td>
</tr>
<tr>
<td></td>
<td>By the end of the lesson, participants will be able to explain and describe:</td>
</tr>
<tr>
<td></td>
<td>• The differences between genuine and counterfeit or illegal products</td>
</tr>
<tr>
<td></td>
<td>• The potential adverse effects of using counterfeit or illegal products</td>
</tr>
<tr>
<td><strong>Benefits:</strong></td>
<td>If the farmers know about the problems of using counterfeit, fraudulent, and sub-standard products, they will not use such products, and so avoid the adverse effects.</td>
</tr>
<tr>
<td></td>
<td>In addition, the crop is properly protected, and there is less risk to the environment.</td>
</tr>
<tr>
<td><strong>Direction:</strong></td>
<td>During this session, we will examine the problem of counterfeit, fraudulent, and sub-standard products, and how to identify such products.</td>
</tr>
</tbody>
</table>
Delivery  
(80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 20 minutes</td>
<td><strong>Brainstorming/Discussion - The Adverse Effects of Counterfeit and Illegal Products</strong></td>
</tr>
</tbody>
</table>

**Ask** if anyone knows of any local counterfeit or illegal products. What are the names of these products?

**Write** the answers on a flipchart.

**Say,** now we are going back to the street market. As well as clothes, electrical items are also sold in such markets, and we have just bought a cheap electric steam iron.

**Ask** what problems might occur when we arrived home and used the iron?

**Write** the answers on a flipchart.

Possible answers are:
- It may not work at all
- A risk of electric shock from poor wiring and components
- The iron may not work properly, it is too hot or too cold
- It may leak water
- It may break after short use

**Explain** that similar problems will also be caused by counterfeit or illegal crop protection products
- They may not work at all
- They may not work properly to control pests
- They may damage the crop
- They may contaminate the environment

**Put up** the flipchart with the definition of counterfeit and illegal products.

**Explain** the differences between genuine branded products and counterfeit and illegal products, with reference to examples given in Fact Sheet.
2. **Work Groups – Adverse Effects of Counterfeit and Illegal Products**

**Put up** three flipcharts and write a heading on each:
- Effects on people
- Effects on crops
- Effects on the Environment

**Divide** the trainees into 3 groups, one for each chart

**Work Group task:**
- Discuss and agree on the adverse effects of counterfeit and illegal products with regard to the chart heading
- Write responses on the chart
- Select someone to report to the full group

Allow a few minutes for the activity, and then ask each group to report in turn.

**Discuss** the answers, adding as necessary from the Fact Sheet.

3. **Discussion – Why Farmers Purchase Counterfeit and Illegal Products**

**Ask** why the farmers are lured or attracted to purchase counterfeit and illegal products

**Write** answers on the flipchart.

**Finish** *(10% of time)*

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Summary:** | **Review:**
| 1 minute | - The definition of counterfeit and illegal products.
| | - The adverse effects of counterfeit and illegal products on crops, people and the environment.
| | - Why farmers purchase counterfeit and illegal products |
| **Questions:** | **Ask** if everyone understands or if there are any additional questions. |
| 1 minute | Answer these provided they are relevant. |
| **Evaluation:** | **Ask:**
| 12 minutes | - What are the differences between genuine products and counterfeit and illegal products.
| | - What are some adverse effects of counterfeit and illegal products |
| | **Hand out** the Assessment Sheet and ask participants to complete two of the questions. |
| | **Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** | **Say** now that participants now know the difference between genuine products and counterfeit and illegal products, and the adverse effects of the latter, they should ensure that only genuine products are sold and used. |
| 1 minute | **Hand out** the Fact Sheet to participants. |
Counterfeit Products:
Products which are not genuine original and branded are called counterfeit products. They resemble genuine products, but do not contain the required quantity of active ingredient, and are accompanied by a false information sheet. Sometimes they are expired.

Illegal Products:
Products which are not registered by the Insecticide board, but are sold, are called illegal.
### Differences Between Genuine Products and Counterfeit and Illegal Products

<table>
<thead>
<tr>
<th>Genuine and Branded Products</th>
<th>Counterfeit and Illegal Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before release into the market, a lot of study and research is done about the product</td>
<td>No study or research/development is done</td>
</tr>
<tr>
<td>Clear instructions about product usage method, warnings, and precautions, etc, are given on the container or information sheet.</td>
<td>The information given is false and not believable</td>
</tr>
<tr>
<td>Products are approved by Government agencies</td>
<td>No approval from any authorized agencies</td>
</tr>
<tr>
<td>Should any faults or mistakes occur with the product, a complaint can be made to the manufacturer. The dealer and the producer are responsible to correct these faults.</td>
<td>The manufacture is unknown, so it is not possible to make a complaint.</td>
</tr>
<tr>
<td>The chemical composition given in the information sheet is always subject to laboratory analysis and testing, and it should tally with test.</td>
<td>No guarantee about its test.</td>
</tr>
<tr>
<td>No restriction or ban on the use of the product on crops (except where specified) and legally allowed to be sold</td>
<td>Such products are banned for use on crops, and are liable to legal provisions.</td>
</tr>
</tbody>
</table>
Counterfeit and illegal pesticides are often mislabeled and not registered for sale or use. They can pose a risk to human health and the environment, and can lead to severe damages or even a total loss of the crop.

**ORIGINAL PESTICIDES**
- Protect yields due to effective pest control.
- Allow a sustainable production of high quality produce.
- Enable farmers to freely trade their produce.
- Pose no unacceptable risks when applied according to the label instructions.

**COUNTERFEIT AND ILLEGAL PESTICIDES**
- Pose a significant risk to human health and the environment.
- Can result in trade bans for the produce.
- Damage the reputation and image of the farmers.
- Can lead to a full destruction of the crop.

**9 TIPS FOR RECOGNIZING COUNTERFEIT AND ILLEGAL PESTICIDES**
- The product is offered by a non-authorized dealer, on the street or sold directly from a truck.
- The seller refuses to provide a proper invoice for the purchase.
- The price of the product is significantly lower compared to the original.
- The label is not written in the local language and/or shows mistakes in grammar or spelling.
- The cap of the container is different from the original.
- The container is not properly sealed.
- The shape of the container is different from the original.
- The logo/trademark on the container or label looks different from the original.
- The holograms do not exist or are different from the original.

DO NOT PURCHASE OR USE COUNTERFEIT OR ILLEGAL PESTICIDES. BE ATTENTIVE AND ALERT. SAFEGUARD YOUR CROPS, PROTECT HUMAN HEALTH AND THE ENVIRONMENT.

REPORT ANY COUNTERFEIT AND ILLEGAL PESTICIDES TO YOUR LOCAL CROP PROTECTION ASSOCIATION OR TO THE RELEVANT AUTHORITIES.

www.croplife.org

Helping Farmers Grow
Assessment Questions

Name: ................................. Date: ............... Mark:

Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

Question 1: What is the different between a counterfeit product and an illegal product?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: What are three consequences of using counterfeit products against crops and the environment?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: Describe two factors that can help to identify counterfeit products
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: How can you prevent farmers from purchasing counterfeit and illegal crop protection products?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

IDENTIFICATION OF COUNTERFEIT AND ILLEGAL CROP PRODUCTION PRODUCTS

We call certain product counterfeit, illegal, or fraudulent. All such products violate the Law, and can neither be sold nor used, even if they are freely available. In addition, no guarantee can be given to the users. There are certain differences between counterfeit and illegal products.

COUNTERFEIT PRODUCTS:

All products which are not genuine or original are called counterfeit.

• Counterfeit products resemble genuine products. Sometimes counterfeit products are effective, but are not manufactured by authorized or branded companies. Hence they are also called misbranded or fraudulent products.

• Counterfeit products may not contain the real active ingredient of the pesticide.

• The information given on the labels may be false, and sometimes the effective period is lapsed.

• The containers may be different. Sometimes the counterfeit or adulterated product is filled in the branded/original containers.

ILLEGAL PRODUCTS:

Any product which does not confirm to the standards prescribed in the Registration legislation is treated as a violation and not entitled to be sold or distributed. Sometimes products are used which might have been restricted or prohibited for use in other countries.

We will know the products which are counterfeit and which are not permissible by the legislation by the information given in the following tables:

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Genuine and Permissible by the Legislation</th>
<th>Counterfeit or but Permissible by the Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detailed study and development</td>
<td>Done thoroughly</td>
<td>Not done or partially done</td>
</tr>
<tr>
<td>Information label</td>
<td>The information given is believable and can be safely used</td>
<td>May not be believable</td>
</tr>
<tr>
<td>Whether permitted by local authorities</td>
<td>Permitted</td>
<td>Not Permitted</td>
</tr>
<tr>
<td>Consumer protection</td>
<td>Should any adverse effects occur, a complaint can be made to the manufacturer</td>
<td>No complaint can be made as the manufacture is not known</td>
</tr>
<tr>
<td>Active ingredients of the chemical</td>
<td>Can compare and test the ingredients in the laboratory</td>
<td>There is no guarantee of the chemical.</td>
</tr>
</tbody>
</table>
ADVERSE EFFECTS

Any product introduced onto the market has to be studied in depth, both in the field and in the laboratory. The manufacturer must apply for the product to be registered with the Pesticide Board and pay the required fees. The product will again be tested in the laboratory and the field, and only then will the product be registered and allowed to be released onto the market.

Such formalities will not be followed with counterfeit and illegal products. Sometimes these products are cheap and lure the farmers, but there are adverse effects and losses from using such misbranded products. There are three types of adverse effects and losses.

EFFECTS ON PEOPLE

Farmers, who either knowingly or unknowingly purchase or use counterfeit products are liable for punishment, financial losses, and health hazards.

- Punishment: Since there is prohibition on the sale, purchase, and use of counterfeit products, the farmer is liable for punishment under the legislation.
- Financial losses: Counterfeit products may not effectively control pests, hence the farmer has to repeatedly spray the pesticide, which will increase costs.
- Health Hazards: Counterfeit products may cause health hazards because the information given on the label is false.

Effects on the crops:
Since the counterfeit products are not able to control pests, the crop is at risk of partial or complete damage. Sometimes these products are also harmful to parasites and predators.

EFFECT ON THE ENVIRONMENT:

- Consumers: The health of the consumer is affected if they eat food containing harmful residues of pesticides.
- Effect on Flowers, Animals and Birds: Similarly, animals and birds may also suffer if they feed on straw or grain containing pesticide residues. Sometimes water also is polluted with dissolved pesticide residues when it rains.

HOW TO IDENTIFY COUNTERFEIT AND ILLEGAL PRODUCTS:

Different kinds of counterfeit, fraudulent and illegal products are seen on the market. However, it is difficult to identify them as some products are sold under the branded name of a company in the same type of container. To some extent, counterfeit, fraudulent and illegal products can be identified by the following methods, although it is not always possible.

- The Registration Authority publishes the names of registered companies or manufacturers, and their registered products. This list can be obtained from the Registration Authority or the dealer. If the name of the company or product is not included in the list it is considered to be counterfeit, fraudulent, or illegal.
- Each original chemical has a specific colour and smell. A counterfeit product can be compared with the original if it is available.
- The information sheet is compulsory for each branded chemical. If it is not available the product is treated as counterfeit.
- The registration number is printed in the information sheet.
- The label contains definitely the date of manufacturing and the date of expiry.
- The container of the chemical is sealed and the lid is tight.
- Test a sample of the product to ascertain if it is effective in controlling pests or not.
In addition to the above, the following precautions will help to avoid the purchase of counterfeit, fraudulent and illegal products.

- Purchase crop protection products only from approved or authorised dealers.
- If the price is considerably below that of the normal retail price, the product is suspect.
- Ensure a receipt is given by the dealer with all details including the batch number and date.
- Do not select new chemicals available in the market without knowing its characteristics.
- Remember the colour and smell of the genuine product, and the information sheet.
- Consult officials of the Department of Agriculture or an authorised dealer to obtain more information about a product.
- Complain to the Police Department if you suspect any product of being counterfeit, or if any adverse effects occur during or after use.

COUNTERFEIT AND ILLEGAL PRODUCTS

**Counterfeit Products:**
Products which are not genuine original and branded are called counterfeit products. They resemble genuine products, but do not contain the required quantity of active ingredient, and are accompanied by a false information sheet. Sometimes they are expired.

**Illegal Products:**
Products which are not registered by the Insecticide board, but are sold, are called Illegal.
DIFFERENCES BETWEEN GENUINE PRODUCTS AND COUNTERFEIT AND ILLEGAL PRODUCTS

<table>
<thead>
<tr>
<th>Genuine and Branded Products</th>
<th>Counterfeit and Illegal Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before release into the market, a lot of study and research is done about the product</td>
<td>No study or research/development is done</td>
</tr>
<tr>
<td>Clear instructions about product usage method, warnings, and precautions, etc., are given on the container or information sheet.</td>
<td>The information given is false and not believable</td>
</tr>
<tr>
<td>Products are approved by Government agencies</td>
<td>No approval from any authorized agencies</td>
</tr>
<tr>
<td>Should any faults or mistakes occur with the product, a complaint can be made to the manufacturer. The dealer and the producer are responsible to correct these faults.</td>
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</tbody>
</table>

GUIDELINES FOR IDENTIFICATION OF COUNTERFEIT AND ILLEGAL PRODUCTS

Any product that is not registered, is misbranded, or is adulterated, or counterfeit is an illegal product. Even if such a product is purchased unknowingly, the purchaser is liable for punishment. By the use of such counterfeit products the farmer not risks severe crop loss, but also there is the possibility of serious health hazards and pollution of the environment. Farmers are thus advised to acquire knowledge of how to identify counterfeit and illegal products.

POINTS FOR IDENTIFICATION OF COUNTERFEIT AND ILLEGAL PRODUCTS

- Discover the name of the company which is responsible for the manufacture of the product and registration by Government agencies. If the company or product name is not found in the approved list, it is considered to be counterfeit. The list can be obtained from Government agencies or dealers Association.
- Know the specific packaging, container, colour, and smell of each genuine product.
- Ensure that the information sheet accompanies the product, and includes all the details.
- The label on the container should contain the registration number, batch number, date of manufacture, date of expiry, and the company logo.
- If product is suspected to be counterfeit, take a sample, use on a limited area and observe the effectiveness.
- Purchase crop protection products only from authorised or licensed dealers.
- Avoid the attraction of lower priced products.
- Be careful about new and unknown products while purchasing.
- If a product is suspected to be counterfeit or illegal, immediately inform the insecticide inspector, the (local Agricultural Officer, or the police.
9.3. IDENTIFYING THE CAUSES OF FAILURE OF PESTICIDE APPLICATIONS
9.3 Identifying the Causes of Failure of Pesticide Applications
Lesson Plan

<table>
<thead>
<tr>
<th>Materials needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Flipchart stands.</td>
</tr>
<tr>
<td>✓ Flipchart paper.</td>
</tr>
<tr>
<td>✓ Markers (4 colours).</td>
</tr>
<tr>
<td>✓ Notebooks, pens, and file covers for participants who have forgotten to bring them.</td>
</tr>
<tr>
<td>✓ Coloured cards.</td>
</tr>
<tr>
<td>✓ Glue stick or blue tack.</td>
</tr>
<tr>
<td>✓ Masking tape.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 minutes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intended audience:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticide Retailers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preparation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Flipchart with the session title “Causes of Failure of Pesticide Applications”, and the Session Objectives.</td>
</tr>
<tr>
<td>✓ Flipchart with Work Group task questions for Activity 1.</td>
</tr>
<tr>
<td>✓ Print off sufficient Attendance Record sheets.</td>
</tr>
<tr>
<td>✓ Print off sufficient Assessment question sheets.</td>
</tr>
<tr>
<td>✓ Print off sufficient Fact Sheets for participants.</td>
</tr>
<tr>
<td>✓ Organise venue and seating arrangements.</td>
</tr>
</tbody>
</table>

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention:</strong></td>
<td>Welcome the retailers to the session.</td>
</tr>
</tbody>
</table>
| **Ask:** | • Who has had experience of farmers complaining that a pesticide application has not worked properly?  
• What possible reason(s) have you given for the failure? |
| **Take** | several responses. |
| **Say** | that in most cases farmers blame the pesticide, or pesticide resistance. While these are possible, there are many other possible causes, and in this session we will be looking at all of these. |
| **Title:** | Refer to the Title Flipchart and tell participants that this training session will cover *Causes of Failure of Pesticide Applications*. |
| **Credibility:** | Give an example of poor performance or failure of a pesticide application that was blamed on the wrong cause, for example a sub-standard pesticide or pesticide resistance. |
| **Objectives:** | Refer to the Title Flipchart with the Lesson Objectives.  
By the end of the session, participants will be able to:  
• State clearly the different possible reasons for the poor performance or failure of a pesticide application.  
• Identify the reason for a pesticide failure.  
• Explain to a farmer what to do in such a case. |
| **Benefits:** | There are several possible reasons for the poor performance or failure of a pesticide application, and if retailers know these possible reasons they are able to provide appropriate advice to farmers, and so provide a better service. |
| **Direction:** | • A work group activity to identify the possible causes of poor performance or failure of a pesticide application forms the bulk of the session.  
• How a retailer should identify the cause of poor performance or failure is then examined in a role play between a “farmer” and a “retailer”. |
## Delivery

### Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. 30 minutes</strong></td>
<td><strong>Work Groups – Causes of Failure of Pesticide Applications</strong></td>
</tr>
<tr>
<td><strong>Trainer Note:</strong> Avoid extended technical discussions in this procedure – the emphasis should be on determining what could cause a pesticide application to fail, <strong>not</strong> what are the detailed recommendations for the control of a particular pest.</td>
<td></td>
</tr>
<tr>
<td><strong>Divide</strong> participant into 4 groups.</td>
<td></td>
</tr>
<tr>
<td><strong>Give</strong> one Crop / Pest combination to each work group.</td>
<td></td>
</tr>
<tr>
<td><strong>Work Group task:</strong> For the crop and pest assigned to your table, agree as a group on the following:</td>
<td></td>
</tr>
<tr>
<td>• Cotton / Aphid</td>
<td></td>
</tr>
<tr>
<td>• Tomato / Whitefly</td>
<td></td>
</tr>
<tr>
<td>• Rice / Brown Plant Hopper</td>
<td></td>
</tr>
<tr>
<td>• Maize / Stemborer</td>
<td></td>
</tr>
<tr>
<td>• Cucumber / Mildew</td>
<td></td>
</tr>
<tr>
<td>• Citrus / Leaf miner</td>
<td></td>
</tr>
<tr>
<td><strong>Say</strong> that groups have 30 minutes for the activity.</td>
<td></td>
</tr>
<tr>
<td><strong>2. 30 minutes</strong></td>
<td><strong>Work Group Reports – Causes of Failure of Pesticide Applications</strong></td>
</tr>
<tr>
<td>After 30 minutes, <strong>ask</strong> the table groups to report for the crop / pest combination assigned to their table.</td>
<td></td>
</tr>
<tr>
<td>All groups should give their reports before there is any discussion.</td>
<td></td>
</tr>
<tr>
<td><strong>Trainer Note:</strong> The emphasis of this activity is to bring out the causes of failure, so <strong>do not</strong> get involved in technical discussions, for example on what is the correct pesticide for a particular pest. However, if for example, the participants cannot agree on the correct pesticide for a particular pest, <strong>say</strong> that this is a possible cause of failure – use of the wrong pesticide, and the retailers should ensure that they know the recommended pesticides to use for all local pests.</td>
<td></td>
</tr>
<tr>
<td><strong>Review</strong> and <strong>summarise</strong> the possible causes of poor performance or failure, adding where necessary from the Fact Sheet.</td>
<td></td>
</tr>
<tr>
<td><strong>Emphasise</strong> that many of the possible causes are due to something that the pesticide user has done, or has not done, during the application, and is therefore under their control.</td>
<td></td>
</tr>
</tbody>
</table>
### 3. 20 minute

**Role Play – Identifying the Causes of Failure of Pesticide Applications**

Ask participants to individually note down responses to the following situation and questions:

A farmer comes into the shop and complains that a pesticide which you sold to him did not work,
- What questions would you ask the farmer?
- What approach would you take with the farmer to ensure that you keep his trust and his business?

**After 4-5 minutes**, say that in fact this farmer is coming to the classroom now, so they’ll be able to try out some questions.

**Role Play Set-Up:**

Ask one participant to play the farmer.

Remind the “farmer” that he is not a difficult farmer, but he has a complaint to make.

Remind the group and the “farmer” that the purpose for the role plays is to practice question-asking and advice-giving, so the farmer should be reasonable.

Ask him to step outside the classroom and prepare his “complaint.” What crop, what pest, what pesticide, what happened.

Ask participants if any of them are ready to play the “retailer” and try out his or her questions and approach.

Select one participant to start. (There is time for 2-3 participants to try out their approach.)

**Conducting the Role Plays:**

**Trainer Note:**
These 2-3 role plays are meant to be quick and spontaneous, with opportunities to debrief after each role play ends, and before the next one begins. Follow these steps:

Ask the participant who volunteered to try out his or her approach as the retailer to stand in the front of the room.
### Conducting the Role Plays:

**Trainer Note:**
These 2-3 role plays are meant to be quick and spontaneous, with opportunities to debrief after each role play ends, and before the next one begins. Follow these steps:

- **Ask** the participant who volunteered to try out his or her approach as the retailer to stand in the front of the room.

- **Set the stage** by explaining that a farmer is about to come into the shop with a complaint. Ask participants to take notes about what they like in the “retailer’s” approach and what they might do differently.

- **Tell** the “farmer” to come in to begin.

- **Allow** the role play to run for 4-5 minutes, at least until the retailer has had a chance to ask some questions.

- **Then stop** the action, but keep the two role players in front of the group.

#### Role Play #1 Debrief:

First ask participants what they liked about the retailer’s approach.

Then ask the “farmer” what the retailer did that was helpful? Not helpful?

Then ask the retailer what he or she was trying to do, and how was it working.

Then ask the participants what they would do differently?

#### Role Play #2:

Ask one of the participants who is assertive about what he or she would do differently to try it out. Invite the participant to the front of the room to play the retailer, and ask the “farmer” to continue where the last role play ended.

Allow 4-5 minutes for “retailer #2” to give the farmer advice.

Debrief as before.

Invite another participant to try his or her approach, and repeat for a third role play if there is time.

**Trainer Note:**
The “retailer” should find out if:
- The pest was correctly identified
- The correct pesticide was used for the pest
- The correct stage of the pest life cycle was treated.
- The correct pesticide dose was used
- The pesticide was applied correctly

The retailer should then advise the farmer to correct any mistakes found as a result of the questioning. If no mistakes were apparent, the farmer should try a pesticide from a different chemical group, and come back to the retailer with the results.
### Summary: 1 minute

**Include** as major messages:
- The four main causes of poor performance or failure of a pesticide application.
- The other possible causes of poor performance or failure.
- That in the majority of instances, the cause of poor performance or failure was under the control of the user.

### Questions: 1 minute

**Ask** if everyone understands or if there are any additional questions.

Answer these provided they are relevant.

**Ask** if the session objectives were met.

### Evaluation: 12 minutes

**Hand out** the Assessment Sheet and ask participants to complete two of the questions.

**Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record.

### Next step: 1 minute

**Say** that in this session we learned about the possible causes of poor performance or failure of a pesticide application. Participants now have additional knowledge with which to give good advice to farmers and so improve the service they provide.

**Hand out** the Fact Sheet to participants.
Assessment Questions

Name: ................................................. Date: ................. Mark: 

Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

Question 1: Give the four main possible causes of poor performance or failure of a pesticide application.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: Give two other possible causes of poor performance or failure of a pesticide application.
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...........................................................................................................................................................................................
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Question 3: Give three possible causes of poor application.
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...........................................................................................................................................................................................

Question 4: How should the cause of poor performance or failure of a pesticide application be identified?
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...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

THE CAUSES OF FAILURE OF PESTICIDE APPLICATIONS

There are many possible causes for the poor performance or failure of a pesticide application. In the majority of instances, the cause is due to something that the pesticide uses has done, or has not done, during the application, and is therefore a factor under their control.

The four most common causes of poor performance or failure are:

Wrong Pesticide Used
- The pest was identified correctly, but the wrong pesticide for the control of the pest was selected and used.
- The pest was not identified correctly, but the correct pesticide was selected for the mis-identified pest, a pesticide which has no effect on the actual pest present. For example, Tomato Yellow Leaf Curl virus was identified as Blight, and a fungicide applied for blight control, when a pesticide should have been used against whitefly, which transmits the disease causing virus.

Wrong Timing of Application
- The pest population was not at a susceptible stage. For example, adults were treated when the pesticide label recommendation is to treat the larval stages, or a disease is too far advanced.

Wrong Dose Rate
- The dose rate used was below the label recommendation, and was too low to kill the pests.
- This can occur either by using a lower than recommended dose in the spray mix, or by poor application leading to poor coverage and/or areas of under-dosing.

Poor Application
- The pesticide was not applied to the right place (e.g. poor underleaf cover for aphid control)
- The pesticide was not applied evenly to the target area, with areas of over- and under-dosing.
- The application equipment was poorly calibrated, or not calibrated at all.
- The wrong type of nozzle was used. For example using a hollow cone nozzle for herbicide application, which should be by a flat fan nozzle.
- The wrong pressure was used so that droplets were the wrong size. For example, the pressure was too low when using a hollow cone nozzle so that large droplets were produced with consequent poor canopy coverage.
- The application equipment was badly maintained. For example hose, filter and nozzle blockages had not been cleaned.
- The application took place in adverse weather conditions. For example, it was too hot, or too windy, or it rained soon after the application. Some herbicides require to be activated by rainfall after application.
The following may also cause a pesticide application to fail:

**Sub-Standard Pesticide**
- A counterfeit pesticide was used, with one or more of:
  - Poor quality formulation.
  - A concentration of active ingredient in the formulation lower than that indicated on the label.
  - No active ingredient in the formulation.
  - No or poor information on the label regarding use recommendations.
  - The pesticide has exceeded the expiry date, and the concentration of active ingredient in the formulation has deteriorated.

