

WHO-UNEP

SOUND MANAGEMENT OF PESTICIDES AND DIAGNOSIS AND TREATMENT OF PESTICIDE POISONING

A RESOURCE TOOL



WHO



UNEP



* Revision of the **“IPCS - Multilevel Course on the Safe Use of Pesticides and on the Diagnosis and Treatment of Pesticide Poisoning, 1994”**

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- | | | |
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- | | | |
|--------------|--|----------|
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- | | | |
|--------------|--|------------|
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- | | | |
|--------------|--|----------|
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|--------------|--|----------|
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No. 8	Fluoroacetate poisoning	I
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No. 12	Glyphosate poisoning	I
No. 13	2,4-Dichloroacetic acid poisoning	I
No. 14	Poisoning with pentachlorophenol and related compounds	I
No. 15	Poisoning with metals	I
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No. 7	Calciferol derivative poisoning	A
No. 8	Fluoroacetate poisoning	A
No. 9	Zinc phosphide poisoning	A
No. 10	Chloralose poisoning	A

No. 11	Thallium poisoning	A
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No. 13	Glyphosate poisoning	A
No. 14	2,4-Dichloroacetic acid poisoning	A
No. 15	Poisoning with pentachlorophenol and related compounds	A
No. 16	Arsenic poisoning	A
No. 17	Organic mercury poisoning	A
No. 18	Organotin poisoning	A
No. 19	Copper salt poisoning	A
No. 20	Thiocarbamate poisoning	A
No. 21	Methyl bromide poisoning	A
No. 22	Chloropicrin poisoning	A
No. 23	Sulfuryl fluoride poisoning	A

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No. 5	Pyrethroid poisoning	A
No. 6	Anticoagulant rodenticide poisoning	A
No. 7	Calciferol derivative poisoning	A
No. 8	Fluoroacetate poisoning	A
No. 9	Zinc phosphide poisoning	A
No. 10	Chloralose poisoning	A
No. 11	Thallium poisoning	A
No. 12	Paraquat and diquat poisoning	A
No. 13	Glyphosate poisoning	A
No. 14	2,4-Dichloroacetic acid poisoning	A
No. 15	Poisoning with pentachlorophenol and related compounds	A
No. 16	Arsenic poisoning	A
No. 17	Organic mercury poisoning	A
No. 18	Organotin poisoning	A
No. 19	Copper salt poisoning	A
No. 20	Thiocarbamate poisoning	A
No. 21	Methyl bromide poisoning	A
No. 22	Chloropicrin poisoning	A
No. 23	Sulfuryl fluoride poisoning	A

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- | | | |
|-------|---|---|
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Preface

The *International Code of Conduct on the Distribution and Use of Pesticides*¹ recognizes that training is essential in implementing and observing its provisions and calls upon international organizations to give high priority to this subject and to support training and capacity strengthening on sound management of pesticides.

The Intergovernmental Forum on Chemical Safety² and the Committee for the Development of a Strategic Approach to International Chemicals Management³ recognize as priorities the improvement of access to information on pesticides, increasing awareness, education and training appropriate to the public and users and training trainers. Increasing concern about the health and environmental effects of pesticide use, as evidenced by multilateral environmental agreements such as the Basel Convention, the Stockholm Convention on Persistent Organic Pollutants and the Rotterdam Convention, also underline the urgent need for capacity strengthening for effective management of pesticides.

This resource tool is intended to meet the need for training in the sound management of pesticides and in the diagnosis and treatment of pesticide poisoning. It can be used to organize training courses for persons from various backgrounds, including the public, workers, health-care professionals and registration personnel and others involved in pesticide management. The material has been designed to allow flexibility in training, on the basis of the existing infrastructure in a country or region. It addresses different needs and includes basic training materials, such as flip charts, and also advanced multimedia presentations. The electronic version allows users to modify the content for local needs.

The current format supports e-learning, and further developments in this respect are planned.

This resource represents a full revision of the 1994 *IPCS Multi-level Course on Safe Use of Pesticides and on Diagnosis and Treatment of Pesticide Poisoning*⁴. The training material in the multi-level course was used widely, especially for training public health workers involved with the use of pesticides. This revised version includes new information on developments in pest management, changes in the treatment of poisoning and guidance on use of web-based information. The part on the environment has been expanded, and information is included on the International Code of Conduct on the Distribution and Use of Pesticides and on the Basel, Stockholm and Rotterdam conventions. New modules have been prepared on first aid and on diagnosis and treatment of poisoning with additional pesticides.

The manual represents a joint effort by the United Nations Environment Programme (UNEP) Chemicals and the World Health Organization (WHO) (IPCS, WHO Pesticide Evaluation Scheme, Roll Back Malaria) to promote sound management of pesticides. Inputs and suggestions from users are welcomed to help improve future versions.

1 Food and Agriculture Organization of the United Nations. *International Code of Conduct on the Distribution and Use of Pesticides*, Food and Agriculture Organization of the United Nations, Rome, 2003.