**Pest Resistance to Pesticide**
- The target pest has developed resistance to the pesticide

**Poor Quality of Spray Mix Water**
- Excessively acidic, alkali, or brackish water used in the spray mix can affect the performance of the pesticide.
- In such instances, poor performance will occur with all farmers using the same water source and pesticide.

**Incompatibility of Pesticide Formulations Used in a Tank Mix**
- This can cause one or more of the pesticides to precipitate out of the spray mix. In such instances, there will probably also be nozzle blockages.
- In some cases there can be chemical or physiological antagonism between the spray mix components.

**Plants Under Stress**
- This only applies to systemic pesticides, where if the plant is under stress, such as a shortage of water, the pesticide is not translocated through the plant to reach the insect pest or site of action within the weed.

The pesticide container label should carry all the information required to avoid the above problems, such as the recommended dosage, the timing of the application with regard to the pest life cycle, etc. The label should also include cautionary warnings, such as incompatibility with other pesticides, or the spray mix water quality required.

**IDENTIFYING THE CAUSES OF FAILURE OF PESTICIDE APPLICATIONS**

If a pesticide application has not given the level of control anticipated, or has failed completely, all the above possible causes should be examined one by one, starting with the four most common, until a possible reason has been identified.

In most instances, the poor control can be attributed to using the wrong pesticide, applying the pesticide at the wrong time, using the wrong dose rate, or poor application. These are all under the control of the pesticide user.

If the user has the required knowledge, which can be given by the retailer, poor performance or failure of a pesticide application will be avoided.
9.3 Identifying the Causes of Failure of Pesticide Applications
10. PERSONAL PROTECTIVE EQUIPMENT (PPE) WHEN USING CROP PROTECTION PRODUCTS
Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper. |
|                  | ✓ Flipchart paper. |
|                  | ✓ Markers (4 colours). |
|                  | ✓ Coloured cards. |
|                  | ✓ Glue stick or blue tack. |
|                  | ✓ Masking Tape. |
|                  | ✓ Pin board and pins. |
|                  | ✓ Circular stickers, approximately 2.5cm in diameter (red, yellow, blue). |
|                  | ✓ Sample containers or labels. |

| Time needed: | 130 minutes (if less time, adjust each section accordingly) |

| Intended audience: | Farmers and crop protection product dealers (resellers) |

|              | ✓ Coloured cards listing personal protective equipment. |
|              | ✓ Pre-drawn figures of people. |
|              | ✓ Photograph or PowerPoint slide of someone with skin contamination. |
|              | ✓ PowerPoint slide or flipchart with Absorption rates of crop protection products into the body (Visual 1). |
|              | ✓ Samples of each PPE, including: |
|              | • elbow length glove |
|              | • overalls |
|              | • apron; hat |
|              | • hooded rain suit |
|              | • goggles and/or spectacles |
|              | • face shield |
|              | • dust mask |
|              | • respirator (full and half face). |
|              | ✓ Coloured cards listing the following crop protection product use situations: |
|              | • all situations |
|              | • preparation with concentrates |
|              | • application |
|              | • inspecting or attending unopened containers |
|              | • moving unopened containers |
|              | • handling opened containers |
|              | • application situations, such as in a greenhouse, tree crops, general weeds, etc., appropriate to the region/country/situation. |
|              | ✓ Print off sufficient Fact Sheets for participants. |
|              | ✓ Print off sufficient Assessment question sheets. |
|              | ✓ Print off sufficient Attendance Record sheets. |
|              | ✓ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction  5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention:</strong></td>
<td>Show a picture of someone who has had skin contamination from crop protection products.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask:</strong></td>
</tr>
<tr>
<td></td>
<td>• What happened</td>
</tr>
<tr>
<td></td>
<td>• How did it happen</td>
</tr>
<tr>
<td></td>
<td>• How often this happens in their district</td>
</tr>
<tr>
<td><strong>Title:</strong></td>
<td>Refer to the Title Flipchart and tell participants that this training session will cover Personal Protective Equipment (PPE) When Using Crop Protection Products.</td>
</tr>
<tr>
<td><strong>Credibility:</strong></td>
<td>Show more pictures.</td>
</tr>
<tr>
<td></td>
<td><strong>Explain</strong> an example of dangerous practices (e.g. Someone mixing a pesticide without PPE).</td>
</tr>
<tr>
<td><strong>Objectives:</strong></td>
<td>Refer to the Title Flipchart with the Lesson Objectives.</td>
</tr>
<tr>
<td></td>
<td>By the end of the lesson, participants will be able to explain and describe:</td>
</tr>
<tr>
<td></td>
<td>• The importance of wearing PPE</td>
</tr>
<tr>
<td></td>
<td>• What PPE should be worn in what situation.</td>
</tr>
<tr>
<td></td>
<td>• How the PPE should be worn</td>
</tr>
<tr>
<td><strong>Benefits:</strong></td>
<td>To protect themselves and their families and their futures.</td>
</tr>
<tr>
<td><strong>Direction:</strong></td>
<td>Begin with how crop protection products enter the body and the absorption rates. Then demonstrate what PPE can be worn, and how.</td>
</tr>
</tbody>
</table>
## Delivery

(80-90% of total time)

### Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. 5 minutes</strong></td>
<td><strong>Work Groups – Routes Where Crop Protection Products Enter the Body</strong></td>
</tr>
<tr>
<td><strong>Remind</strong> participants that in Lesson 3 we discussed how crop protection products entered the body.</td>
<td></td>
</tr>
<tr>
<td><strong>Say</strong> that we will now look at this in greater detail, and start with the reasons WHY we should wear PPE.</td>
<td></td>
</tr>
<tr>
<td><strong>Divide</strong> the participants into groups, approximately four per group, depending on numbers.</td>
<td></td>
</tr>
<tr>
<td><strong>Give</strong> each group a drawing of the person.</td>
<td></td>
</tr>
<tr>
<td><strong>Work Group task:</strong></td>
<td></td>
</tr>
<tr>
<td>• Place the coloured stickers on the drawing where crop protection products can enter the body.</td>
<td></td>
</tr>
<tr>
<td>• Use red to show highly dangerous, yellow to show moderately dangerous, and blue to show slightly dangerous.</td>
<td></td>
</tr>
<tr>
<td><strong>2. 10 minutes</strong></td>
<td><strong>Work Group Reports – Routes Where Crop Protection Products Enter the Body</strong></td>
</tr>
<tr>
<td><strong>Ask</strong> the groups to put up their figures with stickers for all to see.</td>
<td></td>
</tr>
<tr>
<td><strong>Summarise</strong> the results by saying that there are three main routes for crop protection products to enter the body:</td>
<td></td>
</tr>
<tr>
<td>• Dermal (through the skin and/or eyes);</td>
<td></td>
</tr>
<tr>
<td>• Oral (through swallowing/ingestion);</td>
<td></td>
</tr>
<tr>
<td>• Respiratory (through breathing/inhalation)</td>
<td></td>
</tr>
<tr>
<td><strong>Ask</strong> which are the most common, least likely, and rapid forms of entry, and why.</td>
<td></td>
</tr>
<tr>
<td><strong>Mark</strong> their answers on the figure.</td>
<td></td>
</tr>
<tr>
<td><strong>Explain that:</strong></td>
<td></td>
</tr>
<tr>
<td>• Not all parts of the body absorb crop protection products in the same way.</td>
<td></td>
</tr>
<tr>
<td>• Crop protection products have different absorption rates.</td>
<td></td>
</tr>
<tr>
<td><strong>Show</strong> the PowerPoint slide/flipchart of absorption rates of crop protection products into the body.</td>
<td></td>
</tr>
</tbody>
</table>
### Discussion – Dermal Contamination

**Say** we will begin with dermal contamination – contamination through the skin and/or eyes.

**Ask** how this may happen. Possible reasons are:
- Not wearing appropriate PPE
- Soaking through clothing

**Explain** that this is the most common cause of poisoning. Crop protection product may:
- Splash into eyes or onto exposed skin
- Soak through badly maintained protective clothing
- Crop protection products may enter the body through healthy, unwounded skin as well as through wounds and sores.

**Ask** what are the symptoms commonly associated with dermal contamination:
- Burning, or irritation of the skin and eyes;
- Sweating;
- Rashes;
- Headache;
- Nose bleed;
- Tiredness;
- Numbness or weakness of arms, legs, feet, or hands.

**Ask** how this can be prevented – PPE.

### Discussion – Respiratory Contamination

**Say** that now we will discuss respiratory contamination (breathing/inhalation).

**Refer** to the sticker exercise for the respiratory contamination answers.

**Explain** that this is the most rapid form of entry into the body:
- The crop protection product can enter the lungs and get directly into the bloodstream very quickly.
- Some crop protection products are very volatile (evaporate easily) and therefore are very dangerous.
- Using crop protection products in closed spaces or under still air conditions can also make poisoning through inhalation more extreme.

**Ask** what are the symptoms commonly associated with respiratory contamination:
- Dizziness
- Vomiting
- Convulsion
- Coma
- Even death

**Ask** how this can be prevented – PPE.
### 5. Discussion – Oral Contamination

**10 minutes**

**Say** that we will now continue with oral contamination (swallowing/ingestion)

**Refer** to the sticker exercise for the oral contamination answers.

**Ask** how ingestion might occur:
- Deliberate or accidental swallowing of crop protection products
- Eating drinking or smoking with contaminated hands

**Explain** that this is the least likely method of poisoning. However, it is very dangerous to eat, drink or smoke with contaminated hands.

**Ask** what are the symptoms commonly associated with oral contamination:
- Dizziness
- Burning of the alimentary canal
- Vomiting
- Convulsions
- Coma
- Even death.

**Ask** how this can be prevented:
- PPE
- Washing before eating, drinking or smoking
- Storing crop protection products away from those they may harm.

**Explain** that in these activities we have investigated WHY we should wear PPE. Next is the WHAT and HOW of wearing PPE.

### 7. Work Groups – WHAT PPE?

**20 minutes**

**Divide** participants into groups again, ensuring someone in each group is literate.

**Give** each group two items of PPE.

**Work Group task:**
- Name each PPE item
- Explain what it is made of;
- Explain how it protects;
- Explain how it is correctly worn or used.
- Record findings on flipchart paper.

Allow the groups 10 minutes for discussion

**Hold up** one of the cards with a PPE item on it, and **ask** which group has the item.

**Place** the card on a flipchart or pinboard.

**Ask** the group for the answers to the four questions.

**Summarise** after each report is presented, and **correct** where necessary.

**Repeat** for all groups and PPE items.
<table>
<thead>
<tr>
<th>8. 10 minutes</th>
<th><strong>Discussion – WHAT PPE to Wear in What Situation/Activity</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ask</strong> how to determine what to wear for what situation/activity</td>
<td></td>
</tr>
<tr>
<td><strong>Answer</strong> – READ THE LABEL.</td>
<td></td>
</tr>
<tr>
<td><strong>Give</strong> each group a sample label or container.</td>
<td></td>
</tr>
<tr>
<td><strong>Ask</strong> them to determine from the label and/or the pictograms what PPE they should wear for each situation/activity.</td>
<td></td>
</tr>
<tr>
<td><strong>Say</strong> we will continue with this discussion later, but first we will look at HOW PPE should be worn.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>9. 10 minutes</th>
<th><strong>Discussion – HOW Should PPE be Worn</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ask</strong> the order in which the PPE should be put on.</td>
<td></td>
</tr>
<tr>
<td>The correct order is:</td>
<td></td>
</tr>
<tr>
<td>• First overalls</td>
<td></td>
</tr>
<tr>
<td>• Then mask, goggles, hat, boots</td>
<td></td>
</tr>
<tr>
<td>• Finally gloves</td>
<td></td>
</tr>
<tr>
<td><strong>Ask</strong> the order that the PPE should be removed.</td>
<td></td>
</tr>
<tr>
<td><strong>Emphasise</strong> safety – they should not touch the outside surfaces of the PPE with exposed body parts.</td>
<td></td>
</tr>
<tr>
<td>The correct order is:</td>
<td></td>
</tr>
<tr>
<td>• First wash gloves, but do not remove them</td>
<td></td>
</tr>
<tr>
<td>• Then remove hat, goggles, mask, boots, gloves, and overalls.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>10. 20 minutes</th>
<th><strong>Presentation/Discussion – What PPE to Wear in What Situation/Activity (Continued)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emphasise</strong> that for every product and every situation there are different guidelines, which are given on the label.</td>
<td></td>
</tr>
<tr>
<td>For all situations the minimum to wear is overalls, gloves and boots, and we will now discuss for different situations what additional PPE should be worn</td>
<td></td>
</tr>
<tr>
<td><strong>Show</strong> participants a card with a situation/activity on it.</td>
<td></td>
</tr>
<tr>
<td><strong>Ask</strong> what PPE should be worn in that situation.</td>
<td></td>
</tr>
<tr>
<td><strong>Add</strong> where appropriate – for example powders vs liquids, open field vs greenhouse, etc.</td>
<td></td>
</tr>
</tbody>
</table>
| All situations | Adhere to instructions on the label. In the absence of label guidelines, then:  
- A minimum of gloves, boots, and overalls  
- (or long sleeved shirt and long trousers) |
|----------------|----------------------------------------------------------------------------------|
| Measuring & mixing (preparation) | Adhere to instructions on the label. In the absence of label guidelines, then:  
- Gloves, boots, overalls  
- (or long sleeved shirt and long trousers)  
- Apron for liquids.  
- Mask or respirator for powder  
- Face shield or goggles for liquid |
| Application | Adhere to instructions on the label. In the absence of label guidelines, then:  
- Gloves, boots, overalls  
- (or long sleeved shirt and long trousers)  
- Face shield or goggles  
- Mask or respirator |
| Washing & cleaning equipment | Adhere to instructions on the label. In the absence of label guidelines, then:  
- Gloves, boots, overalls  
- (or long sleeved shirt and long pants)  
- Face shield or goggles  
- Apron |

11. **5 minutes**  
After all he situations are discussed, *emphasise* that the label should always be checked to determine what PPE to wear for each situation/activity.
Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong></td>
<td><strong>Remind</strong> participants the routes by which plant protection products enter the body. <strong>Show</strong> items of PPE and <strong>explain</strong> what they protect and how they are worn. <strong>Emphasise</strong> that participants must always read the label to find out what to wear for each situation/activity.</td>
</tr>
<tr>
<td><strong>Questions:</strong></td>
<td><strong>Ask</strong> if everyone understands or if there are any additional questions. Answer these provided they are relevant.</td>
</tr>
<tr>
<td><strong>Evaluation:</strong></td>
<td><strong>Ask</strong> participants to explain items of PPE, what they protect, and how they are worn. <strong>Hand out</strong> the Assessment Sheet and ask participants to complete two of the questions. <strong>Collect</strong> the Assessment Sheet for later marking and entering the marks on the Attendance Record.</td>
</tr>
<tr>
<td><strong>Next step:</strong></td>
<td><strong>Emphasise</strong> why PPE should be worn and how, and the benefits of wearing PPE. <strong>Hand out</strong> the Fact Sheet to participants.</td>
</tr>
</tbody>
</table>

**Visual 1**
Absorption rates of crop protection products into the body

<table>
<thead>
<tr>
<th>Part of the body</th>
<th>Percentage of crop protection product absorbed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalp</td>
<td>32%</td>
</tr>
<tr>
<td>Forehead</td>
<td>36%</td>
</tr>
<tr>
<td>Ear canal</td>
<td>47%</td>
</tr>
<tr>
<td>Forearm</td>
<td>9%</td>
</tr>
<tr>
<td>Palm of the hand</td>
<td>12%</td>
</tr>
<tr>
<td>Abdomen</td>
<td>18%</td>
</tr>
<tr>
<td>Scrotum</td>
<td>100%</td>
</tr>
<tr>
<td>Ball of feet</td>
<td>14%</td>
</tr>
</tbody>
</table>
WHEN MEASURING AND MIXING PESTICIDES ALWAYS WEAR
- Shirt
- Pants
- Boots
- Gloves
- Apron
- Eye protector

WHEN SPRAYING PESTICIDES ALWAYS WEAR
- Shirt
- Pants
- Boots
- Gloves

WHEN WASHING/CLEANING THE SPRAYER AFTER SPRAYING
- Shirt
- Pants
- Boots
- Gloves
- Apron
- Eye protector

WASH PERSONAL PROTECTIVE EQUIPMENT AFTER USE
- Wear a hat for protection from the sun or when spraying tall crops
- Wear a mask for measuring and mixing dry formulations (dusts, powders, granules)
- All users should follow national regulations

WHEN HANDLING PESTICIDES ALWAYS FOLLOW THESE RULES
- Read and understand the label
- Be careful
- Exercise good personal hygiene
- Maintain sprayers in good working order
- Wear the correct Personal Protective Equipment
Assessment Questions

Name: ………………………………………….. Date: …………………… Mark: ___

Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

**Question 1:** Describe the three entry routes of crop protection products into the body.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 2:** Describe some of the symptoms of crop protection product poisoning.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 3:** Describe what to wear and how to wear PPE when applying crop protection products.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 4:** Describe the order of removing contaminated PPE.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
**FACT SHEET**

**HOW CROP PROTECTION PRODUCTS ENTER THE BODY**

**Dermal:**
Through the skin, including through the eyes and ears. This is the most common cause of poisoning, where crop protection product may splash into eyes or onto exposed skin, or soak through badly maintained protective clothing. Crop protection products may enter the body through healthy, unwounded skin as well as through wounds and sores.

**Oral:**
Through the mouth. This is the least likely method of poisoning. However, it is very dangerous if people eat, drink or smoke with contaminated hands.

**Respiratory:**
Through breathing (inhalation). This is the most rapid form of entry into the body, as the crop protection product can enter the lungs and enter the bloodstream very quickly. Some crop protection products are very volatile (evaporate easily) and therefore are very dangerous. Using crop protection products in closed spaces or under still air conditions can also make poisoning through inhalation more extreme.

**ABSORPTION RATES OF CROP PROTECTION PRODUCTS INTO THE BODY**

<table>
<thead>
<tr>
<th>Part of the body</th>
<th>Percentage of crop protection product absorbed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scalp</td>
<td>32%</td>
</tr>
<tr>
<td>Forehead</td>
<td>36%</td>
</tr>
<tr>
<td>Ear canal</td>
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<td>Forearm</td>
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<td>Abdomen</td>
<td>18%</td>
</tr>
<tr>
<td>Scrotum</td>
<td>100%</td>
</tr>
<tr>
<td>Ball of feet</td>
<td>14%</td>
</tr>
</tbody>
</table>
### SYMPTOMS COMMONLY ASSOCIATED WITH CROP PROTECTION PRODUCT POISONING

<table>
<thead>
<tr>
<th>Type</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dermal symptoms</strong></td>
<td>Itching. Burning of the skin, leaving scars. Numbness or weakness of arms, legs, feet or hands. Some serious cases can lead to infertility and even death. Blindness</td>
</tr>
<tr>
<td><strong>Inhalation symptoms</strong></td>
<td>Dizziness, Vomiting, Convulsions, Coma. In serious cases it can lead to respiratory and cardiac failure resulting in death</td>
</tr>
<tr>
<td><strong>Oral symptoms</strong></td>
<td>Dizziness, Vomiting, Burning of the oesophagus, Convulsions, Coma. In serious cases it can lead to respiratory and cardiac failure resulting in death</td>
</tr>
</tbody>
</table>

### WHAT TO WEAR AND HOW TO WEAR IT

<table>
<thead>
<tr>
<th>Body part</th>
<th>Picture</th>
<th>What to wear and how to wear it</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head</strong></td>
<td><img src="image1.png" alt="Hat" /></td>
<td><strong>Hat:</strong> Made of material heavy enough to prevent crop protection products reaching the hair follicles. Make sure it fits well and covers the forehead, neck and sides of the face (if possible).</td>
</tr>
<tr>
<td><strong>Head</strong></td>
<td><img src="image2.png" alt="Hood" /></td>
<td><strong>Hood:</strong> Made from liquid-proof materials. Made from liquid-proof materials. Protect the neck and ears. Only necessary if spraying in dangerous situations – overhead, mistblowers, highly toxic chemicals.</td>
</tr>
</tbody>
</table>

---

**202**
| Feet | **Boots:**  
|      | Heavy-duty, calf length, unlined rubber boots. Wear trousers over the boots to avoid spillage into the boots. |
|      | ![Image of Feet](image1.png) ![Image of Boots](image2.png) |
| Hands | **Gloves:**  
|       | Elbow length, nitrile rubber gloves. Wear over the sleeves. |
| Body | **Overalls:**  
|      | One-piece or two-piece overalls preferably made of cotton. Alternatively, use long sleeved shirt and long pants. Make sure they fit well and all zips and buttons are secure. |
| Body | **Apron:**  
|      | Made from PVC, covering from neck down to knees. Important when handling concentrates. |
## Personal Protective Equipment (PPE) When Using Crop Protection Products

### Face and eyes

<table>
<thead>
<tr>
<th><strong>Faceshield:</strong></th>
<th>Chemical resistant face shield that shields the whole face from splashes.</th>
</tr>
</thead>
</table>

### Eyes

<table>
<thead>
<tr>
<th><strong>Goggles:</strong></th>
<th>Chemical resistant goggles that cover the eyes. Make sure they fit well - adjust the straps if necessary.</th>
</tr>
</thead>
</table>

### Mouth

<table>
<thead>
<tr>
<th><strong>Dust Mask:</strong></th>
<th>Disposable dust mask, which must fit tight over the mouth - adjust the straps if necessary. Only recommended for powders.</th>
</tr>
</thead>
</table>

### Nose and mouth

<table>
<thead>
<tr>
<th><strong>Respirator:</strong></th>
<th>Must fit tight against the face. Follow manufacturer’s instructions on use, fitting, maintenance and replacement.</th>
</tr>
</thead>
</table>

## Putting on and Removing PPE

### Order for putting on PPE

- Start with overalls or an apron
- Then mask, goggles, hat, boots
- Finally gloves.

### Order for removing PPE

- Start by washing gloves (while wearing them) before removing anything.
- Then remove hat, mask, boots, gloves, and overalls.
- Wash hands with soap and water when finished.
WHEN TO WEAR WHAT?
As a general guideline, without a proper risk assessment, use the following PPE in each situation:

<table>
<thead>
<tr>
<th>Situation</th>
<th>Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>All situations</td>
<td>Adhere to instructions on the label. In the absence of label guidelines, then:</td>
</tr>
<tr>
<td></td>
<td>• A minimum of gloves, boots, and overalls</td>
</tr>
<tr>
<td></td>
<td>• (or long sleeved shirt and long trousers)</td>
</tr>
<tr>
<td>Measuring and mixing (preparation)</td>
<td>Adhere to instructions on the label. In the absence of label guidelines, then:</td>
</tr>
<tr>
<td></td>
<td>• Gloves, boots, overalls</td>
</tr>
<tr>
<td></td>
<td>• (or long sleeved shirt and long trousers)</td>
</tr>
<tr>
<td></td>
<td>• Apron for liquids</td>
</tr>
<tr>
<td></td>
<td>• Mask or respirator for powder</td>
</tr>
<tr>
<td></td>
<td>• Face shield or goggles for liquid</td>
</tr>
<tr>
<td>Application</td>
<td>Adhere to instructions on the label. In the absence of label guidelines, then:</td>
</tr>
<tr>
<td></td>
<td>• Gloves, boots, overalls</td>
</tr>
<tr>
<td></td>
<td>• (or long sleeved shirt and long trousers)</td>
</tr>
<tr>
<td></td>
<td>• Face shield or goggles</td>
</tr>
<tr>
<td></td>
<td>• Mask or respirator</td>
</tr>
<tr>
<td>Washing and cleaning equipment</td>
<td>Adhere to instructions on the label. In the absence of label guidelines, then:</td>
</tr>
<tr>
<td></td>
<td>• Gloves, boots, overalls</td>
</tr>
<tr>
<td></td>
<td>• (or long sleeved shirt and long pants)</td>
</tr>
<tr>
<td></td>
<td>• Face shield or goggles</td>
</tr>
<tr>
<td></td>
<td>• Apron</td>
</tr>
</tbody>
</table>
## CARE OF PROTECTIVE CLOTHING

<table>
<thead>
<tr>
<th>Category</th>
<th>Instructions</th>
</tr>
</thead>
</table>
| Cotton hats and overalls or shirts and trousers | • After every spray operation, hats and overalls should be washed using soap or detergent and water.  
• Wash separately from all other clothing.  
• PPE must be stored separately from civilian clothes.  
• Ensure that all work clothing is kept in good condition (no tears, badly worn areas, or holes). |
| Gloves                            | • Gloves must be inspected before use for any signs of wear or tear, particularly between the fingers.  
• Do not touch other parts of the body with gloves during crop protection product use.  
• After spraying, wash gloves before removing them from your hands.  
• After washing, remove the gloves, wash and dry them inside and outside before using them again. |
| Footwear                          | • Footwear must be washed inside and outside and dried at the end of each day’s work.  
• Footwear must be inspected regularly for any sign of damage or leakage and replaced when necessary. |
| Facewear                          | • Face shields, safety glasses, or goggles should be examined before use.  
• Wash with soap and water and dry before reuse. |
| Dust Masks                        | • Dust masks must be discarded after use. |
| Respirators                       | • Full-face and half-face respirators should be cleaned and maintained after use as directed by the manufacturer.  
• Respirator cartridges must be replaced regularly according to the manufacturer’s instructions (at least every 3 months)  
• Cartridges should be marked and dated. |
| Waterproofs                       | • Aprons and rain suits must be checked before every spray operation for wear, tears, and holes.  
• They must be washed after every use with soap and water. |
11. HOW SPRAYERS WORK
Lesson Plan

| Materials needed: | ☑ Flipchart stand with paper. |
|                  | ☑ Flipchart paper. |
|                  | ☑ Markers (4 colours). |
|                  | ☑ Coloured cards. |
|                  | ☑ Glue stick or blue tack. |
|                  | ☑ Masking Tape. |
|                  | ☑ Pin board and pins. |
|                  | ☑ Sample containers or labels. |
|                  | ☑ A range of sprayers applicable to the participants, and fitted with pressure gauges (if available). |
|                  | ☑ A range of nozzle types and sizes. |
|                  | ☑ PPE appropriate to the sprayers being used. |
|                  | ☑ A range of tools (spanners, pliers) to dismantle sprayers if needed. |

| Time needed: | 120 minutes (if less time, adjust each section accordingly) |
| Intended audience: | Farmers and crop protection product dealers. |

|              | ☑ Ensure sprayers are clean (no crop protection product residues), and in good working order. |
|              | ☑ Print off sufficient Fact Sheets for participants. |
|              | ☑ Print off sufficient Assessment question sheets. |
|              | ☑ Print off sufficient Attendance Record sheets. |
|              | ☑ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
## Set up/Introduction

<table>
<thead>
<tr>
<th>Module</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | **Ask** participants:  
  - What sprayers they use  
  - Are they happy with them or not  
  - What problems do they encounter |
| **Title:** | **Refer** to the Title Flipchart and tell participants that this training session will cover *How Sprayers Work.* |
| **Credibility:** | **Tell** participants about some of the sprayers you have used or seen, or some of the sprayer problems you know about. |
| **Objectives:** | **Refer** to the Title Flipchart with the Lesson Objectives.  
  By the end of the lesson, participants will be able to  
  - Select a sprayer appropriate for the spraying task  
  - Explain how the sprayer is used |
| **Benefits:** | Correct selection and operation of a sprayer is fundamental to effective, efficient, and safe pest management. |
| **Direction:** | During this session, we will focus on different types of sprayers and how to use them. |

### Delivery (80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| This lesson is best conducted outdoors where sprayers can be demonstrated by the trainer and used by the participants.  
At bare minimum, use a knapsack sprayer and a mistblower for this lesson.  
If there are other typical sprayers used in the region, then ensure these are available as well. |
| **1. Discussion – Types of Sprayers** | **Ask** the participants to look at the sprayers available and to name what type of sprayer each one is. |
2. **Demonstration – How the Sprayers Work and Are Used**

   For each sprayer type in turn:

   **Explain**, using diagrams and by opening up and dismantling the sprayer, how each sprayer (knapsack and mistblower) works:
   - Piston pump – how the piston works
   - Diaphragm pump – how the diaphragm works
   - Creating and maintaining pressure, and the pressure chamber
   - How the valves work
   - How the trigger mechanism works
   - How the nozzles create droplets
   - Wind shear for the mistblower

   **Demonstrate** correct use

   **Show** how to perform basic maintenance:
   - changing nozzles
   - cleaning filters
   - checking pumps

3. **Individual Activity – Sprayer Operation**

   Allow individual participants time to operate each sprayer (especially those sprayers they are not familiar with) and to see how it works.

4. **Discussion – Good and Bad Features of Sprayers**

   Ask the participants for each sprayer type to identify good and bad features:
   - What would they look for when buying a sprayer, or recommending a sprayer to someone else?

   **Emphasise**:
   - Buying on quality and features, not just price.
   - The importance of good service and spare parts back up.

5. **Demonstration/Discussion – Nozzles**

   Show the participants a range of different nozzles and ask them to identify:
   - The nozzle type
   - The material from which each is made
   - The situation for which it is most suited

   **Explain** and discuss nozzle sizes and codes. **Write** these on a flipchart.

   **Explain** and discuss and demonstrate correct nozzle height.

6. **Demonstration – Pressures**

   **Explain** and discuss pressures and the effect on droplet size.
### 7. How Sprayers Work

**15 minutes**

**Discussion/Demonstration – Spray Droplets, Droplet Size, and Coverage**

- **Explain** and discuss spray droplets, sizes, and spray coverage.
- **Demonstrate** by operating a sprayer the range of droplet sizes and the behaviour of different sizes e.g. drift, coverage.
- **Demonstrate** good and bad coverage using water sensitive paper, or a food dye or similar on white paper.
- **Demonstrate** and discuss spray drift and how to prevent it.

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### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| Summary: 1 minute | Review  
- The types of sprayers  
- Desirable features of sprayers  
- Types of nozzles. |
| Questions: 1 minute | Ask if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |
| Evaluation: 12 minutes | Ask:  
- Where are the filters located in a sprayer?  
- What type of nozzle is used to apply herbicides?  
- How can spray drift be avoided?  
Hand out the Assessment Sheet and ask participants to complete two of the questions.  
Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| Next step: 1 minute | Remind participants that the selection of sprayer and nozzles and correct operation is essential for effective, efficient, and safe pest management.  
Inform participants that in the next lesson we will cover sprayer maintenance.  
Hand out the Fact Sheet to participants. |
Assessment Questions

Name: ................................................. Date: .................. Mark: 

Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

Question 1: Give five desirable features of a knapsack sprayer.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
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Question 2: Name a knapsack sprayer which was studied in the class. Describe how it works.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: Name a mistblower sprayer which was studied in the class. Describe how it works.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: Explain why spray droplet size is important when spraying, and how to control the size of droplet produced by a sprayer.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

TYPES OF SPRAYERS

There are many different types of sprayers available from small hand held units to large tractor mounted units and even to aircraft mounted sprayers. Because each is designed for a particular task, it is important to use the type and size that best suits the situation. If the wrong type of sprayer is used then it will not do the job very well. If it is too small then operation is very inefficient. If it is too large, then money is wasted.

All sprayers work by producing spray droplets which are then directed to the target.

The different types of sprayer are:

**Compression Sprayers**

Compression sprayers have a tank (usually around 1 to 15 litres in capacity) in which the water plus crop protection product mix is placed. A hand operated air pump is used to pressurise the air in the tank above the spray mix. When the trigger is released, this compressed air forces the spray mix out through the nozzle to form the spray.

When the air pressure drops too low to be effective, the tank needs to be re-pressurised. Constant pumping is not required. There is no control over the pressure unless a pressure limiting valve is fitted.

These sprayers are suitable for small areas and may be used for applying herbicides, insecticides or fungicides provided the correct nozzle is used. They are probably the least expensive sprayers available.

**Required features:**

- Made from durable plastic;
- Easy to clean;
- Easy to fill without spilling spray mix (i.e. have a large filling opening);
- Comfortable to carry;
- Easy to pressurise (good pump);
- Easy to empty out left over spray mix;
- Able to be completely drained when spraying by having the hose outlet at the base of the tank
- Have a pressure gauge to indicate pressure or have a pressure limiting valve;
- Have an adjustable nozzle or allow nozzles to be changed easily;
- Have a strap or handle so it can be easily carried.
Knapsack Sprayers

Knapsack sprayers, usually with a capacity of 10 to 20 litres, and are carried on the operator’s back. The spray mix is pressurised by using a handle to operate a pump (either piston or diaphragm). Constant pressure is achieved when the spray mix is pumped into a pressure chamber before flowing down the hand lance. The pressurised liquid flows down the hand lance and forms spray droplets when forced through the nozzle. They require constant, steady pumping.

They are suitable for applying herbicides, insecticides and fungicides to larger areas than a compression sprayer. They also allow a greater level of adjustment. Suitable pressures and nozzles should be used for the job. A small boom with a number of nozzles, or a long lance for tree spraying, may be fitted to some brands.

Required features:
• Comfortable when carried (wide shoulder straps and no frame);
• Easily emptied and cleaned out;
• Ability to control pressure (either pressure gauge or pressure limiting valve);
• Wide filler hole for easy filling;
• Strainer in filler hole;
• Can be pumped by either left hand or right hand;
• Able to adjust or easily replace nozzles;
• Comfortable hand grip and trigger operation on the hand lance;
• Made of durable plastic;
• Good quality pump and hoses;
• Ready availability of spare parts;
• Handle to enable easy picking up and clips for holding the hand lance during storage.
11. How Sprayers Work

Diaphragm pump operated knapsack sprayer (BCPC 1989)

Piston pump operated knapsack sprayer (BCPC 1989)

**Backpack Mistblowers**

These are also known as motorised knapsack sprayers, misters, etc. The spray mix is held in a tank of 10 – 20 litres capacity.

A small 2 stroke motor spins a fan which creates a high speed air stream down the hand lance. When the spray trigger is opened, spray mix flows down a tube into the high speed air stream where it is shattered into spray droplets. The air stream then carries the droplets to the target. This method of forming droplets is called air shear. The rate of flow of spray liquid can be controlled with an adjustable flow control.

They are designed to be operated with the motor and fan at full throttle to ensure there is sufficient air speed to create the droplets correctly. They are suitable for insecticide and fungicide application because the air movement produced swirls the droplets around in the target leaf canopy giving good coverage. They are not suitable for herbicides because they create too much drift. Good safety precautions are required, such as a respirator to avoid breathing in droplets, protective clothing to prevent skin contamination, and hearing protection because of the motor noise.

**Required features:**
- Comfortable when worn on the back;
- Handle to enable easy picking up of the sprayer;
- Easy to empty and clean;
- Easy control of liquid flow;
- Adapters to allow the machine to be adjusted for different tasks e.g. spraying trees or spray row crops on the ground;
- Easy to start;
- Reliable;
- Availability of spare parts.
Wheeled Sprayers

For larger areas, motorised sprayers mounted on wheels with spray tanks of 50 to 100 litres may be more suitable. They may be a mistblower type of sprayer, or a hydraulic sprayer pumping spray mix through a hand lance or a small spray boom. They are usually pushed (or pulled) by hand. A motor operates the pump (usually a diaphragm pump) which draws spray mix from the tank. Filters should be built into the line, and there should be the ability to adjust the pressure. In addition to the usual protective clothing, hearing protection should be worn.

Required features:
• Reliable pump and motor;
• Good service and spare parts support;
• Easy to empty out and clean;
• Large size filler hole with a strainer;
• Pressure regulator;
• Large, easily viewed pressure gauge;
• Well balanced and easy to push or pull along;
• Flexibility of fitting either a boom or a hand lance.
11. How Sprayers Work

Tractor Mounted Boom Sprayers

On large farms, tractor mounted boom sprayers are an efficient way to spray. Tank size may range from 100 litres for small garden tractors to 5,000 litres or more for very large farms.

Sprayers may be mounted directly onto the tractor (e.g. 3 point linkage) or be trailed behind. Pumps may be driven from the tractor motor, or there may be a separate petrol or electric motor mounted on the sprayer. There are a range of pump types.

These sprayers are suitable for insecticides, fungicides and herbicide, with appropriate nozzles and suitable pressure adjustments. Advanced training is needed for proper use.
Tractor Mounted Mistblowers

There are a number of different types of these specialist sprayers designed for large scale tree or row crop spraying. They incorporate a fan which creates air to carry spray droplets into the target canopy to provide good spray coverage of the foliage.

These sprayers are suitable for insecticides and fungicides, but not suitable for herbicides. Specialist training is required for correct operation.
11. How Sprayers Work

**Rotary Atomisers**

These are used in specialist sprayers called Controlled Droplet Applicators (CDA’s). Droplets are formed when spray liquid is dribbled onto a rapidly spinning disc or cone which is spun by a battery operated motor. The range of droplet sizes produced is very narrow and the faster the disc is spinning the finer the droplets. They apply very low volumes of spray.

Spray Droplets

All sprayers rely on the production of spray droplets which must be directed towards the target and deposited in the location where the crop protection product can work. There must be sufficient number of droplets depositing to give enough coverage for the crop protection product to work. Too much spray depositing will cause runoff and wasted spray. Too little coverage and the crop protection product will not work.

All sprayers produce a range of droplet sizes from very fine which are difficult to see by eye, to very large droplets. The size of droplets is described by measuring the diameter of the droplets in microns (Qm). One Qm is 1/1000th of a millimetre. Droplets are classified according to their sizes as follows:

<table>
<thead>
<tr>
<th>Oil Fog Smoke</th>
<th>Sea Fog</th>
<th>Cloud</th>
<th>Mist</th>
<th>Drizzle</th>
<th>Rain</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>1.0</td>
<td>10</td>
<td>100</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

DROP SIZE (micron μm)

Aerosols Sprayers Sprinklers

In spraying, we aim for droplet sizes of between 50 and 500 Qm. At these sizes adequate coverage is achieved. Very fine droplets evaporate very quickly and are lost, and also hang in the air and drift readily. Fine droplets are good for insecticides and fungicides because with air movement they will swirl around foliage and give good coverage on all surfaces (even under leaves). Larger droplets do not give such good coverage but they do not evaporate or drift easily. They are more suited for herbicides.
We can control the size of droplet produced by choosing the type of nozzle to use, the size of the nozzle outlet, and the pressure. Nozzles with large outlets produce larger droplets than those with smaller outlets. Higher pressures produce finer droplets than lower pressures. Sprayers must be operated at the correct pressure as specified by the nozzle manufacturer – usually in the range of 1 bar (100 kPa or 15 psi) to 5 bar (500 kPa or 75 psi) depending on the nozzles.

Spray Quality | Size of Droplets (Qm) | Retention on Leaf Surfaces | Used For | Potential Drift Hazard
---|---|---|---|---
Aerosol | < 50 | Good | Flying insects | Very high
Very Fine Mist | 51 to 100 | Good | Good cover | High
Fine | 101 to 200 | Good | Good cover | Moderate
Medium | 201 to 300 | Moderate | Most products | Low
Coarse | 300 to 500 | Poor | Soil herbicides | Low
Very coarse | > 500 | Bad | Liquid fertilisers | Very low

Sprayers with nozzles must also be operated at the correct height above the target being sprayed. In general, ensure the nozzle is no closer than 50cm to the plants (crop or weed), or to the soil if spray is being applied to the soil. This height is necessary for the spray droplets to form correctly and to be distributed evenly. When using a boom sprayer, height is critical to achieving a uniform distribution of spray across the boom. Set the boom height so that the spray from one nozzle hits the target under the adjacent nozzle as illustrated in the following diagram. Nozzles should be placed 50 cm apart on a boom. If they are 1100 angle nozzles then the height of the nozzle above the target should be 50 cm.
# Nozzles

The nozzle is the most important part of the sprayer. It creates the droplets and also helps control the volume of spray applied. There are many different types and different materials used in their manufacture. Choose the correct type of nozzle for the situation.

<table>
<thead>
<tr>
<th>Nozzle Type</th>
<th>Description</th>
<th>Pressure Range</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flat fan nozzle</strong></td>
<td>Used on boom sprayers where spray from one nozzle has to overlap spray from adjacent nozzles to give uniform coverage across the boom. Used at 2 - 3 bar pressure.</td>
<td>2 - 3 bar</td>
<td>BCPC (1991)</td>
</tr>
<tr>
<td><strong>Even spray flat fan nozzle</strong></td>
<td>Used as a single nozzle for example on a knapsack. Gives uniform deposit of spray across the wetted area. Good for applying a band of spray onto the ground. Do not use on a boom where spray overlap is needed.</td>
<td>1.0 to 1.5 bar</td>
<td>BCPC (1991)</td>
</tr>
<tr>
<td><strong>Flood jet nozzle</strong></td>
<td>Also used on knapsacks as a single nozzle. Gives wide coverage and produces large droplets. Used at 1.0 to 1.5 bar pressure.</td>
<td>1.0 to 1.5 bar</td>
<td>BCPC (1991)</td>
</tr>
<tr>
<td><strong>Hollow cone nozzle</strong></td>
<td>Can be used on a knapsack or on a boom. Used at higher pressure (5 bar) to produce finer spray droplets for insecticides and fungicides. Do not use for herbicides.</td>
<td>5 bar</td>
<td>BCPC (1991)</td>
</tr>
</tbody>
</table>
Nozzle Materials

Nozzles may be made from a range of materials:
Brass nozzles are inexpensive but wear quickly from abrasion. They are suitable for limited use.
Stainless steel nozzles resist abrasion and will not corrode, especially if it has been hardened.
Plastic and nylon nozzles resist corrosion and abrasion. They are inexpensive and easily damaged. They are good for most general spraying if replaced regularly.
Ceramic nozzles are highly resistant to wear and corrosion, but they are expensive. They are best for large scale operations.

All nozzles are now standardised in terms of shape and size, so that they can be interchanged on all machines. Internationally, all nozzles are colour coded according to flow rate. Nozzles should have their type and size coding stamped on them.

Preventing Spray Drift

When spraying it is very important to prevent spray drift contaminating neighbouring crops, animals, waterways, people, or houses where it can cause damage. The most important factor in controlling spray drift is droplet size. Fine droplets drift because they are very light. Larger droplets are heavy and do not drift. However, large droplets may not give good results because spray coverage of the target may be reduced.

Try to aim for medium sized droplets which do not hang in the air and give good coverage of the target. Make sure the target is well covered with spray droplets, but spray should not be running off the target. To reduce the number of small driftable droplets, choose a nozzle which produces larger droplets, or reduce the pressure to the minimum allowed for that nozzle. Nozzles with larger orifices (openings) produce larger droplets. Lower pressures produce larger droplets. Fine nozzles and high pressures produce fine droplets.

The next most important thing for preventing drift is wind speed. Strong winds can blow droplets away. Best results are achieved when wind speeds are between 3 and 15 km/h, or a light steady breeze. Do not spray in a moderate to strong breeze or above. It is also best not to spray under very calm conditions (< 1 kph) because droplets can hang in the air and cause drift. If smoke or dust is hanging in the air above the ground, do not spray. Try to spray when the breeze is blowing droplets away from sensitive areas. To estimate the wind speed, the following adaptation of the Beaufort Scale can be used. This scale was devised by British Rear-Admiral, Sir Francis Beaufort in 1805 based on observations of the effects of the wind.

References


11. How Sprayers Work

Table credits:
12. MAINTENANCE OF SPRAYERS

Before attempting this module, participants should have completed the module on *How Sprayers Work*
# Lesson Plan

## Materials needed:
- Flipchart stand with paper.
- Flipchart paper.
- Markers (4 colours).
- Coloured cards.
- Glue stick or blue tack.
- Masking Tape.
- Pin board and pins.
- Sample containers or labels.

## Time needed:
95 minutes (if less time, adjust each section accordingly)

## Intended audience:
Farmers and crop protection product dealers (resellers)

## Preparation:
- Flipchart on flipchart stand with the title “Maintenance of Sprayers”, and the Lesson Objectives.
- Range of sprayers applicable to participants (one sprayer for each 2-3 participants).
- Tools and lubricant for sprayer maintenance.
- Detergent etc for sprayer cleaning.
- Print off sufficient Fact Sheets for participants.
- Print off sufficient Assessment question sheets.
- Print off sufficient Attendance Record sheets.
- Organise venue and seating arrangements for using the sprayers e.g. open area with plenty of room.

## Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction 5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note</td>
<td>This session is best done outdoors on benches or in a workshop.</td>
</tr>
</tbody>
</table>
| Attention:  | Ask participants if they have had problems with sprayers that were not working properly  
Record their answers on a flipchart. |
| Title:      | Refer to the Title Flipchart and tell participants that this training session will cover *Maintenance of Sprayers*. |
| Credibility:| Describe any instances you know of where sprayers were not maintained correctly. |
| Objectives: | Refer to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to:  
• Explain the checks to undertake before using a sprayer  
• Dismantle a sprayer  
• Undertake maintenance checks on the sprayer parts  
• Reassemble a sprayer  
• Maintain a sprayer in an effective working condition  
• Explain the most common sprayer faults and how to correct them |
| Benefits:   | Understanding the differences between types of crop protection products can assist the farmer in selecting the best crop protection product for a problem. |
| Direction:  | During this session, we will focus on the different types of crop protection products that farmers use. |
## Delivery

(80-90% of total time)

### Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| 1. 10 minutes | **Demonstration – Before Spraying**  
Demonstrate to participants the procedures to follow when preparing a sprayer for use and during spraying:  
- Nozzle selection  
- Check that all parts are operating correctly  
- Fill the sprayer with water, operate and ensure there are no leaks  
- Check the spray pattern is even, with no streaks  
- Continually check sprayer operation during use. |
| 2. 10 minutes | **Demonstration – Sprayer Cleaning and Maintenance**  
Demonstrate to participants the correct procedures for:  
- The tools and spare parts required for sprayer cleaning and maintenance  
- Cleaning a sprayer after use, including checking the plant protection product label for any special instructions  
- Emphasise the difficulty of removing herbicide residues from the sprayer  
- Maintenance checks on filters, nozzles, pump, hoses, joints, lubrication etc  
- Reassembling the sprayer, filling with water, and ensuring that it is operating correctly |
| 3. 10 minutes | **Work Groups – Sprayer Cleaning**  
Divide the participants into groups of 2-3 people.  
**Give each group:**  
- A sprayer  
- Tools for maintenance and cleaning  
- A sample plant protection label or container  
**Work Group task:**  
- Thoroughly clean the sprayer.  
- Check product labels for any instructions on cleaning.  
**Walk round** the groups to observe activities, and to encourage and correct as necessary. |
| 4. 5 minutes | Ask each group to follow correct procedures to thoroughly clean out the sprayer. Check product labels for any instructions on cleaning. |
5. **Work Groups – Sprayer Maintenance**

10 minutes

When all groups have finished cleaning the sprayer, set the next task.

**Work Group task:**
- Dismantle the sprayer as necessary
- Perform maintenance checks on the sprayer – filters, pump, nozzle, pressure regulation, hoses, etc.

**Walk round** the groups to observe activities, and to encourage and correct as necessary.

6. **Work Groups – Sprayer Lubrication**

5 minutes

When all groups have finished maintenance of the sprayer, set the next task.

**Work Group task:**
- Lubricate all moving parts.
- Ensure all moving parts are operating correctly, etc.

**Walk round** the groups to observe activities, and to encourage and correct as necessary.

7. **Work Groups – Final Maintenance Checks**

10 minutes

When all groups have finished lubricating the sprayer, set the next task.

**Work Group task:**
- Reassemble the sprayer.
- Fill with clean water, and adjust the nozzle and pressure.
- Ensure the sprayer is operating correctly.

**Walk round** the groups to observe activities, and to encourage and correct as necessary.

8. **Work Groups – Sprayer Storage**

5 10 minutes

When all groups have finished the final maintenance checks, set the next task.

**Work Group task:**
- Empty the sprayer of water.
- Prepare the sprayer for storage.

**Walk round** the groups to observe activities, and to encourage and correct as necessary.

9. **Presentation – Fault Finding**

10 minutes

Present the contents of the Fault Finding table in the Fact Sheet.

**Use** a sprayer to show the location and remedy for each fault.
### Finish

(10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong></td>
<td>Review</td>
</tr>
<tr>
<td>1 minute</td>
<td>• Importance of sprayer maintenance</td>
</tr>
<tr>
<td></td>
<td>• The main points of sprayer maintenance.</td>
</tr>
<tr>
<td><strong>Questions:</strong></td>
<td>Ask if everyone understands or if there are any additional questions.</td>
</tr>
<tr>
<td>1 minute</td>
<td>Answer these provided they are relevant.</td>
</tr>
<tr>
<td><strong>Evaluation:</strong></td>
<td>Ask participants the steps to take when preparing a sprayer for storage.</td>
</tr>
<tr>
<td>12 minutes</td>
<td>Hand out the Assessment Sheet and ask participants to complete two of the questions.</td>
</tr>
<tr>
<td></td>
<td>Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record.</td>
</tr>
<tr>
<td><strong>Next step:</strong></td>
<td>Remind participants that sprayer maintenance is critical, and that dealers can help farmers with appropriate advice.</td>
</tr>
<tr>
<td>1 minute</td>
<td>Hand out the Fact Sheet to participants.</td>
</tr>
</tbody>
</table>

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#### Visual 1

![Maintenance of sprayers](image-url)

**The benefits of maintaining sprayers are:**
- It saves you money
- It reduces the risk of skin exposure
- It reduces the risk of environmental pollution

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Assessment Questions

Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

**Question 1:** What are five things that must be done to prepare a sprayer for spraying?
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**Question 2:** What are five things that must be done to a sprayer after spraying?
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**Question 3:** Describe the steps to take to clean a sprayer after spraying.
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**Question 4:** If a sprayer had no pressure or intermittent pressure, what could be the causes and what should be done to repair the problem?
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FACT SHEET

It is essential to maintain and service sprayers to ensure they are working correctly and will be effective when used. Sprayers must be adjusted and checked for correct operation and calibrated before any spray job. After spraying they must be cleaned and decontaminated before storing.

BEFORE SPRAYING

- Fit the correct nozzle for the crop protection product to be used and the situation. For example, choose a nozzle that will give a fine spray for insecticide and fungicide application, or a nozzle that will give a coarser spray for herbicides or minimising spray drift. Make sure the nozzle is correctly oriented.
- Check that all nuts and bolts are tight.
- Check all moving parts are oiled or greased as necessary.
- Check that the pressure regulator and controls operate freely.
- Fill the sprayer with clean water.
- Operate the sprayer and ensure there are no leaks - tank, hose, lance, nozzles, lid, air chamber, discharge tube. Check hose connections. Replace any old perished hoses or seals.
- Check that the pump is operating smoothly.
- Set the pressure to give the size spray droplets required.
- Check that the spray pattern is even with no streaks. If the nozzle is blocked clean it carefully using a soft brush and clean water. Do NOT use a piece of wire, etc. as this will damage the nozzle, and do NOT put it in your mouth to blow through it. If the spray pattern is still uneven, replace the nozzle with a new one and discard the old one.
- Calibrate the sprayer to determine the output and the amount of crop protection product to put in the tank. (Calibration of Sprayers is covered in another lesson).

If your sprayer has been left standing for some time, CHECK IT WELL IN ADVANCE OF THE TIME YOU WISH TO USE IT. If it is faulty, have it serviced. The extra effort will save time, money and inconvenience once the season commences.