2 IFCS. Fourth Session of the Intergovernmental Forum on Chemical Safety Final Report (IFCS/FORUM IV/16w, Geneva 004; IPCS. Third Session of the Intergovernmental Forum on Chemical Safety Bahia Declaration on Chemical Safety, IFCS/FORUM III/3w, Geneva, 000.

3 Strategic Approach to International Chemicals Management (SAICM) / International Conference on Chemicals Management. Draft high-level declaration; draft overarching policy strategy; draft global plan of action. Geneva, 2005.

4 World Health Organization IPCS Manual on Pesticide Safety No.002 WHO/PCS/94.3. February 1994.

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Part 1 Overview

1. INTRODUCTION

1.1 Background

Chemical pesticides continue to play essential roles in agriculture and public health. Never before has the public had access to such a variety of pesticides, which, however, have potential adverse effects on health and the environment, which can be aggravated by the conditions of use in many countries. Although it is difficult to arrive at precise estimates, it is generally recognized that a considerable number of people continue to be exposed to and affected by pesticides. As evidence of long-term effects is appearing, it is essential to at least minimize, if not eliminate, such harm, particularly in vulnerable populations.

Ways of counteracting adverse health and environmental risks have been designed. Some of these are based on the use of advanced formulation or application techniques to reduce the quantities of pesticides applied. Others involve integrated pest management, in which biological, cultural, mechanical, physical and chemical methods are used to reduce pest populations to an economically acceptable level with as few harmful effects as possible on the environment and non-target organisms.

The International Code of Conduct on the Distribution and Use of Pesticides, drawn up by the Food and Agriculture Organization of the United Nations (FAO), provides standards of conduct for all public and private entities engaged in, or associated with, the distribution and use of pesticides. It aims to assist in the sound management of pesticides, focusing on risk reduction, protection of human and environmental health and support for sustainable agricultural development. International treaties have called for stronger measures to eliminate certain persistent pesticides and to improve pesticide management. In that context, national and international initiatives recognize the importance of training and capacity building.

Many adverse effects of pesticides can be prevented if trained personnel use correct and appropriate techniques. Registration of pesticides is essential in order to set minimum standards for their sound management and to limit public access to the more hazardous compounds; however, this cannot replace the education of pesticide users.

A science-based tool is needed to educate persons involved at all levels of pesticide regulation, distribution and use, in the treatment of poisoning and also persons concerned about pesticide issues, including the general public. The training must be flexible so that it can be readily updated to include new compounds and techniques and it must be repeated at all levels as changes occur in personnel or application techniques.

1.2 Objectives

This resource tool is presented to meet the widespread need for training in the sound management of pesticides and in the diagnosis and treatment of pesticide poisoning. It is intended:

- to minimize, if not prevent, adverse effects of pesticides through education and training on sound practice, by outlining how such adverse effects can occur and by describing techniques by which they can be prevented;
- to provide insight into the sound management of pesticides for persons engaged in pesticide registration and for public interest groups;
- to train doctors and others who give first aid in particular aspects of the diagnosis and treatment of cases of poisoning; and
- to provide a structure in which training in the sound management of pesticides is integrated at all levels and adapted to the needs of specific groups.

2. OVERVIEW OF THE RESOURCE TOOL

This resource tool is intended for use in formulating multilevel training courses for persons responsible for the management and handling of pesticides and those dealing with pesticide poisoning. It provides basic information for persons concerned with the risks associated with the use of pesticides. It is designed so that each course can be presented at the educational level of the group being trained. Therefore, the subject matter is broken down into succinct points, giving both information and specific advice or instructions. It is the task of the trainer to select the points necessary to achieve the educational objective and to present them in the most relevant form.

Part I presents background information, the objectives and an outline of the structure of the course. It presents the techniques that can be used to conduct the courses and gives an example of a basic module. It also provides suggestions for training trainers in a 2-week course and for the organization of training programmes lasting from 1 h up to 1 week, full-time or part-time, for various groups.

Part II contains the modules, which are the educational material.

2.1 Module description

The modules are arranged by subject and as sub-modules, each concerning a learning point. The educational objectives for various levels are outlined at the beginning of each module. The advantage of the module system is that a trainer can select the modules or sections most suited to the particular target group, taking into account the educational level of the participants. The modules are therefore drafted at three levels of detail and terminology.

The modules are written in condensed form, and the trainer must interpret them to the participants and draw on personal experience or on national practices to ensure that the points made are seen by the participants as applicable to their situation and experience.

2.2 Training levels

The content of each module is presented at three levels to allow trainers to design courses suitable for each target group:

- **Basic:** covers fundamental issues such as personal protection and general information on risk of exposure and environmental contamination;
- **Intermediate:** more detailed, for participants with supervisory or operational responsibilities or who work with highly hazardous compounds and need more understanding of preventive measures; and
- **Advanced:** for participants engaged in the regulation and control of pesticides and management of poisoning.

The emphasis throughout must be the relevance of the material to the group being trained. The participants should have some characteristics in common, such as occupation or interest, and should have a similar educational level.

2.3 Visual aids

Most modules include suggestions about the type of visual aid with which they should be accompanied. These consist of text, diagrams with and without words, and images. Presentation of the visual aids will depend on the facilities available. For all literate groups, text and diagrams can be written on blackboards, on flip charts made of paper or card or on transparent plastic films for overhead projection or by computer, e.g. MS PowerPoint presentations. Images can be shown as prints on flip charts but are better displayed by projection. They can be used for all groups. In a few modules, the slides are suitable for all ethnic or national groups; in most modules, however, images taken in the country or community in which the course is being given should be used, to allow the trainees to identify themselves with the situations pictured. All images that show a wrong practice must be clearly shown as such by a mark on the picture itself.

2.4 Information sources

See **Annex II** to **Part 1**.

3. USING THE RESOURCE TOOL

3.1 Introduction

The manual is meant to assist trainers to present each course at the appropriate educational level of the group being trained. The subject matter is therefore broken down into succinct points, with both information and specific advice or instructions. It is the task of the trainer to select the points necessary to achieve the educational objective and to present them in the most relevant form.

The three levels, basic, intermediate and advanced, refer to the trainees (some of whom will become trainers). Suggestions for modules that could be used to train specific groups are shown in **Page 19**.

3.2 Training trainers

3.2.1 Organizational aspects

Courses are best arranged at institutes where experts and course facilities are readily available. The number of participants should not exceed 30, and the courses should last at least 2 weeks. A typical programme is shown in **Section 3.2.5**, below.

Trainers should be trained to at least the intermediate level presented in this course, and preferably to the advanced level, in the modules relevant for the training they are presenting. Teaching should be interactive and participatory. In training trainers, interaction should be maximized and problem-solving techniques used.

3.2.2 Coordinator's preparation

The coordinator is the overall manager of the course; he or she should be experienced in pesticide management and have experience with a participatory, problem-solving approach to training. The coordinator of a course to train trainers must be familiar with all parts of the Manual and must emphasize to the trainees that the course must be made relevant at all times to the persons whom they will be training. For this reason, flexibility has been built into the course, and success in training will depend considerably on how this flexibility is used.

The coordinator and trainers should work together on an effective approach for delivery before the course. The coordinator should meet with the trainers to discuss goals, objectives, the timetable and group discussion dynamics, and their respective roles. He or she should emphasize the importance of active stimulation of discussion and of using visual aids in group discussions and plenary presentations.

At the end each day's session, the course coordinator and the trainers should meet and discuss the results of the day's work and review the next day's curriculum.

3.2.3 Selection of participants

The total number of people to be trained should be estimated before courses are begun, as this number and the geographical distribution of the courses will determine how many trainers should be trained.

The educational background of the trainers will vary, but it is essential that they should have experience in the management of pesticides and a general interest in both prevention and training techniques.

3.2.4 Before training trainers

The coordinator should allow at least 3 months before a trainers' training course in order to make the arrangements listed below. The success of the course will reflect the thoroughness with which these arrangements are made. A decision should already have been made about whether all or part of the course manual is to be translated into the local language. The preliminary steps to be taken are:

1. Select the participants, and arrange their travel and accommodation for the duration of the course.
2. Arrange a suitable venue for the course. A classroom with tables and chairs, a blackboard with chalk or a whiteboard with felt pens, flip charts with felt pens, an image projector and a screen are likely to be needed.
3. Arrange for a copy of the course material to be available for each participant to keep.
4. Arrange for any guest lecturers needed, and brief them on how their contributions will fit into the course. Lecturers other than the coordinator should take at least one session on each day in order to maintain the interest of the participants and lessen the load on the trainer.
5. Ask the lecturers to follow the plan of the course strictly. They will need a copy of the manual well beforehand for this purpose.
6. Arrange transport to and from the site of a field visit during the first week. Pay a preliminary visit to the site to see if it is a suitable subject for photographs. If so, these could be taken during the visit of the participants to illustrate the care needed to ensure the accuracy of photographs in the context of the course.
7. Make a video recording of practical training sessions, for evaluation purposes.

3.2.5 Specimen module

Table 1 Example of a 2-weeks Trainer's Training Course

Session: 45 - 50 minutes
Morning: 4 Sessions

Breaks: 10 minutes
Afternoon: 2 Sessions

WEEK	DAY	MORNING SESSIONS				AFTERNOON SESSIONS	
		1	2	3	4	5	6
1	1	Objectives and Planning		Arrangement of Courses		Arrangement of Manual	Teaching Techniques
	2	Module 1, A, B, C, D		MOdule 5, A		Module 5, B, C, D	
	3	Module 2, A		Module 2, B, C		Module 3, A, B	
	4	Module 3, C		Module 4, A, B		Field Visit	
	5	Module 6, A, B, C				Module 7, A, B (optional)	Module 7, A, B
2	1	Module 9				Preparation of Visual Aids	
	2	Practical exercises				Evaluation of training each day	
	3						
	4						
5	Evaluation and conclusion of course						

This timetable is intended to be flexible. During the sessions, participants should be advised to note the amount of time spent on each module, so that they can plan their own courses. The first session, on objectives and planning, should include the opening of the course and time for each participant to introduce him- or herself, briefly stating details of their work and experience. This helps to overcome shyness and indicates to the leader those participants who are likely to contribute useful experience during the course.