DURING SPRAYING

- Keep a check on correct operation.
- If the nozzle blocks up, clean it as per the procedure above.
AFTER SPRAYING

- At the end of the spray operation, make sure there is no spray mix remaining in the tank. Either use it on the area being sprayed or discard it in a safe place away from waterways, food crops, animals, houses or people.
- Rinse the sprayer inside and out with clean water. The procedure is:
  - Half fill the tank with clean water.
  - Shake and then discard this rinse water in the area sprayed or in a safe place.
  - Half fill again, pump water through the hose and nozzles.
  - Open the trigger and remove the nozzle and filters.
  - Soak the filters and nozzle in soapy water, clean and rinse.
  - Replace the filter and nozzle and store safely.

Before storing the sprayer away:
- Grease any O-rings and seals with Vaseline.
- Grease moving parts with very light application of oil.
- Check the valves.
- Check that the tank breather valve is not blocked.
- Check that straps are secure.

CARE OF FILTERS

Loss of pressure or liquid flow can be due to a gradual clogging of filters. Wear protective clothing. Inspect filters regularly - after each spraying - and clean. Soak in water and clean with a soft brush. Dispose of washings safely. Replace any blocked or damaged filters immediately.

Ensure all filters are in place before calibration and each time before spraying.


HERBICIDE DECONTAMINATION

Sprayers used to apply herbicides should NOT be used to apply insecticides or fungicides. Irrespective of how carefully the sprayer is cleaned and decontaminated, there is always the risk that there may still be chemical residue which may cause crop damage.
However, if there is no alternative, the sprayer may be decontaminated using the procedure set out below:

- Wash out the sprayer with clean water.
- Flush through the system.
- Thoroughly hose down the outside of the sprayer to remove contaminated dirt and surface chemical.
- Scrub out the inside of the tank, using a stiff brush, taking particular care to clean the underside of the roof of the tank. For sprays containing oils, use a 250 ml of liquid or other suitable detergent per 20 litres of water. For other sprays, use 3 kg of washing soda per 20 litres of water.
- Agitate and spray out.
- Refill the tank with the cleaning solution and leave overnight.
- In the morning, wash out twice with clean water.

**IF IN DOUBT AS TO THE RESIDUAL PROPERTIES AND DECONTAMINATION OF THE CHEMICAL USED, CONSULT THE CHEMICAL MANUFACTURER OR HIS REPRESENTATIVE.**

**LONG TERM STORAGE OF THE SPRAYER**

If the sprayer is to be used regularly, it should be stored under cover after carrying out the cleaning procedure set out above under 'After Spraying'.

If the sprayer is to be stored for a long period, follow these procedures:
- Ensure that the system has been thoroughly flushed out, as chemical sedimentation in the pump will cause serious damage.
- Ensure that all nozzles are thoroughly clean by removing and cleaning.
- Lubricate all moving parts with oil or grease.
- Store the sprayer under cover to provide maximum protection.

**EQUIPMENT FOR MAINTENANCE AND SERVICING**

One person should be made responsible for all equipment used during maintenance, as most of it is very expensive to replace.

Tools and Spare parts required:
- Screwdriver(s) of appropriate size(s)
- Assortment of hose clips of the size being used.
- Spanners to fit the nozzle holders - 2 are needed in order to prevent damage to the nozzle bodies.
- Spanners to fit all nuts and bolts on the spray unit. Try to fit the same size bolts throughout the unit, as this cuts down on the number of spanners needed.
- Spare nozzles of the size being used, as this limits stoppage time. If a nozzle gets blocked a new one is fitted and spraying can resume, the blocked nozzle can then be cleaned later.
- Brush for cleaning nozzles. A soft brush is ideal for this job.
- Soft brush for cleaning the inside and outside of the tank and the mountings.
- Straight edge for checking pulley alignment. A short straight piece of angle iron will do the job.
- Clipboard and checklists with a pen.
- Short pieces of plastic pipe to repair leaking hoses.
- Spare lengths of hose, to match those from the tank to the pump, and from the pump to the pressure gauge and distributor.
- Spare V-Belts.
- A small grease gun if any equipment has grease nipples fitted.
- Any specialised equipment as per manufacturer’s requirements.
## FAULT FINDING

<table>
<thead>
<tr>
<th>Fault</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No pressure or intermittent pressure</strong></td>
<td>Filters blocked</td>
<td>Check and clean filters</td>
</tr>
<tr>
<td></td>
<td>Pump</td>
<td>Check pump operation</td>
</tr>
<tr>
<td></td>
<td>Pressure relief valves</td>
<td>Check and clear</td>
</tr>
<tr>
<td></td>
<td>Nozzles blocked</td>
<td>Remove and clean</td>
</tr>
<tr>
<td></td>
<td>Tank air inlet blocked</td>
<td>Check and clear</td>
</tr>
<tr>
<td><strong>Leakages</strong></td>
<td>Hoses damaged</td>
<td>Repair/replace hoses</td>
</tr>
<tr>
<td></td>
<td>Hose clips loose/damaged</td>
<td>Tighten clips</td>
</tr>
<tr>
<td></td>
<td>Loose pump assembly</td>
<td>Tighten assembly</td>
</tr>
<tr>
<td></td>
<td>Seals &amp; O-rings damaged</td>
<td>Replace seals &amp; o-rings</td>
</tr>
<tr>
<td><strong>No spray when operating</strong></td>
<td>Nozzles blocked</td>
<td>Check and clean nozzles</td>
</tr>
<tr>
<td></td>
<td>Tank outlet blocked</td>
<td>Disconnect outlet pipe and clear</td>
</tr>
<tr>
<td></td>
<td>Inlet filter blocked</td>
<td>Dismantle, clean and reassemble</td>
</tr>
<tr>
<td><strong>Sprayer sprays for short time only</strong></td>
<td>Tank air inlet blocked</td>
<td>Clean</td>
</tr>
<tr>
<td></td>
<td>Inlet pump filter blocked</td>
<td>Dismantle, clean, reassemble</td>
</tr>
<tr>
<td><strong>Uneven spray</strong></td>
<td>Nozzles blocked or worn</td>
<td>Remove, clean and test. Replace if still uneven</td>
</tr>
<tr>
<td></td>
<td>Nozzles not all the same</td>
<td>Remove and replace all.</td>
</tr>
<tr>
<td></td>
<td>Filters blocked</td>
<td>Remove, clean and test. Replace if still uneven.</td>
</tr>
<tr>
<td></td>
<td>Nozzles at boom end lower output - poor pressure</td>
<td>Check and replace nozzles or check pump pressure and repair.</td>
</tr>
<tr>
<td><strong>Pressure going up, but no or little change in output.</strong></td>
<td>Nozzle filters blocked.</td>
<td>Remove, clean and test. Check gauge returns to zero, if not replace.</td>
</tr>
<tr>
<td></td>
<td>Gauge faulty</td>
<td></td>
</tr>
<tr>
<td><strong>Narrow spray fans or cones</strong></td>
<td>Low pressure</td>
<td>Check pump efficiency. Use smaller nozzles. Check for air leaks between tank and nozzles. Check tank is not nearly empty.</td>
</tr>
<tr>
<td><strong>Coarse foam on top of spray liquid in tank.</strong></td>
<td>Faulty agitation.</td>
<td>Check agitation pipes or paddles.</td>
</tr>
<tr>
<td><strong>Very fine foam in spray liquid in tank.</strong></td>
<td>Air leak between tank and pump or in pump.</td>
<td>Repair leak.</td>
</tr>
<tr>
<td><strong>Spray fans or cones streaky.</strong></td>
<td>Nozzles partly blocked.</td>
<td>Remove, clean and test.</td>
</tr>
<tr>
<td></td>
<td>Nozzles worn or damaged.</td>
<td>Remove, replace and test.</td>
</tr>
</tbody>
</table>
13. TYPES OF SPRAYER NOZZLES
Lesson Plan

Materials needed:
- Flipchart stand with paper.
- Flipchart paper.
- Markers (4 colours).
- Coloured cards.
- Glue stick or blue tack.
- Masking Tape.
- Pin board and pins.

Time needed: 60 minutes (if less time, adjust each section accordingly)

Intended audience: Farmers and crop protection product dealers (resellers)

Preparation:
- Flipchart on flipchart stand with the title “Types of Sprayer Nozzles”, and the Lesson Objectives.
- Knapsack sprayer.
- Range of nozzles appropriate to the region.
- Range of nozzles made of different materials.
- Blank table on flipchart of nozzle types and usage (visual 6).
- Print off sufficient hard copies of all nozzle types and spray patterns.
- Print off sufficient Fact Sheets for participants.
- Print off sufficient Assessment question sheets.
- Print off sufficient Attendance Record sheets.
- Organise venue and seating arrangements.
- Flat surface on which to spray, that shows spray patterns (e.g. concrete path, sandy surface).

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction  5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | Ask participants which part of the sprayer is the most important.  
Each participant is likely to describe a different part and reason why this part is the most important.  
Say that the nozzle is the most important part, and that we will find out why in this lesson.  
Show a range of nozzles in a display. |
| **Title:** | Refer to the Title Flipchart and tell participants that this training session will cover *Types of Sprayer Nozzles.* |
| **Credibility:** | Tell participants of an experience (fictitious or true) of problems with using inappropriate sprayer nozzles. |
| **Objectives:** | Refer to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to:  
• Describe the common types of nozzle  
• Describe their spray patterns, droplet sizes, and uses |
| **Benefits:** | If farmers know which nozzle to use they can better apply the product, it will work more efficiently, and it will save them money. |
| **Direction:** | Start off by looking at the nozzles themselves, including how they function. Then cover spray patterns. Discuss appropriate nozzle use in crop protection. |

Delivery  (80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **1.**  
5 minutes | **Discussion – Nozzle Types**  
Ask participants which nozzles they know.  
When each nozzle type is mentioned, stick the picture of that nozzle (Visuals 1-5) with the name on the flipchart, and show the nozzle.  
Ensure the following nozzles are mentioned:  
• Flat fan nozzle  
• Even spray flat fan nozzle  
• Deflector nozzle (flood or anvil nozzle)  
• Hollow cone nozzle  
• Solid cone nozzle  
• (Others, if appropriate) |
<table>
<thead>
<tr>
<th><strong>Move outside</strong> for the next activity to the area where there is a flat surface on which to show spray patterns.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2. 20 minutes</strong></td>
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</tbody>
</table>
6. Discussion – Nozzle Care

5 minutes

Say that proper nozzle care is very important.

Worn and damaged nozzles:
• do not give the correct spray pattern,
• reduce the effectiveness of the crop protection product
• increase costs and crop loss

Ask how to care for and clean a nozzle.

Write responses on the flipchart using the Fact Sheet as a check list

Finish

(10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong></td>
<td><strong>Review:</strong></td>
</tr>
<tr>
<td>1 minute</td>
<td>• The common types of nozzle</td>
</tr>
<tr>
<td></td>
<td>• Nozzle spray patterns</td>
</tr>
<tr>
<td></td>
<td>• Nozzle use</td>
</tr>
<tr>
<td><strong>Questions:</strong></td>
<td><strong>Ask</strong> if everyone understands or if there are any additional questions.</td>
</tr>
<tr>
<td>1 minute</td>
<td>Answer these provided they are relevant.</td>
</tr>
<tr>
<td><strong>Evaluation:</strong></td>
<td><strong>Ask:</strong></td>
</tr>
<tr>
<td>12 minutes</td>
<td>• What size droplets are produced by a hollow cone nozzle, a flat fan nozzle?</td>
</tr>
<tr>
<td></td>
<td>• How is a nozzle blockage cleaned?</td>
</tr>
<tr>
<td></td>
<td><strong>Hand out</strong> the Assessment Sheet and ask participants to complete two of the questions.</td>
</tr>
<tr>
<td></td>
<td>Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record.</td>
</tr>
<tr>
<td><strong>Next step:</strong></td>
<td><strong>Say</strong> that now they know the different types of nozzles and uses. Farmers can select the most appropriate nozzle, and dealers can provide useful advice to farmers.</td>
</tr>
<tr>
<td>1 minute</td>
<td><strong>Hand out</strong> the Fact Sheet to participants.</td>
</tr>
</tbody>
</table>
Visual 1

Flat Fan Nozzle

Visual 2

Even Spray Flat Fan Nozzle
13. Types of Sprayer Nozzles

Visual 3

Deflector Nozzle

Also known as a Flood or Anvil nozzle

Visual 4

Hollow Cone Nozzle
Visual 5

Full or Solid Cone Nozzle
### Nozzle Types and Usage

<table>
<thead>
<tr>
<th>Nozzle Type</th>
<th>Used For</th>
<th>Spray Pattern</th>
<th>Droplet Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat Fan</td>
<td>Flat Fan</td>
<td>Even</td>
<td>Hollow Cone</td>
</tr>
<tr>
<td>Even Spray Flat Fan</td>
<td></td>
<td>Solid Cone</td>
<td>Full or Solid Cone</td>
</tr>
<tr>
<td>Deflector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hollow Cone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full or Solid Cone</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Answer TWO (2) only of the following questions. You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

**Question 1:** Identify the nozzles displayed and explain their spray patterns and uses.

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**Question 2:** From the displayed nozzles, identify the materials from which each nozzle is made. Explain their properties.

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**Question 3:** Explain what happens if nozzles are not replaced regularly.

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**Question 4:** How do you and how do you not take care of sprayer nozzles?

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...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

A nozzle is defined as “any device through which spray liquid is emitted, broken up into droplets, and dispersed”. Thus, the basic functions of a nozzle are:

1. To meter spray liquids.
2. To break up the spray liquid into droplets (atomisation).
3. To spread (disperse) the spray liquid in a specific pattern.
4. To provide hydraulic momentum or impact to the droplets.

The breaking up of spray liquid into droplets and subsequent dispersal requires the use of energy. Nozzles are classified according to the energy used:

- Hydraulic (use water pressure)
- Gaseous (use air pressure)
- Centrifugal (use gravitational pull)
- Electrical (use electricity).

Most conventional spraying equipment uses hydraulic nozzles to transform the spray mixture into droplets. ULV sprayers use a rotary (centrifugal) atomiser instead. Misters use high speed air to break the liquid into droplets.

Spray quality varies with the range of droplet sizes produced, which in turn depends upon nozzle size and pressure. It is essential that the nozzle chosen for a particular crop protection products application should give the spray quality indicated on the product label. Where spray quality or droplet size is not given on the label, it should be selected by considering the target, the product and the weather conditions. The table below indicates the characteristics of different spray qualities.

<table>
<thead>
<tr>
<th>Spray quality</th>
<th>Droplet classification</th>
<th>Size of Droplets (Qm)</th>
<th>Retention on difficult leaf surfaces</th>
<th>Used for</th>
<th>Potential drift hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finest</td>
<td>Aerosol</td>
<td>&lt; 50</td>
<td>Good</td>
<td>Exceptional circumstances</td>
<td>Very high</td>
</tr>
<tr>
<td>Very Fine</td>
<td>Mist</td>
<td>51 to 100</td>
<td>Good</td>
<td>Good cover</td>
<td>High</td>
</tr>
<tr>
<td>Fine</td>
<td>Fine</td>
<td>101 to 200</td>
<td>Good</td>
<td>Good cover</td>
<td>Moderate</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
<td>201 to 300</td>
<td>Moderate</td>
<td>Most products</td>
<td>Low</td>
</tr>
<tr>
<td>Coarse</td>
<td>Coarse</td>
<td>300 to 500</td>
<td>Poor</td>
<td>Soil herbicides</td>
<td>Low</td>
</tr>
<tr>
<td>Very coarse</td>
<td>Coarsest</td>
<td>&gt; 500</td>
<td>Bad</td>
<td>Liquid fertilisers</td>
<td>Very low</td>
</tr>
</tbody>
</table>
**NOZZLE TYPES**

There are many types of nozzles. The most commonly used are:

<table>
<thead>
<tr>
<th>Nozzle type</th>
<th>Used for</th>
<th>Type of sprayer</th>
<th>Spraying pattern</th>
<th>Droplet size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat fan</td>
<td>Herbicides.</td>
<td>Boom and knapsack sprayers</td>
<td>Tapered fan shape spray pattern</td>
<td>Medium to large</td>
</tr>
<tr>
<td>Even spray flat fan</td>
<td>Herbicides</td>
<td>Knapsack sprayers</td>
<td>Even fan shaped pattern</td>
<td>Medium to large</td>
</tr>
<tr>
<td>Deflector (Flood or Anvil)</td>
<td>Herbicides</td>
<td>Knapsack sprayers</td>
<td>Wide fan shaped spray pattern at low pressure</td>
<td>Large</td>
</tr>
<tr>
<td>Hollow cone</td>
<td>Insecticides and fungicides</td>
<td>Knapsack and boom sprayers</td>
<td>Cone shaped with a hollow centre</td>
<td>Fine</td>
</tr>
<tr>
<td>Full or solid cone</td>
<td>Insecticides and fungicides</td>
<td>Boom and knapsack sprayers</td>
<td>Cone shaped with spray in the centre</td>
<td>Fine</td>
</tr>
</tbody>
</table>
NOZZLE MATERIALS

Nozzles can be made of various materials, each with its own characteristics and benefits:

- **Brass**: inexpensive, wears quickly from abrasion; best material for limited use.
- **Stainless steel**: will not corrode; resists abrasion, especially if it has been hardened; one of the best materials for extensive use in spraying.
- **Plastic (nylon and PVDF)**: resists corrosion and abrasion; swells when exposed to some solvents; easily damaged; inexpensive.
- **Aluminium**: resists some corrosive materials; easily corroded by some fertilisers; no longer in use much.
- **Kematal**: a hard wearing type of plastic; highly resistant to abrasion and corrosion; expensive; used by contractors, with a lot of spraying, high pressures or abrasive powder formulations.
- **Tungsten Carbide**: highly resistant to abrasion and corrosion; expensive; used by contractors, with a lot of spraying, high pressures or abrasive powder formulations.
- **Ceramic**: highly resistant to abrasion and corrosion; expensive; used by contractors, with a lot of spraying, high pressures or abrasive powder formulations.

All nozzles are now standardised in terms of shape and size, so that they can be interchanged on all machines. In addition, all nozzles are now colour coded according to flow rate.

WORN NOZZLES

Worn nozzles result in a change of the rate of application rate as well as the spray pattern.
NOZZLE CARE

• Care and replacement of nozzles is critical for precise spraying:
• Do not blow through nozzles to clear them. This is a common cause of oral contamination and poisoning.
• Do not clear blocked nozzles with a sharp object, as this damages the nozzle and will produce irregular or increased spray volume.
• Do not tap nozzles on hard surfaces when blocked.
• Check regularly for wear and tear by measuring output.
• Replace damaged nozzles immediately
• Replace nozzles regularly, at least once per season, if the sprayer is in frequent use.
• Clean nozzles properly after use with water and a soft brush.
13. Types of Sprayer Nozzles
14. SPRAYER CALIBRATION
Lesson Plan

Materials needed:
- Flipchart stand with paper.
- Flipchart paper.
- Markers (4 colours).
- Coloured cards.
- Glue stick or blue tack.
- Masking Tape.
- Pin board and pins.
- Sample containers or labels.

Time needed: 120 minutes (if less time, adjust each section accordingly)

Intended audience: Farmers and crop protection product dealers (resellers)

Preparation:
- Flipchart on flipchart stand with the title “Sprayer Calibration”, and the Lesson Objectives.
- Flipchart with drawing of a field to be sprayed - with the sides marked 50m and 30m.
- Select a crop and pest problem from one of the labels. Have sufficient of these labels to give one to each group.
- An open area close to the classroom to practice calibration.
- Hand held sprayers, thoroughly washed with water (one for each group).
- Clean water.
- Tape measures, 30 or 50 metre (one for each group).
- Measuring jug, accurate to 1 litre (one for each group).
- Calculators (one for each group). Alternatively, if participants have mobile phones, these have calculators.
- Bucket to fill sprayer (one for each group).
- Print off sufficient Calibration Sheets for participants (from the Fact Sheet).
- Print off sufficient Fact Sheets for participants.
- Print off sufficient Assessment question sheets.
- Print off sufficient Attendance Record sheets.
- Organise venue and seating arrangements.

Assessment Questions
The Assessment Questions are an example of sprayer calibration, and will need the following information to be prepared.
- Choose a product label, a sprayer, and a situation applicable to the participants.
For example, spraying a 2 hectare field of vegetables against [local] pest with an insecticide using a knapsack sprayer.
- Sufficient product labels for all participants, or a photocopy of the part of the label containing mixing rate/dosage information.
- The amount of water used by the sprayer for eg 10sq m.
- A flipchart with the following information for participants to refer to during the Assessment Questions:
  - The field size or area
  - The crop/pest situation
  - The amount of water used by the sprayer for eg 10sq m

Attendance Record
As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### 14. Sprayer Calibration

#### Set up/Introduction  
5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | Ask participants how they know how much medicine they need to take if they are ill. Possible answers are:  
- The doctor will tell you  
- You read the instructions on the package of medicine.  
**Ask** what will happen if you do not take the correct dosage. Possible answers are:  
- The medicine will have no effect if you do not take enough  
- You can harm yourself if you take too much.  
**Say** that crop protection products and crops are exactly the same as medicines and sick people. You need to apply the right amount of crop protection products to control the pest, and to not damage the crop. |
| **Title:** | Refer to the Title Flipchart and tell participants that this training session will cover *Sprayer Calibration* |
| **Credibility:** | Describe situations you are familiar with where incorrect calibration resulted in poor crop protection product performance or crop damage. |
| **Objectives:** | Refer to the Title Flipchart with the Lesson Objectives. By the end of the lesson, participants will be able to  
- Calibrate a sprayer  
- Calculate the correct amount of crop protection product to mix and apply |
| **Benefits:** | Over- and under-application of crop protection products can result in poor pest control, crop damage, crop loss, and increased costs. To avoid these problems, a farmer needs to know how to calculate the correct dosage and how to calibrate a sprayer. A dealer should be able assist a farmer with this. |
| **Direction:** | During this session, we will focus on basic dosage calculations for sprayer application and sprayer calibration. We are not going to explain the actual spraying; that will be done in another session. |
### Delivery

(80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. 5 minutes</strong></td>
<td><strong>Work Groups – How Do You Apply the Correct Amount of Crop Protection Product to a Crop?</strong></td>
</tr>
<tr>
<td></td>
<td>Divide the participants into three groups.</td>
</tr>
<tr>
<td></td>
<td>Say that there are a number of steps to take to ensure that the right amount of crop protection product is applied with a sprayer to a crop.</td>
</tr>
<tr>
<td></td>
<td><strong>Work Group task:</strong></td>
</tr>
<tr>
<td></td>
<td>• What steps should be taken to ensure that the right amount of crop protection product is applied with a sprayer to a crop.</td>
</tr>
<tr>
<td></td>
<td>• Note answers in your notebooks</td>
</tr>
<tr>
<td></td>
<td>Allow 2-3 minutes for the groups to think about the answers.</td>
</tr>
<tr>
<td><strong>2. 5 minutes</strong></td>
<td><strong>Work Group Reports – How Do You Apply the Correct Amount of Crop Protection Product to a Crop?</strong></td>
</tr>
<tr>
<td></td>
<td>Ask Group 1 for their first answer. Ask if the other groups agree.</td>
</tr>
<tr>
<td></td>
<td>Write the answer on a flipchart if everyone agrees.</td>
</tr>
<tr>
<td></td>
<td>Repeat for Groups 2 and 3, and then again for the second and third answers.</td>
</tr>
<tr>
<td></td>
<td><strong>Lead</strong> the responses to the correct steps written on the flipchart:</td>
</tr>
<tr>
<td></td>
<td>Read the label.</td>
</tr>
<tr>
<td></td>
<td>• Calculate the area to spray.</td>
</tr>
<tr>
<td></td>
<td>• Calibrate the sprayer.</td>
</tr>
<tr>
<td></td>
<td>• Calculate how many times to fill the sprayer to cover the spraying area.</td>
</tr>
<tr>
<td></td>
<td>• Calculate how much crop protection product to put in each tank of spray.</td>
</tr>
<tr>
<td></td>
<td>• Calculate how much product is needed for the total area.</td>
</tr>
</tbody>
</table>
|             | Write *Calculating the Dosage* as a title on the flipchart and put the flipchart on the wall and leave it there for the rest of the session.
### 14. Sprayer Calibration

<table>
<thead>
<tr>
<th>3.</th>
<th><strong>Work Groups – Step 1: Read the Label</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5 minutes</strong></td>
<td><strong>Say</strong> we will start with the first step – Read the Label</td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong> that different labels carry mixing rate/dosage instructions in different ways:</td>
</tr>
<tr>
<td></td>
<td>• How many millilitres (ml) of product to add to so many litres of water. For example product per 1, 5 or 10 litres of water.</td>
</tr>
<tr>
<td></td>
<td>• As a volume of product to apply to a given area. For example litres per ha (l/ha), or millilitres per area (e.g. ml/100 sq m).</td>
</tr>
<tr>
<td></td>
<td><strong>Distribute</strong> a selection of different labels or containers to each group.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> each group to read the labels and identify the mixing/dosage rate.</td>
</tr>
<tr>
<td></td>
<td><strong>Help</strong> the groups to identify the information if necessary</td>
</tr>
</tbody>
</table>

### 4. | **Work Groups – Step 2: Calculate the Area to Spray** |
| **3 minutes** | **Say** we will now continue with the second step: Calculate the area to spray. |
| | **Put** up the flipchart with the drawing of the area to be sprayed. |
| | **Ask** how large is the field (50 by 30 metres). |
| | **Ask** what is the area of the field (50m x 30m = 1,500 sq m). |
| | **Write** 1,500 sq m on the drawing of the field. |

### 5. | **Discussion - Step 3: Sprayer Calibration** |
<p>| <strong>2 minutes</strong> | <strong>Say</strong> Step 3 is to calibrate the sprayer. |
| | <strong>Ask</strong> if someone can explain what calibration means. |
| | Calibration means taking the measurements and performing the calculations to ensure the correct dose of crop protection product is applied. |
| | <strong>Say</strong> that you are going to demonstrate how to calibrate a knapsack sprayer including the required calculations. Each group will then do their own calibration and calculations. |
| | <strong>Explain</strong> that there are a number of different ways to calibrate. |
| | <strong>Move outside</strong> to your “field” for the next activity. |</p>
<table>
<thead>
<tr>
<th></th>
<th>Demonstration – Step 3: Sprayer Calibration (Continued)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>6.</strong></td>
<td><strong>20 minutes</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong> that the field on the flipchart is 50m x 30m, or 1,500sq m. We need to calculate out how many times to fill the sprayer and how much crop protection product to put in each tank fill.</td>
</tr>
<tr>
<td></td>
<td><strong>Explain</strong> that the process is different if spraying the whole area, or if spraying rows or beds, or if spraying individual trees or plants.</td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong> the Calibration Calculation Sheet shows the different methods. Note that calibrating a powered boom sprayer is different again.</td>
</tr>
<tr>
<td></td>
<td><strong>Demonstrate</strong> the spraying part of calibration:</td>
</tr>
<tr>
<td></td>
<td>• Check the sprayer to make sure it is working correctly.</td>
</tr>
<tr>
<td></td>
<td>• Check the nozzle – show the group.</td>
</tr>
<tr>
<td></td>
<td>• Fill the sprayer with clean water to its full level mark and measure how much water is put in.</td>
</tr>
<tr>
<td></td>
<td>• Peg out an area of 5m x 2m (10sq m).</td>
</tr>
<tr>
<td></td>
<td>• Spray the water at normal pumping rate and walking speed following label directions.</td>
</tr>
<tr>
<td></td>
<td>• Refill the sprayer tank using the measuring jug to the full level mark to see how many litres (l) were used to spray the 10sq m.</td>
</tr>
<tr>
<td></td>
<td><strong>Return</strong> to the classroom to continue the lesson with the participants in their groups.</td>
</tr>
<tr>
<td><strong>7.</strong></td>
<td><strong>Demonstration – Steps 4, 5 and 6: Calculations</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Put up</strong> a flipchart with the heading <em>Calibration</em>.</td>
</tr>
<tr>
<td></td>
<td><strong>Work</strong> through the calibration steps on the Fact Sheet or use the Calibration Sheet. Use the figures from a label and the measurements taken outside.</td>
</tr>
<tr>
<td></td>
<td>• Calculate how many times to fill the sprayer to cover the spraying area.</td>
</tr>
<tr>
<td></td>
<td>• Calculate how much crop protection product to put in each tank of spray.</td>
</tr>
<tr>
<td></td>
<td>• Calculate how much product is needed for the total area.</td>
</tr>
<tr>
<td><strong>8.</strong></td>
<td><strong>Work Groups – Step 3: Sprayer Calibration</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Say</strong> it is now their turn to calibrate a sprayer to apply a crop protection product.</td>
</tr>
<tr>
<td></td>
<td><strong>Distribute</strong> the chosen label for the groups to use. Tell them the crop and pest problem, and ask them to identify the mixing rate/dosage instructions for that crop and pest.</td>
</tr>
<tr>
<td></td>
<td><strong>Move outside</strong> to your “field” for the next activity. Groups should bring their label with them.</td>
</tr>
</tbody>
</table>
### 9. Work Groups – Step 3: Sprayer Calibration (Continued)

| 20 minutes | Give each group:  
| • A sprayer  
| • A tape measure  
| • A measuring jug  
| • A bucket  
| • (A calculator if participants do not have mobile phones). |

**Work Group task:**  
• Ensure the sprayer is working correctly and the correct nozzle is fitted  
• Mark out the calibration spray area  
• Take the necessary actions and measurements to calibrate the sprayer.