Table 2 Suggested Check List for a TTT Course

NAME OF COURSE:	DATES:												
PLACE:	No. of participants:												
<table border="0"> <tr> <td></td> <td colspan="3">ARRANGEMENTS</td> </tr> <tr> <td></td> <td>Starting</td> <td>Target</td> <td>Date</td> </tr> <tr> <td></td> <td>Date</td> <td>Date</td> <td>Completed</td> </tr> </table>			ARRANGEMENTS				Starting	Target	Date		Date	Date	Completed
	ARRANGEMENTS												
	Starting	Target	Date										
	Date	Date	Completed										
SELECTION OF PARTICIPANTS													
Procedure:													
Accommodation:													
Travel:													
PROGRAMME													
(see Table II/1 above)													
GUEST LECTURERS													
ARRANGEMENT OF FIELD VISIT													
Place:													
Preliminary visit:													
ARRANGEMENT OF TRAINING COURSES													
Places:													
Preliminary visits:													
Allocation of trainees:													
REQUIREMENTS FOR WHOLE COURSE													
Manuals:													
Photographic visual aids:													
Notebooks, pens:													
Protective gears:													
REQUIREMENTS FOR MEETING ROOM													
Tables and chairs:													
Black or white board:													
Flipcharts:													
Blank newsprint:													
Image projector:													
Overhead projector:													
Screen:													
Sheets or rolls of transparent plastic film:													
Felt pens:													
Demonstration equipment: gloves, visors, dust masks:													
Templates for preparation of visual aids?													
OTHER NOTES													

Suggestions for modules that could be used to train specific groups

Group

- L Spraymen in a malaria control campaign
- M Supervisors of agricultural spraymen
- N Health workers in agricultural area
- P- Agricultural aviation personnel
- R Pesticide registration personnel
- S Public interest group

Module	Subject	L	M	N	Pa	R	S
1	A	1, 5, 8	1-8		1-8	1-8	1, 5, 7, 8
	B	1, 3	1-3	1-3		1-4	1, 3
	C		1	1, 3		1-3	1, 2
	D					1-3	1-3
2	A	1-4	1-4	1-4		1-4	1-4
	B	1, 2	1, 4	1-4		1-8	1-5
3	A	1-5	1-5	1-6		1, 6	1, 6
	B	1-7	1-7	1-7		1-7	
	C	3, 6, 7	1, 2, 4-9b		9, 10, 12, 13	11	
4	A	1-3	1-3	1-3	1-3	1, 3	1-3
	B	1-2	1-2	1-2	1-2	1-2	1-2
	C	1-2	1-2	1-2	1-2	1-2	1-2
	D	2, 4	1-6	2-6	1-2	1-6	1-6
	E	1-4	1-5	1-5	1-5	1-5	1-5
	F	1-6	1-6	1-6	1-2,4	1-6	1-6
5	A	1	1-3	1-4		1, 2, 4	1, 3
	B	1-4c	1-4 ³	1-4			
	C		1-7 ³	1-7 ³		1-7	
	D		1-9 ³	1-9 ³		1-9	
6	A	1	1-19	1-19		1	1
	B	1	1-19 ³	1-19 ³		1	1
	C	1-2	1-2	1-2		1-2	1-2
7	A						
		This module is for medical officers.					
	B						
8	A		2, 3	1, 3		3	
9		This module is for the trainer.					

a As appropriate modules for group M, with the additional modules shown

b As relevant to the work undertaken

c As relevant to the compounds used

3.3 Trainers

3.3.1 Trainer preparation

The trainer of a course on the sound management of pesticides must be familiar with the whole of this manual, must know the characteristics of the group taking the course and must be able to adapt the course to make it relevant to each group.

Literature references can be inserted into modules by the trainer at the advanced level, if desired.

If there appear to be gaps in the course, the trainer must know how to prepare and test new modules to cover the circumstances or new subjects.

3.3.2 Selection of participants

The number of participants should exceed 10 (to make it cost-effective to arrange the course), but should not be more than 30, as communication within a group suffers after this point.

There is no limitation to who may participate in a course; however, a course is more likely to be successful if the participants share some characteristics, such as occupation, types of pesticides used or scientific or educational background. Public interest groups are likely to be less homogeneous than occupational groups, and therefore the approach has to be more general.

Participants are frequently nominated or selected by the organization sponsoring the course. In the early part of the first session of any course, the trainer should ask each participant to introduce him- or herself and briefly describe his or her experience with pesticides. This enables the trainer to estimate the level of the participants.