**Walk** round to ensure that each group is doing the correct actions, and help as necessary.

*Return* to the classroom to continue the lesson with the participants in their groups.

### 10. Work Groups – Steps 4, 5 and 6: Calculations

| 20 minutes | Distribute copies of the Calibration Sheet to each group.  
| Remind groups that the field size is 1,500sq m. |

**Work Group task:**  
• Calculate the total amount of spray mix is needed for the area  
• Calculate how many times to fill the sprayer to cover the area.  
• Calculate how much crop protection product to put in each tank of spray.  
• Calculate how much product is needed for the total area.

**Ask** each group for the three calculation results. Write these on a flipchart.

**Compare** the results of the groups:  
• The dose of crop protection product required for the total area should be the same for each group.  
• They will probably have different results for total amount of spray mix, numbers of tank fills, and how much product to put in each tank.  
• This is because different operators have different walking and pumping speeds.  
If there are errors, help them with the calculations.
### Discussion/Presentation - Calibration

**Ask** what participants found easy or hard with the process.

**Remind** participants that different labels may give the mixing rates/dosages in different ways. Even so, the principles we have discussed and practiced in this lesson apply to all mixing rate/dosage instruction on the label.

**Give** a quick example of a different calculation if there is time.

**Explain** that if band spraying then the area to spray is the wetted area on the ground. If broadcast spraying, then it is the total ground area.

**Emphasise** the importance of sprayer calibration for ensuring effective and cost efficient pest management.

**Emphasise** that for each spray operation it is necessary to read the label. Also that the sprayer must be re-calibrated when things change, such as different nozzles, or a different operator. Dosages have to be calculated every time.

### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong> 1 minute</td>
<td><strong>Review</strong>, using the flipchart titled <em>Calculating the Dosage</em>, the steps in calibrating a sprayer, calculating the amount of spray mix, and the dosage of crop protection products</td>
</tr>
<tr>
<td><strong>Questions:</strong> 1 minute</td>
<td><strong>Ask</strong> if everyone understands or if there are any additional questions. Answer these provided they are relevant.</td>
</tr>
<tr>
<td><strong>Evaluation:</strong> 12 minutes</td>
<td><strong>Ask</strong> what is calibration. <strong>Ask</strong> if all label instructions are the same for mixing rates/dosages. <strong>Hand out</strong> the Assessment Sheet and ask participants to complete two of the questions. <strong>Collect</strong> the Assessment Sheet for later marking and entering the marks on the Attendance Record.</td>
</tr>
<tr>
<td><strong>Next step:</strong> 1 minute</td>
<td><strong>Remind</strong> participants that for every spray operation, the dosage must be calculated. Sprayers must be calibrated regularly, and every time there are changes such as a different nozzle or operator. <strong>Hand out</strong> the Fact Sheet to participants.</td>
</tr>
</tbody>
</table>
Assessment Questions

Name: ............................................ Date: ................. Mark: 

Answer ALL the following questions.
You may write your answers on this question sheet or tell your trainer the answers.

Question 1: Read the product label. What is the spray mix rate? For example, how much crop protection product is needed per knapsack or area? (2 marks)
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: Work out how much water is needed to spray the field. How much area is covered by 1 tank full of spray? How many times do you need to fill the spray tank to spray the whole field? (6 marks)
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 3: How much crop protection product concentrate do you need to put in each full tank of spray? (1 mark)
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 4: How much crop protection product concentrate do you need to spray the whole field? (1 mark)
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

Chemical manufacturers spend a great deal of time, money, and research to develop effective crop protection products. Research has shown that the most important part of getting good results is the way these products are applied. Poor equipment and poor operators lead to poor results. Skilled operators using good application equipment that is correctly adjusted and calibrated will achieve good results.

Calibration means:
1. Adjusting the sprayer for the situation (crop protection product used, target pest, weather conditions and surrounding sensitive areas)
2. Taking the measurements of the amount of spray (crop protection product plus water) applied
3. Performing the calculations to ensure the correct dose of crop protection product is applied.

The calculation of the dosage of a crop protection product as well as the rate of application to the target area is very important. If the calculations are wrong or if you do not follow label instructions, you will end up with either applying too much or not enough crop protection products.

The instructions on the label with regard to the amount you are applying assume spray is applied to just less than runoff. That is, plant leaves are wet but spray is not dripping off them. Check the label for instructions.

**Over-application** can cause:
- Damage to crops.
- Increased hazard to the applicator.
- Excess residue on crops.
- Wasted crop protection product and higher costs.

**Under-application** can cause:
- No, or less control of the pests.
- Need to re-spray again making double time and costs.

CROP PROTECTION PRODUCT APPLICATION CALCULATIONS

Some crop protection products like dusts and granules are ready-to-use formulations. These products do not need much calculation. You just apply the recommended quantity as described on the label to the target area.

For those crop protection products which need to be mixed with water it is necessary to:
1. Calculate how much crop protection product to buy.
2. Calculate how much crop protection product to apply.

Before calibrating your sprayer, make sure it is working correctly and that it is adjusted correctly for the crop protection product to be applied. For example, fit the correct nozzle.
CALIBRATION

There are a number of steps involved.

Step 1: Read the label

Before you start, you should read the label to check it is the correct product to use, how to use it, and the safety precautions required. The label will tell you the application rate. This should be either:

• Amount of product per volume of water. For example: ml per 20 litres.
• Amount of product per area sprayed: For example ml per 50 square metres or litres per ha.

Note: The following example is an extract from a Bayluscide label. It is not the full label.

The label says to mix 70-100 ml of Bayluscide per 16 litres of water (e.g. 1 knapsack) and to apply 250 litres of this mix (or 15 knapsacks full) per hectare.

or,

Mix 100–140 ml of Bayluscide per 16 litres and apply 180 litres or 11 knapsacks per hectare.

The label also says for transplanted rice to apply 1 litre of Bayluscide in 180-250 litres of water per hectare.

or,

If water depth is more than 3cm, or rainfall is expected soon, spray 1.5 litres of product per hectare.
**Step 2: Calculate the total field area to spray**

It is important to know the area of the field to be sprayed to calculate how much crop protection product is needed to cover the field, and how many times the spray tank will need to be filled.

If you are spraying an area, measure the length and width of the field.

Example: length = 50 metres, and width = 30 metres.
Calculate the total area of the field.
Example: 50m x 30m = 1,500 square metres.

If you are spraying rows or beds, calculate the total length of the rows or beds.
Example: If one row is 100m long and there are 10 rows, total length is 100m x 10 = 1,000m.

**Step 3: Peg out a known area**

Measure and mark out an area of 5m x 2m (10sq m), or measure and mark out 10m of row, or select one tree.

**Step 4: Measure how many litres of water it takes to spray the marked area**

Fill the sprayer with clean water to its full level mark and measure how much water the tank can hold.
Example: A knapsack sprayer can hold 15 litres.
Fit the nozzle that will be used when applying the crop protection product.
Spray the 10sq m, or 10m of row, with water at normal pumping rate and walking speed until the sprayer is empty.
Refill the sprayer tank using the measuring jug to the full level mark to see how many litres (l) were used to spray the 10sq m Example: 2 litres of water sprayed.

**Step 5: Calculate the total volume of spray required to spray the total field area**

If spraying the marked 10sq m, divide the litres of water applied to the 10sq m by 10, and multiply by the number of square metres of the total area to spray.
Example: If it took 2 litres of water to spray the 10sq m, and the field is 50m x 30m (1,500sq m), then the total volume to spray the 1,500sq m is:
2 litres ÷ 10sq m x 1,500sq m = 300 litres.

If spraying the marked 10m of row, multiply the number of litres of water applied to the 10m of row by the total length of all rows, and divide by 10.
Example: If it took 2 litres of water to spray 10m of row, and there are 10 rows each 100m long (1,000m of rows), then the total volume to spray the 1,000m is:
2 litres x 1,000m ÷ 10 = 200 litres.

**Step 6: Calculate how many times the sprayer needs to be filled to spray the field area**

Calculation: Divide the total volume of water required by the sprayer tank size.
Example: If the total volume required is 300 litres and the sprayer tank holds 15 litres then the number of tank fills is:
300 litres ÷ 15 litres = 20 tank fills.
Step 7: Calculate how much concentrate to put into each tank

To calculate how much crop protection product to add to each tank fill, the calculation will depend on how the application rate is stated on the label.
If the label says to apply an amount of concentrate per area (e.g. 1 litre/ha), the calculation of the amount (in ml) to add to each tank is:
Multiply the label rate (litre/ha) by the number of litres of water in the tank, then divide by the spray volume in litres applied to the marked 10sq m.
Example: if the label says “apply 1 litre per ha”, and we are using a sprayer that holds 15 litres, and we applied 2 litres to the 10sq m, the calculation is:
1 litre x 15 litres ÷ 2 litres = 7.5 ml to add to each tank fill.

If the label says to mix a dilution rate (e.g. “mix 10ml of product per 10 litre of water”, the calculation of the amount (in ml) to add to each tank is:
Divide the label stated amount of product by the label stated volume of water, then multiply by the number of litres of water in the spray tank.
Example: If the label says “mix 10ml of product per 10 litre of water”, and we are using a sprayer that holds 15 litres, the calculation is:
10ml ÷ 10 litres x 15 litres = 15 ml to add to each tank fill.

Step 8: Calculate how much crop protection product is needed to spray the total field area

Calculation: Multiply the ml of crop protection product per tank by the number of tank fills required to spray the field area.
Example: If 7.5ml is required for each tank and 20 tanks are needed, the calculation is:
7.5ml x 20 tanks = 150 ml of product is needed to spray the total field area.

The Sprayer Calibration Calculation Sheet may assist with calculations.

WHEN DOING CALCULATIONS, BE VERY CAREFUL OF UNITS AND DECIMAL POINTS. ALWAYS CROSS CHECK YOUR CALCULATIONS.

AFTER SPRAYING, WASH THE SPRAYER INSIDE AND OUT WITH WATER. WASH YOURSELF AND YOUR PROTECTIVE CLOTHING, AND PUT ON CLEAN CLOTHES.
## Sprayer Calibration Calculation Sheet

1. **Check the pesticide label for application directions.**
   
   Follow the column that matches the situation.

2. **Calculate total area to spray**
   
   \[
   \text{width (m)} \times \text{length (m)} = \text{m}^2
   \]

3. **Peg out a known area to spray e.g.**
   
   \[
   5 \text{ m} \times 2 \text{ m} = 10 \text{ square metres (m}^2\text{)}
   \]

4. **Fill the sprayer with clean water. Measure how many litres of water it takes to spray this known area.**

5. **Calculate the total volume of spray required to spray the total area**

6. **Calculate how many times you need to fill the sprayer**

7. **Calculate how much pesticide concentrate to put in each tank**

   **Check the label**

   \[
   \text{1 ha} = 10,000 \text{ m}^2
   \]

   \[
   \text{1 litre} = 1,000 \text{ mL}
   \]

8. **Calculate how much total pesticide is needed for the total area**

<table>
<thead>
<tr>
<th>Ground spraying</th>
<th>Spraying rows or beds</th>
<th>Spraying trees</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check the column if label rate is amount of pesticide per hectare L/ha</strong></td>
<td><strong>Follow this column if label rate is amount pesticide / volume</strong></td>
<td><strong>Follow this column if label rate is amount pesticide / volume</strong></td>
</tr>
<tr>
<td><strong>Calculate total area to spray</strong></td>
<td><strong>Length of 1 row (m \times ) \text{no. of rows} = \text{total length of rows} (m)</strong></td>
<td><strong>Total number of trees</strong></td>
</tr>
<tr>
<td>(\text{width (m)} \times \text{length (m)} = \text{m}^2)</td>
<td>(\text{10 m of row or bed})</td>
<td>(\text{One tree})</td>
</tr>
<tr>
<td><strong>Peg out a known area to spray e.g.</strong></td>
<td>(\text{Spray volume / 10m}^2 = \text{L / 10m}^2)</td>
<td>(\text{L per tree} = \text{L/tree})</td>
</tr>
<tr>
<td>(5 \text{ m} \times 2 \text{ m} = 10 \text{ square metres (m}^2\text{)})</td>
<td>(\text{Spray volume / 10m of row} = \text{L/10m})</td>
<td>(\text{L per tree} \times \text{number of trees} = \text{L})</td>
</tr>
<tr>
<td><strong>Calculate the total volume of spray required to spray the total area</strong></td>
<td>(\text{L/10m} \times \text{total row length} (m \div 10) = \text{L})</td>
<td>(\text{L})</td>
</tr>
<tr>
<td>(\text{L / 10m}^2 + 10 \times \text{area} \times \text{m}^2)</td>
<td>(\text{L/10m} \times \text{total row length} (m \div 10) = \text{L})</td>
<td>(\text{L per tree} \times \text{number of trees} = \text{L})</td>
</tr>
<tr>
<td><strong>Calculate how many times you need to fill the sprayer</strong></td>
<td>(\text{Total volume L + tank size} = \text{L})</td>
<td>(\text{Total volume L + tank size} = \text{L})</td>
</tr>
<tr>
<td>(\text{Total volume L + tank size} = \text{L})</td>
<td>(\text{Total volume L + tank size} = \text{L})</td>
<td>(\text{Total volume L + tank size} = \text{L})</td>
</tr>
<tr>
<td><strong>Calculate how much pesticide concentrate to put in each tank</strong></td>
<td>(\text{Check label rate:})</td>
<td>(\text{Check label rate:})</td>
</tr>
<tr>
<td>(\text{Label concentrate rate (L/ha)} \times )</td>
<td>(\text{Label amount / volume} \div \text{L per tree} \times \text{L water in tank})</td>
<td>(\text{Label amount / volume} \div \text{L per tree} \times \text{L water in tank})</td>
</tr>
<tr>
<td>(\text{Litres of water in tank} \div )</td>
<td>(\text{Amount / 1L} \times \text{L water in tank})</td>
<td>(\text{Amount / 1L} \times \text{L water in tank})</td>
</tr>
<tr>
<td>(\text{Litres to spray 10m}^2)</td>
<td>(\text{L water in tank})</td>
<td>(\text{L water in tank})</td>
</tr>
<tr>
<td>(\text{amount of pesticide / tank} \div \text{mL})</td>
<td>(\text{amount of pesticide / tank})</td>
<td>(\text{amount of pesticide / tank})</td>
</tr>
<tr>
<td><strong>Calculate how much total pesticide is needed for the total area</strong></td>
<td>(\text{total mL pesticide needed})</td>
<td>(\text{total mL pesticide needed})</td>
</tr>
<tr>
<td>(\text{mL pesticide / tank} \times \text{no. of tanks} = \text{total mL pesticide needed})</td>
<td>(\text{mL pesticide / tank} \times \text{no. of tanks} = \text{total mL pesticide needed})</td>
<td>(\text{mL pesticide / tank} \times \text{no. of tanks} = \text{total mL pesticide needed}|</td>
</tr>
</tbody>
</table>

**Note:**

- \(1 \text{ ha} = 10,000 \text{ m}^2\)
- \(1 \text{ litre} = 1,000 \text{ mL}\)
14. Sprayer Calibration
15. MEASURING AND MIXING CROP PROTECTION PRODUCTS
## Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper. |
|                 | ✓ Flipchart paper. |
|                 | ✓ Markers (4 colours). |
|                 | ✓ Coloured cards. |
|                 | ✓ Glue stick or blue tack. |
|                 | ✓ Masking Tape. |
|                 | ✓ Pin board and pins. |
|                 | ✓ Sample containers or labels. |

| Time needed: | 120 minutes (if less time, adjust each section accordingly) |

| Intended audience: | Farmers and crop protection product dealers (resellers) |

| Preparation: | ✓ Flipchart on flipchart stand with the title “Measuring and Mixing Crop Protection Products”, and the Lesson Objectives. |
|              | ✓ PowerPoint presentations of measuring and mixing of liquid and powder crop protection products. |
|              | ✓ Full set of PPE. |
|              | ✓ Knapsack sprayer. |
|              | ✓ Source of water |
|              | ✓ Liquid and powder crop protection product substitutes. |
|              | ✓ Measuring equipment, including cylinders, jugs, scale, funnels, buckets, and basin. |
|              | ✓ Coloured cards with words: Preparation, Measuring and Mixing, and Aftercare. |
|              | ✓ Print off sufficient Fact Sheets for participants. |
|              | ✓ Print off sufficient Assessment question sheets. |
|              | ✓ Print off sufficient Attendance Record sheets. |
|              | ✓ Organise venue and seating arrangements. |

## Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### Set up/Introduction

5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention:</strong></td>
<td>Show all the measuring and mixing equipment. Remind participants of the safety measures to take before, during, and after application of crop protection products.</td>
</tr>
<tr>
<td><strong>Title:</strong></td>
<td>Refer to the Title Flipchart and tell participants that this training session will cover <em>Measuring and Mixing Crop Protection Products</em>.</td>
</tr>
<tr>
<td><strong>Credibility:</strong></td>
<td>Tell participants a story from your own experiences - for example a possible accident, or an incorrect measurement of a product which resulted in a field problem.</td>
</tr>
<tr>
<td><strong>Objectives:</strong></td>
<td>Refer to the Title Flipchart with the Lesson Objectives. By the end of the lesson, participants will be able to correctly weigh and measure crop protection products according to their formulation. Explain these procedures to other persons.</td>
</tr>
</tbody>
</table>
| **Benefits:** | Incorrect measuring and mixing can result in under- or over-application of a crop protection product with adverse consequences, such as:  
- Poor efficacy of the product  
- Crop damage  
- Additional cost  
- Excessive pesticide residues in the harvested crop. |
| **Direction:** | During this lesson, we will focus on measuring and mixing crop protection products. We will not discuss the application of crop protection products. |
Delivery (80-90% of total time)

Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. 15 minutes</strong></td>
<td><strong>Work Groups – Three Steps in Measuring and Mixing Crop Protection Products</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Explain</strong> that, like application safety, there are three steps in measuring and mixing crop protection products.</td>
</tr>
<tr>
<td></td>
<td>• Preparation</td>
</tr>
<tr>
<td></td>
<td>• Measuring and Mixing</td>
</tr>
<tr>
<td></td>
<td>• Aftercare</td>
</tr>
<tr>
<td></td>
<td><strong>Put</strong> the three coloured cards with the words Preparation, Measuring and Mixing, and Aftercare on the flipchart.</td>
</tr>
<tr>
<td></td>
<td><strong>Divide</strong> the participants into three groups.</td>
</tr>
<tr>
<td></td>
<td><strong>Distribute</strong> blank coloured cards and markers to each group.</td>
</tr>
<tr>
<td></td>
<td><strong>Give</strong> each group a different topic: Preparation; Measuring and Mixing; Aftercare.</td>
</tr>
<tr>
<td></td>
<td><strong>Work Group task:</strong></td>
</tr>
<tr>
<td></td>
<td>• Discuss what is involved in your topic</td>
</tr>
<tr>
<td></td>
<td>• Write answers on the blank cards - one card per answer.</td>
</tr>
<tr>
<td></td>
<td>Allow 10 minutes for the group discussions.</td>
</tr>
<tr>
<td><strong>2. 15 minutes</strong></td>
<td><strong>Work Group Reports – Three Steps in Measuring and Mixing Crop Protection Products</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> each group in turn to present their results, and put their answer cards below the heading card on the flipchart.</td>
</tr>
<tr>
<td></td>
<td><strong>Do not</strong> give comments yet and do not allow comments from other groups. Only ask questions if something is not clear.</td>
</tr>
</tbody>
</table>
### Discussion of Work Group Reports – Three Steps in Measuring and Mixing Crop Protection Products

**Begin** with *Preparation*.

Allow participants a minute or two to look at the answer cards under ‘Preparation’.

**Lead** participants with questions and discussions on the following key points:
- What equipment is necessary?
- Calibrated scales
- Personal Protective Equipment
- A separate area
- Avoid outdoors
- Scoops and jugs
- Closed containers to transport
- Clean afterwards
- Read the label
- Measuring and mixing equipment,
- Spill kit.

**Repeat** for *Measuring and Mixing*, and for *Aftercare*, ensuring the following key points are covered:

**Measuring and Mixing:**
- Wear appropriate PPE – boots, gloves, overalls, apron, dust mask (powders) or face-shield (liquids)
- Open the crop protection product container
- Measure the correct amount (liquids or powders)
- Reseal the crop protection product container
- Add water to sprayer
- Pre-mix crop protection products
- Add to sprayer
- Agitate
- Add more water
  - Agitate

**Aftercare:**
- Return crop protection products to safe storage area
- Clean the measuring and mixing equipment
- Clean the mixing and measuring area
- Clean protective clothing.
Demonstration – Procedures for Mixing Liquid and Powder Crop Protection Products

Liquid Crop Protection Products:
Call for two volunteers.

Instruct the two volunteers in measuring and mixing liquid crop protection products so they demonstrate to the other participants. (Refer to the Fact Sheet for the procedures)

Ask throughout the demonstration for comments and suggestions from the other participants.

Review the measuring and mixing steps again, either through your own demonstration, or a PowerPoint presentation.

Powder Crop Protection Products:
Call for two more volunteers.

Repeat the activity for powder crop protection products

---

### Finish (10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Summary:** 1 minute | Review:  
- The factors in preparation, measuring and mixing and aftercare  
- The steps for measuring and mixing liquid and powder crop protection products |
| **Questions:** 1 minute | Ask if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |
| **Evaluation:** 12 minutes | Ask what are three important points for preparation, for measuring and mixing, and for aftercare.  
Hand out the Assessment Sheet and ask participants to complete two of the questions.  
Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** 1 minute | Emphasise to participants the importance of personal safety, as well as the safety of others and the environment, when measuring and mixing crop protection products.  
Hand out the Fact Sheet to participants. |
Assessment Questions

Answer TWO (2) only of the following questions. 
You may write your answers on this question sheet or tell your trainer the answers. 
All questions are the same value (5 marks).

Question 1: What factors are important in preparing to measure and mix crop protection products?
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Question 2: What factors are important during the measuring and mixing of crop protection products?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
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Question 3: What are the procedures for measuring and mixing a liquid crop protection product?
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Question 4: What are the procedures for measuring and mixing a powder crop protection product?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
Liquid crop protection products have a much higher risk of skin and eye contamination than powders.