3.3.3 Organizational aspects

The length of the course will depend on the group. Only general guidance can be given about how much of the course material can be covered in a session (45–50 min), as coverage depends on the participants. In some modules, discussion points are suggested, which take longer than a module, which is only descriptive. In a comprehensive course lasting 1 or more days, it is probably not practicable to cover more than one module in a session. The modules are not all the same length, but probably no more than five sub-modules should be attempted in a session if they are to be properly presented and if participation is to be encouraged.

The course should be split into sessions of no more than 45–50 min each, followed by breaks of 10–15 min. In courses lasting 1 day or more, the last session should include an evaluation of the course.

For public interest groups, two sessions might be enough; therefore, only a few aspects can be dealt with adequately.

3.3.4 Before a course

The trainer should allow at least six weeks' time to prepare for the course.

- If you have not selected the participants, obtain information on the characteristics of those selected.
- Either arrange suitable accommodation for the course or visit the accommodation provided. A room in a quiet place is needed, furnished with tables and chairs. The arrangement of the tables should allow discussion and interaction. The availability of a black or white board or a blank flip-chart should be checked. Slide or image projectors will probably be needed for the course, and the equipment should be arranged, with an adequate power source.
- Select the modules appropriate to the group, and draw up the course programme. See the notes on timing of sections, subjects and modules above.
- Select the visual aids for the modules chosen, and list any demonstration equipment needed.
- Decide if handouts are to be given out during the course. Provide notebooks and pens or pencils, so that participants can make their own notes.
- In longer courses, decide whether a guest lecturer will be asked to take one or more sessions. This stimulates the participants and takes some load off the trainer, but the guests must be briefed and asked to follow the modules selected.
- If a field visit is to be included in the course, arrange this or get details about it. In any case, make a preliminary visit to decide on the points to be covered during the visit. The aim of the field visit is to illustrate problems and appropriate and inappropriate working practices.

SUGGESTED CHECK LIST FOR A COURSE

Name of Course:

Dates:

Place:

Number of sessions:

Number of participants:

Characteristics of participants:

Programme: (Enter module numbers. Draw a line under last session each day)

Session	Module	Subject(s)	Nos
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			

Guest lecturer?

Sessions:

Arranged?

Field Visit?

Sessions:

Place:

Preliminary visit (date):

Points to be covered:

Meeting Room:

Preliminary visit (date):

Computer	Chairs	Black/white Board
Tables	Flip-chart	Power Point
Overhead projector	Screen	Slide or Overhead Projector
Felt pens	Notebooks	Chalk
Pens/pencils		

To Take to Course:

Handouts

Visual aids

Demonstration equipment:

Gloves

Visor

Labels

Dust Mask

Other Notes:

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first aid	6 B 11
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ANNEX I. Glossary

Words that are used frequently in the modules are defined. Medical terms used in Section VII are not included. Abbreviations in parentheses refer to the sources from which the definitions were taken.

ABSORPTION	Process by which a chemical is taken up into the tissues of plants and animals
ACARICIDE	Chemical that controls mites and ticks
ACCUMULATION (OR CUMULATION)	Of a chemical: increase in the amount in the body when absorption exceeds excretion Of an effect: produced by repeated doses that singly do not have an effect
AEROSOL	Fine mist of solid or liquid particles suspended in air
AVICIDE	Pesticide used for control of birds (IUPAC)
ACTIVE INGREDIENT	Component of a formulation responsible for direct or indirect biological activity against pests and diseases or in regulating metabolism or growth
ANTIDOTE	Chemical or drug intended to counteract the effect of a poison
BIOACTIVE	Affecting the structure or function of living organisms
BIOLOGICAL CONTROL AGENT	An organism that adversely affects pest species
CARCINOGENIC	Causing cancer or contributing to the causation of cancer
CHOLINESTERASE	Enzyme present in animals and humans and essential for nerve function
CONCENTRATE	Pesticide formulation that requires dilution before application
CLASSIFICATION	Distribution (of pesticides and their formulations) into classes and categories of the same type according to, e.g. hazard or function
DETOXICATION (IN BODY)	Process by which a toxic substance is rendered less harmful
DILUENT	Liquid or solid material used to dilute a concentrated pesticide formulation before application
DOSE	Amount of chemical administered to, taken up by or absorbed by an organism, system or (sub)population (IPCS), or amount of chemical given or applied per unit of plant, animal or surface
DUSTABLE POWDER	Free-flowing powder suitable for dusting (GIFAP)
EFFECT	Change in state or dynamics of an organism, system or (sub)population caused by exposure to an agent (IPCS)
EMETIC	Chemical that causes vomiting
EMULSIFIABLE CONCENTRATE	Homogeneous liquid formulation applied as an emulsion after dilution in water (WHO/FAO, 2002)
ENZYME	Highly selective protein that enables reactions in living cells or body fluids under physiological conditions
EXPOSURE (TO A CHEMICAL)	Concentration or amount of an agent that reaches a target organism, system or (sub)population in a specific frequency for a defined duration
FIRST AID	Emergency treatment given to a sick or injured person before medical aid is available
FOGGING CONCENTRATE	Formulation suitable for application with fogging equipment, either directly or after dilution (WHO/FAO, 2002)
FORMULATION	Combination of ingredients designed to render a product useful and effective for the purpose claimed; form of pesticide purchased by users
FORMULATOR	An industrial concern that adds one or more pesticidal active ingredients to other chemicals to make a mixture suitable for application
FUNGICIDE	Pesticide used for control of fungi (IUPAC)