Follow these steps when measuring & mixing liquid crop protection products:

• Protect yourself: wear boots, overalls, gloves, apron, and face-shield.
• Always make sure the sprayer is on a level surface before filling.
• Follow the instructions for filling on the product label. If none are given, half fill the sprayer tank with clean water before adding the product.
• Never take water direct from a stream or other water course. Use an intermediate water bowser or other suitable vessel.
• Do not allow any run back of crop protection product into the water supply during filling.
• Open the crop protection product container. Only open one pack at a time.
• Measure the right amount of crop protection product in a suitable measuring cylinder or supplied cup.
• Pour the measured crop protection product into the spray tank. (Concentrates which can be easily mixed with water can be poured directly into the half-filled spray tank. Concentrates which cannot be easily mixed with water, such as wettable powders should first be “creamed” with a little water in a bucket, before pouring the “cream” into the half-filled spray tank.)
• When pouring the concentrate into the tank, pour slowly, allowing air to enter the pack so avoiding glugging and splashing.
• Close the crop protection product container.
• Empty containers should be stored securely (in the crop protection product store) ready for disposal.
• Triple rinse the measuring container and pour the rinse water into the spray tank.
• Fill the tank to the right volume whilst agitating the contents. If spraying is delayed, thoroughly agitate the tank before resuming the operation (unless otherwise instructed on the label).
• Do not fill spray tanks too full so that they leak. Plan in advance how much water you need.
• Close the spray tank properly.
• Agitate the tank again.
• Return any unused crop protection product to the store. If this is not practical, because you are working away from the store itself, make sure spare product is secured and not posing any danger to people or the environment.
• The sprayer is now ready for application.
MEASURING AND MIXING WETTABLE POWDER CROP PROTECTION PRODUCTS

Wettable powder crop protection products have a much higher risk of dust inhalation than liquid crop protection products.

Follow the same principles as mentioned above for liquid crop protection products, but note some differences for powder crop protection products:

• Protect yourself: wear boots, overalls, gloves, apron, and dust mask.
• Half fill the sprayer tank with clean water before adding the product.
• Never take water direct from a stream or other water course. Use an intermediate water bowser or other suitable vessel.
• Do not allow any run back of crop protection product into the water supply during filling.
• Open the crop protection product container. Only open one pack at a time.
• Measure the right amount of crop protection product, using a calibrated scale or in a suitable supplied measuring cup.
• Put the wettable powder in a suitable mixing container, such as a small bucket.
• Close the crop protection product container.
• Add a small amount of water to the mixing container and mix until it becomes a smooth paste.
• Add more water to make it into an easily pourable “cream”.
• Pour the “creamed” crop protection product into the spray tank.
• Triple rinse the measuring cup, stirrer, and the mixing container, and pour the rinse water into sprayer tank.
• Agitate the tank so the crop protection products mix well with the water.
• Fill the spray tank to the required level.
• Close the spray tank properly.
• Agitate the tank again.
• Return any unused crop protection product to the store. If this is not practical, because you are working away from the store itself, make sure spare product is secured and not posing any danger to people or the environment.
• The sprayer is now ready for application.
16. CLEANING AND DESTRUCTION OF CONTAINERS FOR DISPOSAL
Lesson Plan

<table>
<thead>
<tr>
<th>Materials needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Flipchart stand with paper.</td>
</tr>
<tr>
<td>✓ Flipchart paper.</td>
</tr>
<tr>
<td>✓ Markers (4 colours).</td>
</tr>
<tr>
<td>✓ Coloured cards.</td>
</tr>
<tr>
<td>✓ Glue stick or blue tack.</td>
</tr>
<tr>
<td>✓ Masking Tape.</td>
</tr>
<tr>
<td>✓ Pin board and pins.</td>
</tr>
<tr>
<td>✓ Sample containers or labels.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time needed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 minutes (if less time, adjust each section accordingly)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intended audience:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farmers and crop protection product dealers (resellers)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preparation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Flipchart on flipchart stand with the title “Types of Crop Protection Products”, and the Lesson Objectives.</td>
</tr>
<tr>
<td>✓ PowerPoint presentations of:</td>
</tr>
<tr>
<td>• Principles of Cleaning and Destruction of Empty Containers</td>
</tr>
<tr>
<td>• Disposal</td>
</tr>
<tr>
<td>✓ Sample containers: metal, glass, plastic, paper, cardboard, aerosol.</td>
</tr>
<tr>
<td>✓ A sprayer.</td>
</tr>
<tr>
<td>✓ Appropriate PPE: gloves, overalls, boots, face-shield or goggles, apron.</td>
</tr>
<tr>
<td>✓ (If available - Posters of cleaning and destruction instructions for each container type).</td>
</tr>
<tr>
<td>✓ Print off sufficient Fact Sheets for participants.</td>
</tr>
<tr>
<td>✓ Print off sufficient Assessment question sheets.</td>
</tr>
<tr>
<td>✓ Print off sufficient Attendance Record sheets.</td>
</tr>
<tr>
<td>✓ Organise venue and seating arrangements.</td>
</tr>
</tbody>
</table>

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
## Set up/Introduction

**5 minutes (5-10% of total time)**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | **Show participants the empty containers.**  
*Say* that these are empty crop protection product containers.  
*Ask* if any can be re-used at all?  
*Answer:* Not for food or water, but perhaps for replacing damaged containers.  
*Ask* what are the two main principles for dealing with used crop protection product containers:  
Clean  
Destroy |
| **Title:** | **Refer** to the Title Flipchart and tell participants that this training session will cover *Cleaning and Destruction of Containers for Disposal.* |
| **Credibility:** | **Tell** participants your experiences with crop protection product container cleaning and destruction. |
| **Objectives:** | **Refer** to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to explain and describe the procedures for:  
• Cleaning empty crop protection product containers  
• Destroying empty crop protection product containers |
| **Benefits:** | Knowledge and understanding of the correct procedures for cleaning and destroying empty crop protection product containers will help prevent possible poisoning of people or animals, and help to avoid damage to the environment. |
| **Direction:** | During this session, the focus is on the cleaning and destruction of commonly used crop protection product containers. We will not discuss disposal of unused product, this will be covered in a later lesson. |
### Delivery (80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **1.** 10 minutes | **Presentation – Principles of Cleaning and Destruction of Containers for Disposal**  
**Show** participants the range of representative crop protection product containers: metal, glass, plastic, paper, cardboard, and aerosol.  
**Show** the PowerPoint slide of the principles:  
- Wear protective clothing  
- Containers must be emptied  
- Then cleaned or rinsed  
- Stored temporarily (crop protection product store) for later disposal  
- Cleaning of equipment, PPE, and self.  
**Remind** participants of the reasons for correct cleaning and destruction: To prevent poisoning of people, animals, and the environment. |
| **2.** 20 minutes | **Demonstration – Cleaning and Destruction of Containers for Disposal**  
**Explain** clearly that for this demonstration, gloves are the only protective equipment being used. For proper cleaning and destruction then gloves, boots, overalls, apron, and goggles should be worn for protection.  
**Demonstrate** how to clean and destroy each of the six types of containers (refer to the Fact Sheet for details).  
Each demonstration should show:  
- PPE  
- Safety of others  
- Proper emptying of container into sprayer tank  
- Cleaning (triple rinsing for liquid containers)  
- Destruction  
- Safe keeping for future disposal  
- Cleaning of equipment  
- Cleaning of PPE  
- Cleaning of self. |
| **3.** 10 minutes | **Work Groups Practical - Cleaning and Destruction of Containers for Disposal**  
**Divide** participants into four groups, and give one container type per group.  
**Work Group task:**  
- Clean and destroy the group container  
  (Follow the poster instructions - If posters are available)  
**Walk** round the groups to ensure that the steps are being correctly followed.  
When the groups have finished, say that the containers are now ready for disposal. |
4. Cleaning and Destruction of Containers for Disposal

10 minutes

**Discussion/Presentation – Disposal**

Ask what participants normally do with their used containers

A variety of answers, some acceptable and some unacceptable, are likely.

Explain, using the PowerPoint presentation, that there are several options.

- Deliver containers to a country container collection system for disposal
- Deliver containers to a licensed incinerator – unlikely in a developing country, although many cement kilns are now accepting containers as fuel – burns at very high temperatures
- If legal in the country, burn the containers
- If legal in the country, bury the containers, or the ashes if burning is allowed.

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**Finish (10% of time)**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary: 1 minute</td>
<td>Review the principles of cleaning and destruction of containers for disposal.</td>
</tr>
<tr>
<td>Questions: 1 minute</td>
<td>Ask if everyone understands or if there are any additional questions. Answer these provided they are relevant.</td>
</tr>
<tr>
<td>Evaluation: 12 minutes</td>
<td>Ask: What PPE should be worn during cleaning and destruction. Hand out the Assessment Sheet and ask participants to complete two of the questions. Collect the Assessment Sheet for later marking and entering the marks on the Attendance Record.</td>
</tr>
<tr>
<td>Next step: 1 minute</td>
<td>Inform participants that we will learn how to dispose of the cleaned and crushed containers in a later lesson. Hand out the Fact Sheet to participants.</td>
</tr>
</tbody>
</table>
Answer TWO (2) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

**Question 1:** Explain the cleaning and destruction procedure for metal and plastic containers.

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**Question 2:** Explain the cleaning and destruction procedure for glass containers.

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**Question 3:** Explain the cleaning and destruction procedure for paper and cardboard containers.

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**Question 4:** What are the possible options for disposal of cleaned and destroyed containers?

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...........................................................................................................................................................................................
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FACT SHEET

Empty crop protection containers must be cleaned and then destroyed, so that they cannot be used again. This will reduce pollution of the environment and protect people and animals from the risk of accidental poisoning. It is also economical and efficient if washings are added to the spray tank to ensure all crop protection product is used up.

In the store, sufficient space should be made available for empty and used containers awaiting disposal. There should also be an inventory system to record collection and disposal of used containers.

Crop protection products are sold in different types of containers. The most common are:
- Containers for liquid formulations made of metal, plastic, or glass
- Container for dry/solid formulations made of plastic, paper, or cardboard.

Follow these steps

1. Quarter-fill the container with water
2. Close the container and shake for 30 seconds
3. Empty the container by placing it upside down over spray tank. Hold it there for 30 seconds more

Always wear protective clothing

Protect your health – puncture the container so it cannot be re-used and send to recycler
CLEANING OF LIQUID CONTAINERS

- Use the triple rinsing principle. It has been shown by research, that there is no detectable residue in a container if it has been triple rinsed properly.
- Wear suitable PPE – boots, overalls, gloves, apron, face shield or goggles.
- Empty the container into the sprayer tank – knapsack, mistblower, or boom sprayer.
- Fill container with clean water - about a quarter full.
- Close the lid and shake for 30 seconds.
- Pour the rinse into the sprayer tank.
- Repeat this twice so that the container is rinsed three times.

DESTRUCTION OF METAL AND PLASTIC CONTAINERS

- Triple rinse the container.
- Spray the contents of the sprayer over the crop.
- After cleaning, puncture the container with a sharp object.
- Squash the container to make it as small as possible.
- Place the crushed container inside the crop protection product store for safe keeping until disposal.
- Clean the equipment used to puncture the containers.
- Clean your protective clothing.
- Clean yourself.

NB: In a large operation, it may be necessary to keep some containers intact, for use as alternative containers for damaged containers.

DESTRUCTION OF GLASS CONTAINERS

- Triple rinse the container.
- Spray the contents of the sprayer over the crop.
- Place the glass container inside a strong sack (plastic or hessian) and crush with a blunt object.
- Place the destroyed container and bag into an appropriate disposal container for later disposal.
- Clean the equipment used to puncture the containers.
- Clean your protective clothing.
- Clean yourself.

DESTRUCTION OF PAPER AND CARDBOARD CONTAINERS

- These cannot be rinsed with water, for obvious reasons.
- Wear suitable PPE – boots, overalls, gloves, apron, face-shield or goggles.
- Empty the container into the sprayer tank – knapsack, mistblower, or boom sprayer.
- Spray the contents of the sprayer over the crop.
- Hole the container so that it cannot be used again.
- Fold the container as small as possible and put into suitable disposal container for later disposal.
- Clean the equipment used to hole the containers.
- Clean your protective clothing.
- Clean yourself.
BURRYING AND BURNING OF CLEAN AND DESTROYED CONTAINERS

• Burying of washed and crushed containers is allowed in some countries. If this is the case, bury the destroyed containers following the guidelines in the lesson on the disposal pit.
• Burning of washed and crushed containers is allowed in some countries. If this is the case, destroy the containers following the guidelines in the lesson on incineration.

EMPTY AEROSOL CONTAINERS

Empty aerosol containers **MUST NOT** be punctured or burnt. They should be put into a suitable container for later disposal.

DISPOSAL OF DESTROYED CONTAINERS

There are normally several options:
• Deliver containers to a country container collection system for disposal
• Deliver containers to a licensed incinerator – unlikely in a developing country, although many cement kilns are now accepting containers as fuel – burns at very high temperatures
• If legal in the country, burn the containers
• If legal in the country, bury the containers
• If legal in the country, burn and bury the ashes
17. APPLICATION SAFETY
Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper.  
|                  | ✓ Flipchart paper.  
|                  | ✓ Markers (4 colours).  
|                  | ✓ Coloured cards.  
|                  | ✓ Glue stick or blue tack.  
|                  | ✓ Masking Tape.  
|                  | ✓ Pin board and pins.  
|                  | ✓ Sample containers or labels. |
| Time needed:     | 65 minutes (if less time, adjust each section accordingly) |
| Intended audience: | Farmers and crop protection product dealers (resellers) |
| Preparation:     | ✓ Flipchart on flipchart stand with the title “Application Safety”, and the Lesson Objectives.  
|                  | ✓ Knapsack, and/or mistblower sprayer, with nozzles.  
|                  | ✓ Full set of PPE.  
|                  | ✓ PowerPoint presentations of visuals  
|                  |   • Attention in Set Up activity  
|                  |   • Full set of slides from Fact Sheet – Safety before, during and after application  
|                  | ✓ Print off sufficient Fact Sheets for participants.  
|                  | ✓ Print off sufficient Assessment question sheets.  
|                  | ✓ Print off sufficient Attendance Record sheets.  
|                  | ✓ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction 5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | **Show** slides of:  
• Using a leaking sprayer  
• Spraying in a strong wind  
• Eating after spraying  
**Ask** participants if they have seen similar situations. |
| **Title:** | **Refer** to the Title Flipchart and tell participants that this training session will cover *Application Safety.* |
| **Credibility:** | **Tell** participants a story about a dangerous experience applying crop protection products. |
| **Objectives:** | Refer to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to explain and describe, and implement, correct application practices before, during, and after spraying. |
| **Benefits:** | Safety of the operator, other people, animals, and the environment. |
| **Direction:** | During this session, we will discuss application safety before, during and after spraying. |
### Module/Time | Activity
--- | ---
1. | Say that there are three stages of safe application of crop protection products:  
• Before application  
• During application  
• After application

2. | Discussion/Presentation – Safety Before Application  
15 minutes  
Ask participants what safety procedures must be followed before application.  
Record answers on the flipchart.  
Show the Safety Before Application PowerPoint presentation.  
Use the Fact Sheet Safety Before Application as a checklist  
Explain and demonstrate each slide/procedure, using appropriate PPE, the sprayer, and sample containers.

3. | Discussion/Presentation – Safety During Application  
15 minutes  
Ask participants what safety procedures must be followed during application.  
Record answers on the flipchart.  
Show the Safety During Application PowerPoint presentation.  
Use the Fact Sheet Safety During Application as a checklist  
Explain and demonstrate each slide/procedure, using appropriate PPE, sprayer, and containers

4. | Discussion/Presentation – Safety After Application  
15 minutes  
Ask participants what safety procedures must be followed after application.  
Record answers on the flipchart.  
Show the Safety After Application PowerPoint presentation.  
Use the Fact Sheet Safety After Application as a checklist  
Explain and demonstrate each slide/procedure, using appropriate PPE, sprayer, and containers
## Finish

(10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| Summary: 1 minute | **Review** the main points of the three stages of application:  
• Before  
• During  
• After |
| Questions: 1 minute | **Ask** if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |
| Evaluation: 12 minutes | **Ask** how can application equipment pose problems of safety?  
**Hand out** the Assessment Sheet and ask participants to complete two of the questions.  
**Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| Next step: 1 minute | **Inform** participants that in the next lesson we will discuss how to manage an accidental spillage of crop protection product.  
**Hand out** the Fact Sheet to participants. |
Only use pesticides when needed. Get advice before buying pesticides and only purchase them at authorised retailers.

When storing pesticides make sure they are kept in a well-ventilated, securely locked place.

Check sprayer regularly for leaks and that nozzles work properly. Wear personal protection equipment while mixing and loading.

While spraying pesticides, always wear personal protection equipment and only use calibrated equipment with no leaks. Spray early in the morning or late in the evening when it is less windy. Do not eat, drink or smoke while spraying.

After spraying pesticides, take a shower and put on clean clothes. Wash the spray equipment and personal protection equipment while protecting water sources and the environment. Store all equipment separately and safely.

In case of accidental contamination, wash and apply first aid according to the label. Then take the person to the nearest medical centre and bring the product label with you.
Assessment Questions

Name: .............................................  Date: ..........................  Mark: 

**Answer TWO (2) only of the following questions.**
You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

**Question 1:** Describe the safety measures to take before spraying.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
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**Question 2:** Describe the safety measures to take during spraying.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 3:** Describe the safety measures to take after spraying.
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

**Question 4:** Before, during, and after spraying, how can you protect yourself, other people, and the environment?
...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
FACT SHEET

There are three stages of safety when applying crop protection products:
- Safety **before** application
- Safety **during** application
- Safety **after** application

**SAFETY BEFORE APPLICATION**

| ![Image 1] | Wear the appropriate PPE. |
| ![Image 2] | Ensure the PPE is in good condition. |
| ![Image 3] | Read the label to ensure that the right crop protection product has been selected |
| ![Image 4] | Read the label for dosage instructions. |
| ![Image 5] | Choose the correct nozzle type and flow rate. |
| ![Image 6] | Inspect the equipment for leaks, loose fittings, and signs of wear and tear. Repair any problems before spraying |
| Ensure the sprayer has been recently calibrated. |
| Ensure that the correct area will be sprayed |
| Avoid torn or damaged containers, leaks and spills. |
| Spray with care for your own safety (prevent skin and clothing contamination). |
| Ensure the safety of other people, especially children and women. |
| Ensure the safety of the crop and non-target crops and areas. |
| ![Image](image) | **Never mix crop protection products with hands; Use a stirrer.** |
| ![Image](image) | **Do not spray if it is raining or about to rain. Check the weather conditions.** |
| ![Image](image) | **Do not spray if there are strong winds. Check the weather conditions.** |
| ![Image](image) | **Measure and mix the correct amount and dosage** |
| ![Image](image) | **After measuring and mixing, clean the equipment.** |
| ![Image](image) | **Ensure there are washing and decontamination facilities nearby** |
## SAFETY DURING APPLICATION

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Wear the appropriate PPE.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Never leave crop protection products and equipment unattended</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Never allow children to apply crop protection products</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>Never leave crop protection product containers open</td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>Do not spray in a strong wind</td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>Spray so that wind blows crop protection product away from you</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>Keep people away from the application area.</td>
</tr>
<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>Spray in the cool of day (early morning or late afternoon)</td>
</tr>
<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>Maintain correct walking speed and an even pumping action.</td>
</tr>
<tr>
<td><img src="image4.png" alt="Image" /></td>
<td>Check nozzles for even distribution.</td>
</tr>
<tr>
<td><img src="image5.png" alt="Image" /></td>
<td>Stop application if nozzles are blocked or equipment leaks.</td>
</tr>
<tr>
<td><img src="image6.png" alt="Image" /></td>
<td>Avoid contact with recently sprayed foliage.</td>
</tr>
<tr>
<td><img src="image7.png" alt="Image" /></td>
<td>Keep spray equipment well maintained.</td>
</tr>
</tbody>
</table>
Never clean nozzles by blowing into them. Use something soft such as a grass stem or soft brush.

Never eat, drink or smoke during application. Never touch face with contaminated hands.

Wash hands before and after going to the bathroom.

SAFETY AFTER APPLICATION

Erect warning signs to say the area has been treated, and giving the re-entry period. Prevent any re-entry without protective clothing.

Use all the spray mix. If there is spray mix left over, apply to the crop or surrounds.

Collect all waste, such as empty containers, for safe disposal. Return empty container to the nearest authorized collection site.
<table>
<thead>
<tr>
<th>Wash the sprayer and parts.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wash gloves before removing.</td>
</tr>
<tr>
<td>Wash protective clothing.</td>
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<tr>
<td>Wash yourself after spraying.</td>
</tr>
<tr>
<td>Keep and fill out spray records.</td>
</tr>
</tbody>
</table>
17. Application Safety
18. MANAGING AN ACCIDENTAL SPILLAGE
Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper. |
|                  | ✓ Flipchart paper. |
|                  | ✓ Markers (4 colours). |
|                  | ✓ Coloured cards. |
|                  | ✓ Glue stick or blue tack. |
|                  | ✓ Masking Tape. |
|                  | ✓ Pin board and pins. |
|                  | ✓ Sample containers or labels. |

| Time needed: | 60 minutes (if less time, adjust each section accordingly) |

| Intended audience: | Farmers and crop protection product dealers (resellers) |

| Preparation: | ✓ Flipchart on flipchart stand with the title “Types of Crop Protection Products”, and the Lesson Objectives. |
|              | ✓ Coloured cards with names of spill equipment (refer to Fact Sheet). |
|              | ✓ Full set of spill equipment (refer to Fact Sheet). |
|              | ✓ Full set of PPE |
|              | ✓ Sample containers filled with water and/or sand to represent liquid and solid crop protection products. |
|              | ✓ Print off sufficient Fact Sheets for participants. |
|              | ✓ Print off sufficient Assessment question sheets. |
|              | ✓ Print off sufficient Attendance Record sheets. |
|              | ✓ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
### Set up/Introduction

**5 minutes (5-10% of total time)**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
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</table>
| **Attention:** | **Knock over** one of the sample crop protection product containers filled with water.  
**Tell** participants this is an accidental crop protection product spill.  
**Ask** participants what should be done now? |
| **Title:** | **Refer** to the Title Flipchart and tell participants that this training session will cover *Managing an Accidental Spill*. |
| **Credibility:** | **Tell** participants a story (true or fictitious) about any experiences of accidental crop protection product spills. |
| **Objectives:** | **Refer** to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to:  
• Describe the equipment needed to clean up a crop protection product spill.  
• Explain the procedures for cleaning up a liquid and powder crop protection product spill. |
| **Benefits:** | Knowing what equipment to use and how safely clean up and dispose of a spill will help to prevent contamination of the environment, and more importantly prevent any danger to humans. |
| **Direction:** | During this session, we will begin by looking at what PPE we might need, look at the equipment required to clean up a spill, and finally learn how to clean up a liquid and a powder spill. |

### Delivery

**(80-90% of total time)**

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **1.**  
**5 minutes** | **Discussion – What PPE to Wear When Cleaning Up an Accidental Spill**  
**Show** participants the full set of PPE.  
**Ask** which items they should wear when cleaning up an accidental spill.  
**Record** the answers on a flipchart.  
**Show** the items of PPE that should be worn, and **explain** why each item should be worn. |
### Discussion – Equipment Needed to Clean Up an Accidental Spill

**Ask** what equipment might be needed for cleaning up the spill and getting it ready for disposal.

**Record** the answers on a flipchart, or by using the coloured cards with names of spill equipment.

**Add** as necessary using the Fact Sheet as a checklist.

**Show** the spill clean-up equipment, and explain why and how each item is used.

### Demonstration – Cleaning Up a Liquid Spill

**Remind** participants of the accidental spill at the beginning of the lesson.

**Repeat** the “accident” and knock over a sample container filled with water. Leave the container lying on its side.

**Ask** for a volunteer who will clean up the liquid spill and prepare for disposal.

**Say** that the other participants must give instructions to the volunteer on what to do or actions to take.

**Guide** the instructions from the group to ensure they follow the steps in the Fact Sheet for a liquid spill.

**Record** each step on the flipchart as it occurs.

### Demonstration – Cleaning Up a Powder Spill

Say that now we know how to clean up a liquid spill, we will now clean up a powder spill.

**Repeat** the “accident” again and knock over a sample container filled with sand. Leave the container lying on its side.

**Ask** for a volunteer who will clean up the powder spill and prepare for disposal.

**Say** that the other participants must give instructions to the volunteer on what to do or actions to take.

Guide the instructions from the group to ensure they follow the steps in the Fact Sheet for a powder spill.

**Emphasise** the need for damp sand only in certain circumstances.

**Record** each step on the flipchart as it occurs.

### Presentation – Spillage Report System

**Explain** the Spillage Report System if it is appropriate for participants.
### Finish

(10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary:</strong></td>
<td><strong>Review:</strong></td>
</tr>
<tr>
<td>1 minute</td>
<td>- PPE required</td>
</tr>
<tr>
<td></td>
<td>- Safety of others</td>
</tr>
<tr>
<td></td>
<td>- Equipment required</td>
</tr>
<tr>
<td></td>
<td>- Clean up procedures</td>
</tr>
<tr>
<td></td>
<td>- Washing afterwards</td>
</tr>
</tbody>
</table>

| **Questions:** | Ask if everyone understands or if there are any additional questions.  |
| 1 minute       | Answer these provided they are relevant. |

| **Evaluation:** | Ask:  |
| 12 minutes     | - Under what circumstances should we use damp sand when cleaning up a powder spill  |
|                | - What is the final action to take after cleaning up a spill  |

**Hand** out the Assessment Sheet and ask participants to complete two of the questions.

**Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record.

| **Next step:** | Say that participants should now gather the necessary clean up equipment, place it in or near the plant protection product store, and put up a poster to explain the actions to take in the event of a spill. |
| 1 minute       | **Hand out** the Fact Sheet to participants. |
Answer TWO (2) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers. All questions are the same value (5 marks).

Question 1: What equipment should be available to deal with an accidental spillage?
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Question 2: Explain how to clean up an accidental spill of liquid crop protection product.
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Question 3: What safety issues must be considered when dealing with an accidental spill?
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Question 4: Explain the Spillage Report System.
...........................................................................................................................................................................................
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...........................................................................................................................................................................................
FACT SHEET

Leaks and spills can be prevented by careful handling of crop protection product containers, good storage conditions, and stock control with visual checks. However, in the unlikely event of a spill or a leak, then store keepers must be prepared to deal with the problem.

EQUIPMENT REQUIRED

The following equipment should be kept inside the store to deal with a leak or spillage:

- Buckets of absorbent material.
- Buckets of dry sand (absorbs crop protection product) which can be used as an alternative. Can also be used for fire fighting.
- Large, flat spade to place the absorbent material around and over the spill, and to collect the contaminated waste.
- Broom to mix the absorbent or sand with the spilled crop protection product and then to sweep up the mix.
- A pan to collect the sweepings.
- Clean buckets to put sweepings into for appropriate disposal.
- Cloth and water to clean up any residue.

STOCK CHECKS AND EMERGENCY TELEPHONE NUMBERS

- The stock of plant protection products in the store must be examined daily for leaks (look for puddles, piles of dust, stained packaging, or increases in the level of smell).
- Emergency telephone numbers (fire, medical, police, store owner) and/or radio call signs must be displayed inside the storeroom, for use in the case of emergencies.
- There must be a “Spillage Emergency Instructions” poster on the wall in the crop protection product store which gives the procedures to follow and actions to take in the event of a spill.
SPILLAGE EMERGENCY INSTRUCTIONS

The poster displayed on the crop protection product store wall, should give the following procedures and actions:

IN THE EVENT OF A LIQUID SPILLAGE

• Ensure the safety of others by keeping them away from the spill.
• Put on Personal Protective Clothing (always treat the product as dangerous until you have read the label).
• Stop the leak by moving the container so that the point of leak is at the highest side (lay container on its side or stand on other end).
• Soak up the spill with either the absorbent mix or dry sand.
• Brush up carefully and place sweepings in bucket.
• Collect the sweepings for later disposal.
• If the original container is damaged, decant the remaining liquid crop protection product into a clean labelled container.
• If the original container is undamaged and the spill was caused by knocking it over when open, reseal the container.
• Clean away any residues with damp cloth, and dispose of the cloth.
• After dealing with the spillage clean the equipment, PPE, and yourself.

IN THE EVENT OF A POWDER SPILLAGE

• Ensure the safety of others by keeping them away from the spill.
• Put on Personal Protective Clothing (always treat the product as dangerous until you have read the label).
• If available, use an appropriate and safe commercial vacuum cleaner to clean up the powder.
• Alternatively, cover the spill with absorbent mix or dry sand
• Damp sand can be used when excessive dust may arise from sweeping/brushing.
• Brush up carefully without making too much dust.
• Place sweepings in bucket.
• Collect the sweepings for later disposal.
• Mend the container or decant the powder into a clean sealable container, and label properly.
• Clean away any residues with damp cloth, and dispose the cloth.
• After dealing with the spillage clean the equipment, PPE and yourself.
18. Managing an Accidental Spillage

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Keep people and animals away from the spill and put on appropriate PPE.</td>
</tr>
<tr>
<td>2.</td>
<td>Stand the container upright so that no further spill occurs, and surround the spill with absorbent material.</td>
</tr>
<tr>
<td>3.</td>
<td>Brush the absorbent material into the spill and mix it to absorb the crop protection product.</td>
</tr>
<tr>
<td>4.</td>
<td>Place sweepings into a spare labelled container, for later disposal.</td>
</tr>
<tr>
<td>5.</td>
<td>Repair the container or decant into an appropriate empty container.</td>
</tr>
<tr>
<td>6.</td>
<td>Wash the equipment</td>
</tr>
<tr>
<td>7.</td>
<td>Wash yourself</td>
</tr>
</tbody>
</table>
SPILLAGE REPORT SYSTEM

A plant protection store must have a Spillage Report System, where the following procedure is followed:
* After dealing with a spillage, the spillage is immediately reported to management.
* All spillages are recorded in a book, under the following headings:
  * Date
  * Time
  * Name of crop protection product
  * Formulation
  * Estimated amount spilled
  * Action taken
  * By whom
  * Report acknowledged by manager
  * Signed by manager and storekeeper
* Stock records are updated to indicate the amount lost during the spillage.
19. FIRST AID
Lesson Plan

| Materials needed: | ✓ Flipchart stand with paper.  
|                  | ✓ Flipchart paper.  
|                  | ✓ Markers (4 colours).  
|                  | ✓ Coloured cards.  
|                  | ✓ Glue stick or blue tack.  
|                  | ✓ Masking Tape.  
|                  | ✓ Pin board and pins.  
|                  | ✓ Sample containers or labels.  
| Time needed: | 90 minutes (if less time, adjust each section accordingly)  
| Intended audience: | Farmers and crop protection product dealers (resellers)  
| Preparation: | ✓ Flipchart on flipchart stand with the title “Types of Crop Protection Products”, and the Lesson Objectives.  
|              | ✓ PowerPoint presentation of visuals:  
|              |   • Routes of Entry of Crop Protection Products into the Body.  
|              |   • First Aid for Immediate, Skin, Swallowed, and Eye Contamination  
|              |   • Record Keeping  
|              | ✓ Cards with the symptoms of poisoning on each.  
|              | ✓ Cards with three groups of symptoms:  
|              |     • Initial symptoms  
|              |     • Following or accompanying symptoms  
|              |     • Late symptoms  
|              | ✓ Print off sufficient Fact Sheets for participants.  
|              | ✓ Print off sufficient Assessment question sheets.  
|              | ✓ Print off sufficient Attendance Record sheets.  
|              | ✓ Organise venue and seating arrangements.  

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up/Introduction  5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module/ Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | **Ask** if anyone has ever been contaminated with crop protection products or if they know of a situation where this occurred?  
**Ask** if they knew what to do at the time.  
**Ask** what was the result of the contamination for the affected person. |
| **Title:** | **Refer** to the Title Flipchart and tell participants that this training session will cover *First Aid*. |
| **Credibility:** | **Tell** participants a story about a crop protection product poisoning incident known to you. |
| **Objectives:** | **Refer** to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to:  
• Describe how to recognise the symptoms of poisoning by crop protection products.  
• Describe the equipment required to deal with an incident of poisoning.  
• Explain the procedures to follow in case of an incident of poisoning. |
| **Benefits:** | Knowing these procedures will help to save lives. |
| **Direction:** | During this session, we will look at the causes of poisoning, the symptoms of poisoning, immediate First Aid procedures, and then examine in more detail the specific First Aid for skin and eye contamination, for inhalation poisoning, and for swallowed crop protection product poisoning. |

Delivery  (80-90% of total time)

**Explanation, Demonstration, Exercise, and Guidance:**

<table>
<thead>
<tr>
<th>Module/ Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **1.**  
**5 minutes** | **Discussion – Routes of Entry of Crop Protection Products into the Body**  
**Remind** participants of the lesson 3 – Toxicity and Other Hazards, regarding how crop protection products enter the body.  
**Ask** participants to explain each one:  
• Dermal (skin/eyes),  
• Inhalation (breathing)  
• Ingestion (swallowed).  
**Show** the PowerPoint presentation of the three routes of entry (refer to Fact Sheet). |
<table>
<thead>
<tr>
<th>2.</th>
<th><strong>Full Group - Symptoms of Poisoning by Crop Protection Products</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10 minutes</strong></td>
<td><strong>Ask</strong> what poisoning symptoms are likely if contamination or poisoning occurred.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> participants to write their answers on coloured cards, (one answer per card), and pin the cards on the flipchart.</td>
</tr>
<tr>
<td></td>
<td>When participants have finished, <strong>put up</strong> on a flipchart the three heading cards of Initial Symptoms, Following or Accompanying Symptoms, and Late Symptoms.</td>
</tr>
<tr>
<td></td>
<td><strong>Take</strong> the participant answer cards one by one and put them under the correct heading.</td>
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<tr>
<td></td>
<td><strong>Add</strong> any missing symptom cards.</td>
</tr>
<tr>
<td></td>
<td><strong>Summarise</strong> the symptoms using the Fact Sheet as a checklist.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3.</th>
<th><strong>Discussion/Demonstration - Immediate First Aid</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10 minutes</strong></td>
<td><strong>Ask</strong> two participants to volunteer.</td>
</tr>
<tr>
<td></td>
<td><strong>Explain</strong> that one volunteer has been contaminated with crop protection product, and the other is a colleague.</td>
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<tr>
<td></td>
<td><strong>Ask</strong> participants what should be done immediately if someone is suspected of suffering from crop protection product contamination or poisoning.</td>
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<tr>
<td></td>
<td><strong>Record</strong> answers on the flipchart until there are no more responses.</td>
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<td></td>
<td><strong>Using</strong> the volunteers, demonstrate step by step the procedures to follow using the Fact Sheet as a checklist.</td>
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<tr>
<td></td>
<td><strong>Show</strong> the PowerPoint of Immediate First Aid.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4.</th>
<th><strong>Discussion/Demonstration - First Aid for Skin Contamination</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>10 minutes</strong></td>
<td><strong>Ask</strong> two other participants to volunteer.</td>
</tr>
<tr>
<td></td>
<td><strong>Explain</strong> that one volunteer has been contaminated on the skin with crop protection product, and the other is a colleague.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask</strong> participants what should be done if someone is suspected of suffering from skin contamination from a crop protection product.</td>
</tr>
<tr>
<td></td>
<td><strong>Record</strong> answers on the flipchart until there are no more responses.</td>
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<tr>
<td></td>
<td><strong>Using</strong> the volunteers, demonstrate step by step the procedures to follow using the Fact Sheet as a checklist.</td>
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<tr>
<td></td>
<td><strong>Show</strong> the PowerPoint of First Aid for Skin Contamination.</td>
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<td></td>
<td>5. 10 minutes</td>
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<thead>
<tr>
<th></th>
<th>6. 10 minutes</th>
<th>Discussion/Demonstration – First Aid for Eye Contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Ask</strong> two other participants to volunteer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Explain</strong> that one volunteer has been contaminated in the eye by a crop</td>
</tr>
<tr>
<td></td>
<td></td>
<td>protection product, and the other is a colleague.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Ask</strong> participants what should be done if someone is suspected of eye</td>
</tr>
<tr>
<td></td>
<td></td>
<td>contamination by a crop protection product.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Record</strong> answers on the flipchart until there are no more responses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Using</strong> the volunteers, demonstrate step by step the procedures to follow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>using the Fact Sheet as a checklist.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Show</strong> the PowerPoint of First Aid for Eye Contamination.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>7. 10 minutes</th>
<th>Discussion – When and When Not to Induce Vomiting</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Ask:</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If someone has swallowed a plant protection product, should we</td>
</tr>
<tr>
<td></td>
<td></td>
<td>make them vomit?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If yes, then why</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If No, then why</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Record</strong> answers on the flipchart under two headings, ‘Yes’ and ‘No’,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>until there are no further responses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Referring</strong> to the Fact Sheet as a checklist, <strong>explain</strong> the situations in which the victim should be made to vomit, and the situations in which this must not be done.</td>
</tr>
</tbody>
</table>
## Discussion - Record Keeping

### Activity

**Ask** what records should be kept following an incidence of contamination or poisoning.

**Record** answers on the flipchart until there are no more responses.

**Show** the PowerPoint of Record Keeping, referring to participant responses on the flipchart as appropriate.

---

### Finish

(10% of time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Summary:** 1 minute | **Emphasise:**  
- Speed of response to an incident of contamination or poisoning  
- Read the label  
- Decontamination  
- Seek medical assistance |
| **Questions:** 1 minute | **Ask** if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |
| **Evaluation:** 12 minutes | **Ask:**  
- What records should be kept after an incident of contamination or poisoning by a crop protection product  
**Hand out** the Assessment Sheet and ask participants to complete two of the questions.  
**Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** 1 minute | **Say** that participants now know what to do in cases of crop protection contamination or poisoning. Ask them to pass their knowledge on to other people.  
**Hand out** the Fact Sheet to participants. |
It is easier to prevent poisoning than to treat it, so always read the label safety instructions. In case of any incident, these are the steps you should follow:

**SKIN**
If pesticides get in contact with your skin, remove any contaminated clothing and wash the skin with abundant soap and water.

**EYES**
If pesticides get in contact with your eyes, wash with a gentle stream of cool clean water for at least 15 minutes. Wash each eye individually, from inside out, to prevent cross contamination.

**INHALATION**
If you accidentally breathe in pesticides, find a ventilated place where you are able to get some fresh air. Loosen your shirt and belt. If breathing stops, artificial respiration must be performed using proper equipment.

**MOUTH**
If you accidentally swallow pesticides, you must seek medical help as quickly as possible. Do not drink anything. Keep calm and comfortable as much as you can and do not induce vomiting.

**REMEMBER, AFTER TAKING THESE FIRST AID STEPS, SEEK MEDICAL HELP AS QUICKLY AS POSSIBLE AND BRING THE PRODUCT LABEL WITH YOU.**
Answer TWO (2) only of the following questions.
You may write your answers on this question sheet or tell your trainer the answers.
All questions are the same value (5 marks).

Question 1: Describe the immediate procedures to follow for anyone contaminated with crop protection products.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................

Question 2: Describe the procedure for a person with skin contamination.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
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Question 3: Describe the procedure for a person with eye contamination.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
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Question 4: Explain when and when not to induce vomiting in a patient who has swallowed crop protection product.

...........................................................................................................................................................................................
...........................................................................................................................................................................................
...........................................................................................................................................................................................
19. First Aid
FACT SHEET

CROP PROTECTION PRODUCT POISONING AND EMERGENCY FIRST AID

• If you spill crop protection product onto your skin or clothes, wash immediately.

• If you inhale crop protection product fumes, tell the supervisor and allow him to take appropriate action.

• If you feel sick when using crop protection products:
  • Stop working immediately
  • Tell your supervisor
  • Go outside into the open to get fresh air
  • Allow the supervisor to take appropriate action.

• If you suspect someone has symptoms of poisoning, attend to the patient immediately.

THE LABELS OF ALL CROP PRODUCTION PRODUCTS GIVE THE SYMPTOMS OF POISONING, FIRST AID TREATMENT, AND THE PRESCRIBED ANTIDOTE.

ROUTES OF ENTRY OF CROP PROTECTION PRODUCTS INTO THE BODY

<table>
<thead>
<tr>
<th>Route of Entry</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dermal absorption</td>
<td>Through the skin, including through the eyes and ears. This is the most common cause of poisoning, where crop protection product may splash into eyes or onto exposed skin, or soak through badly maintained protective clothing. Crop protection products may enter the body through healthy, unwounded skin as well as through wounds and sores.</td>
</tr>
<tr>
<td>Oral ingestion</td>
<td>Through the mouth. This is the least likely method of poisoning. However, it is very dangerous if people eat, drink or smoke with contaminated hands.</td>
</tr>
<tr>
<td>Inhalation</td>
<td>Through breathing. This is the most rapid form of entry into the body, as the crop protection product can enter the lungs and get directly into the bloodstream very quickly. Some crop protection products are very volatile (evaporate easily) and therefore are very dangerous. Using crop protection products in closed spaces or under still air conditions can also make poisoning through inhalation more extreme.</td>
</tr>
</tbody>
</table>
SYMPTOMS COMMONLY ASSOCIATED WITH POISONING:

Initial symptoms:
- Dizziness
- Discomfort
- Headache
- Weakness or fatigue
- Nausea
- Vomiting
- Excessive sweating
- Shaking
- Tightness of the chest.

Following or accompanying symptoms:
- Blurred vision
- Diarrhoea
- Excessive salivation
- Watering of the eyes
- Hyper-excitability
- Twitching of the muscles of the eyelids
- Constriction of the pupils
- Mental confusion

Late symptoms:
- Fluid in the chest
- Tremors
- Convulsions
- Coma
- Loss of urinary or bowel control
- Respiratory and cardiac failure.

CATEGORIES OF POISONING

Acute poisoning is the severe poisoning which occurs after exposure to a single dose of crop protection product. The appearance of symptoms may be sudden and dramatic or they may be delayed.

Chronic poisoning is the poisoning which usually occurs as a result of repeated, small, non-lethal doses over a long period of time. Many symptoms may appear, such as nervousness, slowed reflexes, irritability, or a general decline in health. Some test animals are unable to reproduce normally after repeated exposure to crop protection products.

FIRST AID TREATMENT

In any case of poisoning or suspected poisoning call or consult a medical doctor as soon as possible, show the doctor the label on the container or provide information about recent contact with crop protection products and present him with the name of the crop protection product(s), preferably the common name (active ingredient) of the poison(s).
**IMMEDIATE FIRST AID ACTION**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>First establish whether the poisoning or illness is a result of crop protection product contamination.</td>
<td></td>
</tr>
<tr>
<td>Check the area for your own safety.</td>
<td></td>
</tr>
<tr>
<td>Wear appropriate PPE if necessary.</td>
<td></td>
</tr>
<tr>
<td>Remove the patient from source of poisoning.</td>
<td></td>
</tr>
<tr>
<td>Remove any contaminated clothing or PPE and work clothes.</td>
<td></td>
</tr>
<tr>
<td>Keep the patient still, calm and reassured. Check where or what type of contamination has occurred, and provide first aid as described below.</td>
<td></td>
</tr>
<tr>
<td>Call supervisor and management immediately, show them the label of container of suspected poisoning source. Let management read and act accordingly.</td>
<td></td>
</tr>
<tr>
<td><strong>First Aid</strong></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Do not give the patient anything to eat, drink or smoke.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Keep patient warm if cold.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Keep patient cool if hot.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Place patient on side with head lower than rest of body (recovery position).</strong></td>
<td></td>
</tr>
<tr>
<td><strong>If the patient stops breathing, then get a qualified first aider to apply artificial respiration. Avoid contamination of the first aider.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Obtain medical help immediately. Take the container, a copy of the label, and any other information available for medical personnel to read.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Few crop protection products have antidotes. Information about possible antidotes can be found on the label. Only a medical practitioner may administer antidotes.</strong></td>
<td></td>
</tr>
</tbody>
</table>
### FIRST AID FOR SKIN CONTAMINATION

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Carefully remove any contaminated clothing (PPE and work clothes).</td>
</tr>
<tr>
<td>2</td>
<td>Wash contaminated skin or hair thoroughly using plenty of clean water.</td>
</tr>
<tr>
<td>3</td>
<td>Wash again with soap and water.</td>
</tr>
<tr>
<td>4</td>
<td>If blisters appear, apply soothing ointment.</td>
</tr>
<tr>
<td>5</td>
<td>Obtain medical help immediately. Take the container, a copy of the label, and any other information available for medical personnel to read.</td>
</tr>
</tbody>
</table>
### FIRST AID FOR EYE CONTAMINATION

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Flush the eyes with plenty of clean running water (e.g. tap water for at least 15 minutes).</td>
</tr>
<tr>
<td>2.</td>
<td>Cover the eye with a sterile eye pad or clean non-fluffy material.</td>
</tr>
<tr>
<td>3.</td>
<td>Obtain medical help immediately. Take the container, a copy of the label, and any other information available for medical personnel to read.</td>
</tr>
</tbody>
</table>

### FIRST AID FOR SWALLOWED CROP PROTECTION PRODUCT

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Only induce vomiting, if the crop protection product label allows. Otherwise, follow the directions on the attached charts.</td>
</tr>
<tr>
<td>2.</td>
<td>Induction of vomiting should only be carried out on conscious patients. Sit or stand the patient upright.</td>
</tr>
<tr>
<td>3.</td>
<td>Do not induce vomiting.</td>
</tr>
</tbody>
</table>
Never feed anything orally by mouth to a contaminated patient.

Place patient on side with head lower than rest of body (= recovery position).

Obtain medical help immediately. Take the container, a copy of the label, and any other information available for medical personnel to read.

**FIRST AID FOR INHALATION OF CROP PROTECTION PRODUCT**

Read the label for instructions on the procedures to follow.

Never feed anything orally by mouth to a contaminated patient.

Place patient on side with head lower than rest of body (= recovery position).

Obtain medical help immediately. Take the container, a copy of the label, and any other information available for medical personnel to read.
EVALUATION AND RECORD KEEPING

If poisoning has occurred, identify the causes of the incident and take action to prevent its recurrence.

Ensure the following questions are answered
• What happened
• How did it happen
• When did it happen
• Why did it happen
• Where did it happen
• What corrective action needs to be taken to prevent a similar incident

Ensure that the corrective action to prevent possible future incidents.
PROCEDURES TO FOLLOW IF SOMEONE HAS BEEN POISONED BY A CROP PROTECTION PRODUCT

WHAT TO DO IF SOMEONE HAS BEEN POISONED BY PESTICIDES

ON REACHING THE PATIENT
- GET MEDICAL HELP AS QUICKLY AS POSSIBLE
- OBSERVE CAREFULLY
- KEEP CALM - REASSURE PATIENT
- AVOID ANY RISK TO YOURSELF

HOW DID POISONING OCCUR?

IF IT IS SWALLOWED

IS PATIENT BREATHING?
- No
  - CLEAR AIRWAYS, GIVE ARTIFICIAL RESPIRATION MONITOR BREATHING CLOSELY

IS PATIENT CONSCIOUS?
- No
  - IS TIME TO TAKE PATIENT TO MEDICAL TREATMENT MORE THAN 1 HOUR?
    - No
      - DO NOT INDUCE VOMITING
    - Yes
      - INDUCE VOMITING

IS THE PATIENT...?
- HAVING FITS/CONVULSIONS?
  - REMOVE ALL DANGEROUS OBJECTS FROM AROUND PATIENT, DO NOT FORCIBLY RESTRAIN
- TOO HOT?
  - SPONGE WITH COLD WATER
- TOO COLD?
  - KEEP COVERED WITH BLANKET, COAT, ETC.

IS PATIENT STILL IN CONTACT WITH PESTicide SOURCE?