GRANULE	Free-flowing solid formulation of a defined granule size range, ready for use (WHO/FAO 2002)
HAZARD	Inherent property of an agent or situation that can have adverse effects on an exposed organism, system or (sub)population
HERBICIDE	Pesticide used for control of unwanted plants or weeds
HOUSEHOLD PESTICIDE	Dilute, ready-to-use product for use or application by the general public and available over the counter, e.g. aerosol dispensers, mosquito coils (Module 1A6)
INGEST	Eat or swallow, take in through the mouth
INHALE	Breathe into the lungs
INSECTICIDE	Pesticide used to control insects (IUPAC)
LARVICIDE	Chemical used for controlling insect larvae
LD ₅₀	Statistically derived dose (of a pesticide) expected to kill 50% of test organisms under defined conditions
MICROORGANISM	Virus, bacterium or fungus or a unicellular plant or animal
MITICIDE	Pesticide used to control mites (IUPAC)
MOLLUSCICIDE	Pesticide used to control snails, slugs and other molluscs (IUPAC)
OIL-IN-WATER EMULSION	Fluid, heterogeneous formulation consisting of a solution of pesticide in an organic liquid dispersed as fine globules in a continuous water phase (WHO/FAO, 2002)
OIL-MISCIBLE LIQUID	Homogeneous liquid formulation applied after dilution in an organic liquid
ORGANISM	Any living plant, animal or microorganism
PASTE	Water-based, film-forming composition
PELLETED FORMULATION	Dry pesticide formulation consisting of discrete particles usually > 10 mm ³ and designed to be applied without a liquid carrier (WHO/FAO)
PEST	Organism that attacks food and other materials essential to mankind or otherwise affects human beings adversely (IUPAC)
PESTICIDE	See Module 1A1
POTENTIATION	Dependent action in which a chemical enhances the harm done by another so that their combined effect is greater than the sum of the effects of each one separately
POUR-ON FORMULATION	Solution for pouring onto the skin of animals at high volume (usually > 100 ml per animal) (WHO/FAO, 2002)
PRE-HARVEST INTERVAL	Time that must elapse between latest application of a pesticide and harvesting of a crop to prevent adverse effects
RISK	Probability of an adverse effect in an organism, system or (sub)population caused under specified circumstances by exposure to an agent
RODENTICIDE	Pesticide used to control mice, rats and other rodents
SOLUBLE POWDER	Powder formulation applied as a true solution of active ingredient after dissolution in water but which may contain insoluble inert ingredients (WHO/FAO, 2002)
STORAGE (OF A CHEMICAL IN THE BODY)	Deposition of a chemical in an organ or tissue in which it is apparently inactive as long as it stays there
SPECIFICITY	Capacity of a chemical to affect only the target organism, without affecting other organisms in the same environment
SYNERGISM	As applied to pesticides, a chemical without pesticidal activity which enhances the action of a pesticide; as applied generally, sometimes synonymous with potentiation
SYSTEMIC PESTICIDE	Compound that is absorbed and translocated throughout a plant or animal

TABLET	Pre-formed solid of uniform shape and dimensions, usually circular, with either flat or convex faces, the distance between the faces being less than the diameter (WHO/FAO, 2002)
TARGET AREA	Area to be treated with a pesticide
TARGET SPECIES	Species that a pesticide is designed to control
TECHNICAL PRODUCT	Material resulting from a manufacturing process, comprising the active ingredient and associated impurities; may include small amounts of necessary additives (WHO/FAO, 2002)
THRESHOLD	Minimum dose or concentration of a chemical at which an effect is first induced; dose or concentration of an agent below which a stated effect is not observed or expected to occur (IPCS)
TOXICITY	Inherent property of an agent to cause an adverse biological effect (IPCS)
ULTRA-LOW VOLUME	Volume of pesticide spray applied at a very low rate per unit area
ULTRA-LOW-VOLUME LIQUID	Homogeneous liquid ready for use in ultra-low-volume equipment

Abbreviations and acronyms

IUPAC	International Union of Pure and Applied Chemistry
IPCS	International Programme on Chemical Safety
GIFAP	International Group of National Associations of Manufacturers of Agrochemical Products (now Crop Life)
FAO	Food and Agriculture Organization of the United Nations
WHO	World Health Organization

ANNEX II. Other sources of information

Instructions for treatment and use of insecticide treated mosquito nets

Preventing health risks from the use of pesticides in agriculture

International code of conduct on the distribution and use of pesticides

WHO recommended classification of pesticides by hazard

Pesticide training tool-kit, a guide for community workers

Management of poisoning - A handbook for health care workers - **Chapters 5 and 7**

Links to other sites

A. World Health Organization (WHO)

International Programme on Chemical Safety (IPCS)

Environmental Health Criteria. <http://www.who.int/ipcs/publications/ehc/en/index.html> (accessed 17 November 2005).