IF IT IS ON SKIN OR WAS INHALED

IS PATIENT BREATHING?
- No
  - CLEAR AIRWAYS, GIVE ARTIFICIAL RESPIRATION MONITOR BREATHING CLOSELY

DOES LABEL RECOMMEND MAKING PATIENT VOMIT?
- No
  - CHECK PRODUCT LABEL FOR FIRST AID INSTRUCTIONS

IS PATIENT CONSCIOUS?
- No
  - IS PESTicide IN EYES?
    - No
      - REMOVE ANY CONTAMINATED CLOTHES AND WASH SKIN
    - Yes
      - WASH OUT EYES WITH PLENTY OF CLEAN WATER FOR AT LEAST 10 MIN

NO, OR NO LABEL PRESENT

IS PESTicide IN EYES?
- No
  - MOVE AWAY FROM CONTAMINATION

CLEAR AIRWAYS, GIVE ARTIFICIAL RESPIRATION MONITOR BREATHING CLOSELY

OBTAIN MEDICAL HELP AS SOON AS POSSIBLE. GIVE THE DOCTOR THE PRODUCT LABEL
19. First Aid
20. DISPOSAL: GENERAL
Lesson Plan

| Materials needed:          |  ✓ Flipchart stand with paper.  |
|                          |  ✓ Flipchart paper.             |
|                          |  ✓ Markers (4 colours).         |
|                          |  ✓ Coloured cards.              |
|                          |  ✓ Glue stick or blue tack.     |
|                          |  ✓ Masking Tape.                |
|                          |  ✓ Pin board and pins.          |
|                          |  ✓ Sample containers or labels.  |

| Time needed:              |  85 minutes (if less time, adjust each section accordingly) |

| Intended audience:         |  Farmers and crop protection product dealers (resellers) |

| Preparation:              |  ✓ Flipchart on flipchart stand with the title “Disposal: General”, and the Lesson Objectives. |
|                          |  ✓ Flipchart or PowerPoint with the five sources of crop protection product waste. |
|                          |  ✓ Flipchart or PowerPoint with Disposal Methods. |
|                          |  ✓ PPE appropriate to disposal. |
|                          |  ✓ Print off sufficient Fact Sheets for participants. |
|                          |  ✓ Print off sufficient Assessment question sheets. |
|                          |  ✓ Print off sufficient Attendance Record sheets. |
|                          |  ✓ Organise venue and seating arrangements. |

Attendance Record

As participants arrive, ask them to enter their name and other information on the Attendance Record. There is also a column on the form to enter their marks from the Assessment Questions at the end of the training session.
Set up / Introduction 5 minutes (5-10% of total time)

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
</table>
| **Attention:** | Show the flipchart or PowerPoint with the five sources of crop protection product waste:  
- Undiluted product from obsolete stock, leftovers, spillages, or leaks  
- Excess/unused diluted spray mixture  
- Empty containers and packaging  
- Heavily contaminated clothing and cleaning materials  
- Water from sprayer, equipment, PPE, and personal washing  
**Ask** how participants deal with crop protection product waste from these sources. |
| **Title:** | Refer to the Title Flipchart and tell participants that this training session will cover *Disposal: General.* |
| **Credibility:** | Tell participants a story of your own experience in disposal. |
| **Objectives:** | Refer to the Title Flipchart with the Lesson Objectives.  
By the end of the lesson, participants will be able to  
- Give an overview of the types and sources of crop protection product wastes  
- Describe the procedures for disposal of these wastes  
- Describe how to avoid waste crop protection products |
| **Benefits:** | Knowing the procedures for handling, and for avoiding, waste prevents harm to people, animals and the environment. |
| **Direction:** | Say that during this session, we will look at:  
- Sources of crop protection product waste  
- Avoidance of waste  
- Disposal principles  
- Disposal of the different types of crop protection product waste from different sources  
In this lesson we will not be examining methods of disposal, we will look at that in the next lesson. |
Delivery (80-90% of total time)

Explanation, Demonstration, Exercise, and Guidance:

<table>
<thead>
<tr>
<th>Module/Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 10 minutes</td>
<td>Work Groups – Avoidance of Crop Protection Product Waste</td>
</tr>
<tr>
<td></td>
<td>Refer to the introduction flipchart or PowerPoint with the five sources of crop protection product waste.</td>
</tr>
<tr>
<td></td>
<td>Say that in the introduction we discussed the five sources of waste. Waste from each of these sources can occur during handling and use of a crop protection product.</td>
</tr>
<tr>
<td></td>
<td>The first principle in management is to avoid crop protection product waste from all of these sources.</td>
</tr>
<tr>
<td></td>
<td>Divide participants into four groups. Give each group one of the topics:</td>
</tr>
<tr>
<td></td>
<td>• Purchase</td>
</tr>
<tr>
<td></td>
<td>• Transport</td>
</tr>
<tr>
<td></td>
<td>• Storage</td>
</tr>
<tr>
<td></td>
<td>• Use</td>
</tr>
<tr>
<td></td>
<td>Work Group task:</td>
</tr>
<tr>
<td></td>
<td>• How can you avoid producing waste crop protection products in your topic (e.g., how to avoid spills and leaks, etc., during purchase)</td>
</tr>
<tr>
<td></td>
<td>• Write answers on a flipchart.</td>
</tr>
<tr>
<td>2. 15 minutes</td>
<td>Work Group Reports – Avoidance of Crop Protection Product Waste</td>
</tr>
<tr>
<td></td>
<td>Ask the first group to present their results.</td>
</tr>
<tr>
<td></td>
<td>Ask if other participants agree with the results, or have something further to contribute.</td>
</tr>
<tr>
<td></td>
<td>Repeat for the other three groups.</td>
</tr>
<tr>
<td></td>
<td>Summarise the results, adding where appropriate using the Fact Sheet as a checklist.</td>
</tr>
<tr>
<td>3. 5 minutes</td>
<td>Discussion/Presentation – Principles of Disposal</td>
</tr>
<tr>
<td></td>
<td>Say that although we try to avoid crop protection product waste as much as possible, waste cannot be avoided completely.</td>
</tr>
<tr>
<td></td>
<td>Ask what do you think are the general principles when disposing of crop protection product waste?</td>
</tr>
<tr>
<td></td>
<td>Take several answers, and then present Principles of Disposal of Crop Protection Product Waste from the Fact Sheet.</td>
</tr>
<tr>
<td></td>
<td>Work Groups – Disposal of Specific Types of Waste</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>4.</td>
<td><strong>10 minutes</strong></td>
</tr>
<tr>
<td></td>
<td>Refer again to the flipchart or PowerPoint with the sources of crop protection product wastes.</td>
</tr>
<tr>
<td></td>
<td>Say that in the introduction we discussed the five sources of waste. We will now identify how to dispose of waste from each of these sources.</td>
</tr>
<tr>
<td></td>
<td>Divide participants into three groups. Give each group two of the following sources of waste (the first source is divided into two categories):</td>
</tr>
<tr>
<td></td>
<td>• Undiluted product from obsolete stock, leftovers,</td>
</tr>
<tr>
<td></td>
<td>• Spillages, or leaks</td>
</tr>
<tr>
<td></td>
<td>• Excess/unused diluted spray mixture</td>
</tr>
<tr>
<td></td>
<td>• Empty containers and packaging</td>
</tr>
<tr>
<td></td>
<td>• Heavily contaminated clothing and cleaning materials</td>
</tr>
<tr>
<td></td>
<td>• Water from sprayer, equipment, PPE, and personal washing</td>
</tr>
<tr>
<td></td>
<td><strong>Work Group task:</strong></td>
</tr>
<tr>
<td></td>
<td>Discuss and agree on <strong>two</strong> actions to take for disposing of waste from each source. Write answers on a flipchart.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Work Group Reports – Disposal of Specific Types of Waste</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.</td>
<td><strong>15 minutes</strong></td>
</tr>
<tr>
<td></td>
<td>Ask the first group to present their results.</td>
</tr>
<tr>
<td></td>
<td>Ask if other participants agree with the results, or have something further to contribute.</td>
</tr>
<tr>
<td></td>
<td>Repeat for the other three groups.</td>
</tr>
<tr>
<td></td>
<td>Summarise the results, adding where appropriate using the Fact Sheet as a checklist.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Presentation – Disposal Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.</td>
<td><strong>5 minutes</strong></td>
</tr>
<tr>
<td></td>
<td>Present the flipchart or PowerPoint on Disposal Methods.</td>
</tr>
<tr>
<td></td>
<td><strong>Ask:</strong></td>
</tr>
<tr>
<td></td>
<td>• How do farmers actually dispose of crop protection product waste</td>
</tr>
<tr>
<td></td>
<td>• How can they be encouraged to follow the above methods</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Discussion – Safety Precautions and Hygiene</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td><strong>5 minutes</strong></td>
</tr>
<tr>
<td></td>
<td>Ask what safety precautions should be taken when handling or disposing crop protection product waste.</td>
</tr>
<tr>
<td></td>
<td><strong>Take</strong> several answers.</td>
</tr>
<tr>
<td></td>
<td>Summarise by saying that the same safety precautions given on the label must always be taken when handling crop protection products regardless of the activity. This includes handling and disposal of waste.</td>
</tr>
<tr>
<td>Module/Time</td>
<td>Activity</td>
</tr>
<tr>
<td>-------------</td>
<td>----------</td>
</tr>
</tbody>
</table>
| **Summary:** 1 minute | **Summarise** the main points:  
• Sources of waste  
• How to avoid waste  
• Disposal principles  
• Disposal methods  
• Safety precautions. |
| **Questions:** 1 minute | **Ask** if everyone understands or if there are any additional questions.  
Answer these provided they are relevant. |
| **Evaluation:** 12 minutes | **Ask** what personal protective clothing should be worn when disposing of crop protection product waste  
**Hand out** the Assessment Sheet and ask participants to complete two of the questions.  
**Collect** the Assessment Sheet for later marking and entering the marks on the Attendance Record. |
| **Next step:** 1 minute | **Remind** the group that the avoidance of crop protection product waste is better than dealing with waste.  
**Ask** participants to go back to their shops, warehouses, or farms and implement procedures to avoid and deal with waste.  
**Hand out** the Fact Sheet to participants. |
Visual 1

Container management

FOLLOW THESE RECOMMENDATIONS TO ENSURE THE PROPER DISPOSAL OF EMPTY PESTICIDE CONTAINERS

- **Foil/flexible packaging**
  - Non-rinsable
  - Incineration

- **Treated seed and seed treatment containers**
  - Non-rinsable
  - Incineration

- **Plastic containers**
  - Rinsable
  - Recyclable

- **Metal containers**
  - Rinsable
  - Recyclable

All empty triple rinsed containers, as well as non-rinsable containers, should be returned to an authorized collection point where they will be disposed of in an environmentally sound manner.

Containers **SHOULD NEVER** be re-used or disposed of through indiscriminate dumping, open air incineration of any kind or incineration in unauthorized facilities.

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Helping Farmers Grow
Answer TWO (2) only of the following questions. 
You may write your answers on this question sheet or tell your trainer the answers. 
All questions are the same value (5 marks).

**Question 1:** Describe ways to avoid crop protection product waste.

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**Question 2:** What are the main sources of crop protection product waste?

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**Question 3:** Outline the general principles to follow when dealing with crop protection product waste.

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**Question 4:** Describe how to dispose of excess/unused spray mixture.

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Name: ............................................  Date: ..................  Mark:  
INTRODUCTION

The best way of avoiding the problem of disposal of crop protection product waste is not to produce any waste. In reality however, some waste is inevitable, if only the empty containers and packaging. Spillages or indiscriminate disposal may be hazardous, and usually any loss of crop protection product is expensive. To minimise these problems, plans should be made in advance to meet any disposal needs to ensure that disposal is safe and responsible.

Crop protection product waste can consist of:
• Undiluted product from obsolete stock, leftovers, spillages, or leaks
• Excess/unused diluted spray mixture
• Empty containers and packaging
• Heavily contaminated clothing and cleaning materials
• Water from sprayer, equipment, PPE, and personal washing

An additional, but less common, source of waste is fire-fighting water.

THE PRIMARY PRINCIPLE IN THE MANAGEMENT OF CROP PROTECTION PRODUCT WASTE IS TO AVOID THE PRODUCTION OF WASTE.

AVOIDANCE OF CROP PROTECTION PRODUCT WASTE

Avoidance when purchasing crop protection products
• Only purchase what you need. Calculate carefully the amount needed for the crop, and try to avoid being left with a surplus. For example, do not buy a large container if only a small portion of its contents is likely to be used by the end of the season.
• Choose suitable container sizes. Avoid large containers, and do not buy large containers if handling facilities on the farm cannot cope.
• Do not accept damaged containers. Examine all containers to ensure that they are not leaking or badly dented, and that caps and seals are intact.
• Do not accept inadequately labelled containers. Make sure that the labels can be easily read.

Avoidance when transporting crop protection products
• Seal small containers in plastic bags: as an added precaution, any small containers should be sealed inside a strong plastic bag.
• Inform drivers: those staff collecting crop protection products must understand the danger of crop protection products, what the containers hold and what to do in the case of an emergency.
• Care in loading and unloading: special care must be taken during loading and unloading to prevent container damage and spills. Do not push containers off the back of the vehicle. Load in a controlled way - forklift truck, hoist or suitable ramp, such as planks and old tyres to stop containers at the ground.
• Intact carrying surface: the vehicle transporting the crop protection products must have a well maintained carrying surface which does not have protruding nails, metal strips or wood splinters which can damage containers.
• Proper stacking: always load containers the correct way up, so that leaks from lids or tops do not occur; ensure fragile packages are not crushed.
• Secure loads: ensure containers are secured properly so that they do not move, roll about or fall off the transport vehicle.
• Do not accept leaking or damaged containers.
• Keep the load dry.
AVOIDANCE WHEN STORING CROP PROTECTION PRODUCTS

• Ensure the crop protection product store is properly secured - locked and out of reach of unauthorised people, children and animals.
• The crop protection product stocks should be properly managed - correctly placed, properly marked, upright, placed on intact shelves or pallets, appropriate height.
• Ensure proper stock controls - orderly stock arrangement, segregation of different crop protection product types, “first-in, first-out” stock control, controlled receiving and issuing of stocks.
• Regular store and stock inspections to ensure containers are not leaking. Avoid re-packing, unless in an emergency - carefully seal and mark re-packed crop protection products; never use food containers; use up re-packed crop protection products as soon as possible.
• Have emergency procedures for spills and leaks - sawdust-lime mix, sand, broom, spade, buckets or strong plastic bags.
• Have emergency procedures and facilities for personnel contamination - protective clothing, showers.
• procedures and facilities for personnel contamination - protective clothing, showers.

AVOIDANCE WHEN USING CROP PROTECTION PRODUCTS

Waste and spillage of crop protection products may occur during use due to several issues, all of which need attention in order to avoid waste:

• Spills when measuring.
  - Special care during measuring and weighing crop protection products is essential to avoid spillages.
  - Pour liquids carefully.
  - Take care not to create clouds of dust when working with powders.
  - Use appropriate equipment for measuring and weighing crop protection products.
  - Do not use cracked measuring cylinders or jugs.
  - Close crop protection product containers properly after weighing and measuring and carefully return to appropriate place in the store.
  - Have appropriate decanting equipment.
  - Deal with spills and leaks immediately.
  - These procedures should be displayed on the crop protection product store wall.

• Spills when filling sprayers.
  - Avoid using containers that are too heavy to handle safely, or have appropriate equipment to handle heavy containers.
  - Fill sprayers from containers of manageable size.
  - Use a funnel to pour concentrates into small sprayer apertures.
  - Avoid “glugging” during pouring.
  - Avoid overfilling sprayer tanks when topping up with water.

• Spills and Leakages from spraying equipment.
  - Avoid spills and leaks by having well maintained application equipment.
  - Weekly equipment checks are essential.
  - Keep written records of equipment checks.
  - Regularly maintain all spray equipment, and any faults must be repaired immediately.

• Surplus crop protection product after application.
  - Sprayers should be properly calibrated to avoid excess or insufficient spray mix being prepared.
  - The correct amount of mix necessary for the application should be calculated and measured accurately.
PRINCIPLES FOR THE DISPOSAL OF CROP PROTECTION PRODUCT WASTE

If the measures for avoiding crop protection product waste are followed, the amount of waste can be greatly reduced. However, when waste does occur it must be disposed of by methods which:

- Are safe for those handling the waste
- Leave any contaminated areas or objects clean
- Minimize the risk of environmental contamination

There are a number of general principles for disposal of crop protection product waste which must always be taken into account:

- Always comply with local legal requirements.
- Always dispose of wastes as and when they arise. Avoid accumulation of large quantities for disposal.
- Consult the product label for any specific advice.
- If in doubt, seek expert advice from the supplier or local authorities.
- Always wear the protective clothing appropriate to the product when disposing of crop protection product waste.
- Never dispose of crop protection product waste in such a manner as to put at risk people, livestock, wildlife, crops and other plants, foodstuffs or water supplies.
- Never dump crop protection products indiscriminately.

The preferred methods of disposal are given in the following sections, listed according to the origin of the waste.

DISPOSAL OF UNWANTED OR UNUSED CROP PROTECTION PRODUCT CONCENTRATES (OBSOLETE STOCKS)

Crop protection products cost money and, apart from the problems of waste disposal, it makes sound sense to minimise surpluses. This can be achieved by careful calculation beforehand of the total requirements for the job.

However, disposal of crop protection product concentrates may be necessary, such as when:

- Packaging has been accidentally damaged
- The product is past the expiry date
- Approval for use of the Product has been withdrawn
- The product may be surplus to requirements.

- An unused crop protection product may be in good condition, and it could be used later. In this case it may be possible to return in the unopened and otherwise sound containers to the supplier for resale. Alternatively, a neighbouring farmer can use it. If not, and the container is unopened, ask the retailer or local adviser if they can find users.
- Where unused concentrates cannot legally or safely be used, it will be necessary to use a specialist waste disposal contractor, or ask to the supplier if he will accept it for disposal.
- Any obsolete stocks must be disposed of in a proper manner (refer to Methods of Disposal). Obey the laws of the country regarding disposal of crop protection products.
DISPOSAL OF WASTE FROM SPILLAGES AND LEAKS

Should there be a spill or leak of a crop protection product:
- Protective clothing, such as gloves, boots and eye protection must be worn as recommended on the product label.
- Keep unauthorized persons, children and animals away from the affected area.
- Prevent further waste by closing the container properly, or shifting its position to stop a leakage, or placing into another container.
- With dry waste, such as powders and granules, cover with dry sand or earth and sweep up and shovel into closable containers for safe disposal. The use of damp sand or water may release toxic or inflammable gases from certain products.
- With liquid waste, use lime, sand, earth, or any other absorbent material to soak up the spillage. Shovel this into closable containers for disposal.
- Wash the contaminated spillage area thoroughly with water. Do not allow the wash water to run off into any watercourse, stream, well, borehole or dam. If necessary soak up the wash water with more absorbent material and place this in the disposal container.
- Make sure that all other containers near the spillage are thoroughly decontaminated from splashes or dust by thorough washing.
- Any waste from spillages or leaks must be disposed of in a proper manner (refer to Methods of Disposal). Obey the laws of the country regarding disposal of crop protection products.

DISPOSAL OF CONTAMINATED CLOTHING AND CLEANING MATERIALS

- Slightly contaminated clothing should be washed separately from other clothing, with detergent and several changes of water.
- Heavily contaminated articles and those which cannot be easily decontaminated (such as protective clothing soaked in crop protection product, leather shoes, or rags and cotton waste which have been used for cleaning up spillages) must be disposed of properly.

DISPOSAL OF DILUTED CROP PROTECTION PRODUCTS

Unused diluted crop protection product remaining in a sprayer tank after spraying is complete is formally called contaminated aqueous waste. This can be disposed of in the following ways:
- Re-spraying part of the crop or area which has just been treated, provided this will not cause damage to the crop (or to a following crop, as might be the case with certain residual weed killers), and will not leave excessive residues on edible crops.
- NOTE: If this is to be done, then the unused crop protection product remaining in the sprayer tank must be further diluted with water tenfold and sprayed at double speed. This will only increase the dose rate by 5%.
- Alternatively, dilute with water tenfold and spray onto a barrier areas around the crop or greenhouse, or onto fallow land or land which is due to be cultivated, taking care not to put grazing animals at risk, nor put following crops at risk. Cultivated land provides the best conditions for biodegradation of crop protection products.
- Larger quantities of diluted crop protection product waste must be disposed of in a proper manner (refer to Methods of Disposal). Obey the laws of the country regarding disposal of crop protection products.
DISPOSAL OF SPRAYER WASHINGS

Good sprayer cleaning is essential. It avoids risks to other crops sprayed and ensures the sprayer is ready for the next job. Washing also helps avoid blockages.

- The best place to wash the sprayer is on a purpose built “wash down area”, consisting of: concrete slab with walls to prevent drift and bunds to prevent spills; drain to sump, constructed similarly to the disposal pit; running water and hoses; signed “Keep Out”, “Not a Drinking Point”.
- If a wash down area with sump is available, then rinse washings into the sump for collection by a waste disposal contractor.
- Alternatively spray out onto barrier area, another approved crop or fallow land, but remember not to spray out onto a sensitive crop or land intended for cropping with a sensitive crop.
- Larger quantities of sprayer washings must be disposed of in a proper manner (refer to Methods of Disposal). Obey the laws of the country regarding disposal of crop protection products.

TANK CLEANING PROCEDURE

If tank rinse nozzles are fitted: Add clean water to the spray tank until it is approximately a quarter (25%) full then mix in a cleaning agent recommended for sprayer decontamination at the correct dilution rate for the volume of liquid in the spray tank. No further water needs to be added at this stage. Use the tank rinsing nozzles and re-circulate for 2 minutes and spray out as in 2 above.

If tank rinse nozzles are not fitted: Add clean water to the spray tank until it is approximately a quarter (25%) full then mix in a cleaning agent recommended for sprayer decontamination at the correct dilution rate for the full volume of liquid in the spray tank. Fill the sprayer tank to the brim and then re-circulate for 2 minutes and spray out as in 2 above.

NB Some herbicides must be deactivated with ammonia-based agents and may require leaving in the tank for a short period - check the label. Do not mix chlorine and ammonia based cleaning agents

Remove the boom end caps and repeat the Tank Cleaning Procedure, but without the cleaning agent.
Wash the outside of the sprayer with clean water. A low volume washing brush is more effective and uses less water than a high pressure spray gun.
Remove nozzle and nozzle filters, and scrub clean with a soft brush. Refit these and the other filter elements.
Completely drain tank, spray booms and all water pipes.

Once cleaned, the sprayer washings need to be disposed appropriately:
- If a wash down area with sump is available, then rinse washings into the sump for collection by a waste disposal contractor.
- Alternatively spray out onto barrier area, another approved crop or fallow land, but remember not to spray out onto a sensitive crop or land intended for cropping with a sensitive crop.
- Larger quantities of sprayer washings must be disposed of in a proper manner (refer to Methods of Disposal). Obey the laws of the country regarding disposal of crop protection products.
DISPOSAL OF EMPTY CONTAINERS AND PACKAGING

- Containers need to be cleaned and made unusable. Container cleaning is covered in *Cleaning and Destruction of Containers for Disposal*.
- Containers must be disposed of in a proper manner (refer to Methods of Disposal). Obey the laws of the country regarding disposal of crop protection products.

METHODS OF DISPOSAL

Crop protection product waste must be disposed in a safe manner, according to the laws of the country. There are several methods for the disposal of crop protection product waste.

**Waste disposal contractor**
If available, a licensed waste disposal contractor is the easiest way to dispose of waste, but is expensive.

**Licensed incinerator**
- As a general rule it is safe for crop protection product waste to be burnt in incinerators licenced for the purpose.
- When licenced incinerator is to be used for disposal of crop protection product waste, the nature of the waste must be made known to the incinerator operators.
- Great care must be taken in transporting the waste to the incinerator to ensure that no leaks and spillage occur, and that the vehicle is thoroughly cleaned after unloading.
- Whenever possible, the incinerator operator should be asked to collect the waste.
- The disadvantages of using a licenced incinerator are:
  - The cost of incineration
  - The cost of transport
  - The danger and extra care needed in transporting the used containers.

**On-farm incinerator**
- Where the use of on-farm incinerators is legal in the country, these are cheap and easy to use. Even so, the appropriate precautions must be taken when they are used.
- A useful on-farm incinerator is the one based on a design which has been tested at Silsoe College in the U.K. This basically consists of a 44 gallon drum, with holes of specific sizes cut into and around the circumference, placed on a stand off the ground.

**Licensed landfill sites**
- In the absence of a licenced incinerator and where burning on the farm is not permitted or is not practicable, crop protection product waste may be disposed of in a landfill site, provided it is licensed for this purpose by a competent authority (such as a municipality).
- If the site operators will collect the waste in their own specialized vehicles. This will minimise the problems of spillage and leaks during transport.
- The site operators must always be notified of the identity of crop protection product waste.

**On-farm burial**
- In the absence of the above methods of disposal, and if it is legal in the country, it may be necessary to dispose of small quantities of wastes by burial on the farm in a *Disposal Pit*.
- It is recommended that several farmers should cooperate in the establishment and use of a disposal pit, and that they should seek the advice of local authorities.
- Construction and use of a disposal pit are covered in more detail in 19.2 Disposal Pit.
SAFETY PRECAUTIONS AND HYGIENE

Whenever handling crop protection products or crop protection product waste, the safety precautions on labels must be observed. Pay special attention to:

• Always wear the recommended protective clothing and equipment for the crop protection product.
• Wash before eating, drinking, smoking, or going to the toilet.
• Always wash hands thoroughly after handling crop protection products or waste.
• Wash contaminated skin immediately, with soap and water.
21. POST-COURSE EVALUATION
Overview of the Session

During Session 1 the participants sat a pre-course evaluation to assess their level of IPM knowledge prior to attending the course. The first participant activity of this session is to sit the same test again so as to evaluate their change in knowledge as a result of the course. It was for this reason that participants did not receive their pre-course test papers back following the pre-course evaluation in Session 1.

Participants then complete a course evaluation questionnaire while the trainers mark the papers, after which the pre- and post-course marks are given to the participants and they receive both sets of answer papers.

Certificates are then presented to the participants showing their attendance at the course. The presentation could be by the trainers, or perhaps by an invited local Ministry of Agriculture, Health or Environment official, or a representative of a private sector pesticide, agrochemical, or farmer association.

Following the presentation of Certificates, the course is officially closed.

Session Objectives

By the end of the session, Participants will be able to:
• Evaluated their changes in knowledge of IPM.
• Received a Certificate of Attendance and a copy of the Handbook.
• Established networking contacts with other participants if these did not previously exist.

By the end of the session, Facilitators will have:
• Evaluated individual participant changes in knowledge of IPM.
• Received feedback from participants on the structure and contents of the course, and any suggestions they have for improvement.
• Established networking contacts with the participants if these did not previously exist.

Introduction to the Session

OBJECTIVES OF THE PROCEDURE:
Welcome participants to the final Session of the course.

Present the session objectives, and give a brief overview of the procedures.

Course Summary

OBJECTIVES OF THE PROCEDURE:
• To summarise the main course messages for participants.

Review the Overall Goals of the training course from Session 1 and provide a course summary with lessons learned from each of the sessions.

Ask the participants:
• Have these Overall Goals of the training course been met?
Post-Course Evaluation

OBJECTIVES OF THE PROCEDURE:

- To evaluate participant's changes in knowledge of responsible use of pesticides after attending the course.

Distribute the Post-Course Evaluation.

This is a same multiple choice evaluation with 25 questions as given in the Course Introduction.

Ask the participants to put a tick or cross in the box next to what they think is the correct answer to the question.

Allow 20 minutes for the participants to complete the test, then collect the papers. Make sure that the participants have written their names on the papers.

Participant Course Evaluation, Networking, and Marking of Papers

OBJECTIVES OF THE PROCEDURE:

Distribute the compiled list of participant contact details. Ask participants to check that their details are correct.

Distribute the Participant Course Evaluation.

Say that participants can now have a short break while you mark the papers. Ask them to complete the Participant course evaluation during this break. Ask one of the participants to collect the completed questionnaires while you are marking the post-course papers.

Encourage them to establish longer term relationships and contacts during this period (if they have not already done so) as these could be valuable in the future, particularly if participants are from both the public and private sectors.

Mark the papers.

Evaluation Results

Present the post-course evaluation results to participants. Compare these to the pre-course results, congratulating those who have made good progress, particularly those who had low marks at the start of the course and who have improved their results.

Give each participant both sets of their answer papers.

Ask the participants:
- Has the course helped them to understand what is meant by IPM and how it is implemented?
- Will this knowledge be of benefit to them?
- How will they use this knowledge?
- Now that they have the results, will the pre-and post-course evaluation help them to identify their knowledge strengths and where these could be improved?
- If this was their first experience of participatory training, what they liked/did not like about the training method.
Course Closure

Officially close the course.

Again thank participants for their contributions, and the public or private sector representative if they are present.

Post-Course Evaluation

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CropLife International is the voice of the global plant science industry. It champions the role of agricultural innovations in crop protection and plant biotechnology in supporting and advancing sustainable agriculture; helping farmers feed a growing population while looking after the planet; and progressing rural communities. The world needs farmers, and farmers need plant science. CropLife International is proud to be at the heart of helping farmers grow.