Health and Safety Guides. <http://www.who.int/ipcs/publications/hsg/en/index.html> (accessed 17 November 2005).

International Chemical Safety Cards. <http://www.who.int/ipcs/publications/icsc/en/index.html> (accessed 17 November 2005).

WHO recommended classification of pesticides by hazard and guidelines to classification 2004. http://www.who.int/ipcs/publications/pesticides_hazard/en/ (accessed 17 November 2005).

Joint WHO/FAO meeting documents on pesticide residues (JMPR). <http://www.who.int/ipcs/publications/jmpr/en/index.html> (accessed 17 November 2005).

Pesticide Data Sheets <http://www.who.int/ipcs/publications/pds/en/index.html> (accessed 17 November 2005).

Endocrine disruptors. http://www.who.int/ipcs/publications/endocrine_disruptors/endocrinedisruptors/en/index.html (accessed 17 November 2005).

IPCS INCHEM. <http://www.inchem.org/> (accessed 17 November 2005).

WHO Pesticides Evaluation Scheme (WHOPES)

WHO specifications for pesticides used in public health. <http://www.who.int/whopes/quality/en/> (accessed 17 November 2005).

WHO recommendations on safe and effective use of public health pesticides. <http://www.who.int/whopes/recommendations/en/> (accessed 17 November 2005).

Guidelines for testing public health pesticides. <http://www.who.int/whopes/guidelines/en/> (accessed 17 November 2005).

Pesticide application equipment. <http://www.who.int/whopes/equipment/en/> (accessed 17 November 2005)

Insecticide resistance monitoring and management. <http://www.who.int/whopes/resistance/en/> (accessed 17 November 2005).

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2

Modules

MODULE 1 : General

MODULE 2 : Absorption and Effect of Pesticides

MODULE 3 : Personal Protection

MODULE 4 : Protection of Others

MODULE 5 : Chemical Groups and Modes of Action of Pesticides

MODULE 6 : First Aid Treatment of Pesticide Poisoning

MODULE 7 : Medical Treatment of Pesticide Poisoning

MODULE 8 : Other Related Subjects

MODULE 9 : Evaluation

MODULE 10 : Pesticide Documents



General

Module 1: General

Subject A: General considerations on pesticides

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Subject B: Classification and labelling

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No. 2 Classification by formulation	I
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Subject C: Regulatory control of pesticides

No. 1 Registration of pesticides	B
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Subject D: International conventions

No. 1 Rotterdam Convention	A
No. 2 Stockholm Convention	A
No. 3 Basel Convention	A

Educational objectives

A. Basic

Subject A: Should be able to define ‘pest’, ‘disease vector’, ‘pesticide’, ‘integrated pest management’, ‘integrated vector management’ and ‘household pesticide’; list different pest control and management methods; explain why pesticide use should be limited to a minimum, when pests need to be controlled and what to check before using pesticides; describe safety measures for household use of pesticides.

Subject B: Should be able to interpret a pesticide label to identify measures to protect him- or herself, the general public and the environment.

Subject C: Should be able to explain the meaning and importance of registering pesticides.

B. Intermediate

See basic educational objectives.

Subject A: Should be able to explain the meaning of systemic pesticide, active ingredient, formulation, toxicity (acute and chronic) and difference between hazard and risk. Should be able to explain how pesticides can be classified and name effects of pesticides on non-target species.

Subject B: Should be able to name factors influencing the hazard of formulations, such as the toxicity and concentration of the active ingredient and the physical form of the formulation.

Should be able to interpret the information on a pesticide's label to choose the best pesticide for given circumstances, as well as how to apply, transport, store and dispose of it and its container correctly.

Subject C: Should be able to describe decisions taken during registration of pesticides, list areas covered by the FAO Code of Conduct, describe how access to hazardous formulations is usually restricted.

C. Advanced

See basic and intermediate educational objectives.

Subject A: Should be able to explain the meaning of 'contact poison', 'stomach poison', 'fumigant', 'LD₅₀', 'TD', 'NOEL', 'LOEL'.

Subject B: Should be able to describe the WHO hazard classes.

Subject C: Should be able to describe how registration should be organized; how to minimize health and environmental risks during distribution and use of pesticides; to compare the FAO Code of Conduct with the national registration system and legislation on distribution and use of pesticides.

Subject D: Advanced technical participants involved with registration should be able to describe the general objectives of the Stockholm, Rotterdam and Basel conventions and how these are realised, the obligations of the participating countries, explain the meaning of 'POPs' and the prior informed consent procedure. They should be able to describe their country's situation regarding the conventions.

Note: The subjects of classification and labelling are introduced at an early stage of the course, as other parts of the course are related to these concepts.

Module No. 1 A 1

Module: 1 General

Subject: A General considerations on pesticides

Number: 1 Use of pesticides

Level: Basic

Main points

Definitions

- A ‘pest’ is an organism that harms useful plants, domestic animals or humans. Pests can harm humans directly or indirectly, for example by destroying stored food or buildings.
- A ‘disease vector’ is an organism, often a biting insect, which transmits disease to humans or animals.
- ‘Pesticide’ usually refers to any chemical used to kill pests.

Why pesticide use should be limited to a minimum

Pesticide use must be judicious and should be limited to a minimum because pesticides are toxic and can have serious negative effects on health and the environment, as well as on agricultural ecosystems. Negative effects can occur throughout the life cycle of a pesticide, i.e. from production, transport, storage and application to disposal.

Eliminating overuse and unnecessary use of pesticides

Because of these potential negative effects, pesticides should be used only as a last resort, as part of an integrated pest management or integrated vector management programme.

Integrated pest management and integrated vector management

- Integrated pest management (IPM) and integrated vector management (IVM) are strategies that involve one or combinations of control techniques to optimize pest or vector management according to local conditions. Such strategies require careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep use of pesticides and other interventions to levels that reduce or minimize risks to human health and the environment. **see Module 4C1.**

Non-chemical ways of controlling pests or disease vectors include:

- environmental management measures, such as removing standing water where malaria mosquitoes can breed;

- cultural practices, such as crop rotation or using plant varieties resistant to disease; or
- biological control with pathogens, parasites and predators, such as insects or spiders (e.g. *Encarsia* wasp against whitefly, Nucleopolyhedroviruses against army worms, *Bacillus thuringiensis* var. *israelensis* against mosquito larvae).

Subsidiary points

Why pesticide use should be limited to a minimum

- Pesticides are toxic chemicals, and, can cause short- or long-term toxicity in humans. Toxic effects can occur in persons handling them (see **Modules 2, 5, 6, 7**) or in members of the public who come into contact with them (**Module 4A2**). At present, good quality protection equipment and application gear and adequate storage sites and antidotes are often not available or are unaffordable in many countries. There is also lack of knowledge about the necessary safety measures and insufficient regulatory control.

Examples: Farmers can be poisoned when they apply highly hazardous pesticides to which they should not have access. Acute effects can be nausea, respiratory problems, convulsions, even death. Long-term effects can include cancer and birth defects. Children can accidentally come into contact with pesticides that are not stored safely. Food can become contaminated during transport. High levels of pesticide residues occur when intervals before harvest are not respected. Milk and meat can be affected indirectly, when domestic animals are accidentally sprayed or eat contaminated feed.

- Pesticides can also have negative effects on the environment. See **Module 4A1**

Examples: They can be found in drinking-water. Useful organisms such as bees and fish have been killed, as well as predatory birds that play a crucial role in the ecological balance.

- Target pests or vectors can become resistant to pesticides. Secondary pest infestations can be triggered off by decimation of natural enemies that used to keep them under control. This has often led to undesirable escalation of pesticide use and therefore of crop protection costs. For vector control, other, usually more expensive chemicals must be applied, with the risk that ultimately no suitable alternatives will remain (see **Module 4C1**)

IPM/IVM

The focus of IPM is to manage agricultural ecosystems in such a way that pest problems are prevented.

Pests should be controlled with chemicals only if they are causing or are expected to cause unacceptable damage. The risk that chemical control in itself could enhance pest problems should be taken into consideration.

For example: A plant disease might appear only in years with a lot of rain. If there is no rain, no control is needed.

Furthermore, an insect might cause damage only when present in large numbers. When the population is below a certain level, no control is needed.

More specific chemicals, such as growth regulators and pheromones that attract insects, are preferred because they tend to be more selective and have less impact on the agricultural ecosystem. Nevertheless, it is still necessary to assess the associated risks and check whether their use is needed.

More targeted use of pesticides, such as in baits, traps or treated bednets, can limit the amounts used and thus the negative effects; however, care must be maintained during handling these chemicals.

If toxic chemicals have to be applied as a last resort as part of an IPM/IVM programme, those responsible should:

- check whether the pest has been correctly identified, so that the right type of pesticide is applied;
- find out which pesticide is least hazardous under the circumstances in which it is to be used; and
- follow the training modules to take adequate safety measures to protect people (**Module 3**), the environment and the general public (**Module 4**).

Discussion points

- How is ‘pesticide’ defined in your country?
- Is there a regulatory system for control of pesticides in your country?
- What examples of integrated pest management and integrated vector management are you aware of in your country?
- Does the regulatory system cover crop pesticides, those used for vector control and veterinary drugs?
- Is information on nationally approved or registered pesticides available to the general public in your country?
- To what extent do you use pesticides in your day-to-day practice and for what purpose?
- What examples of pesticide overuse and misuse do you know in your country?

Training notes

- The definition of ‘pesticide’ in the International Code of Conduct on the Distribution and Use of Pesticides is: “Pesticide means any substance or mixture of substances intended for preventing, destroying or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or which may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit, and substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.”

Module No. 1 A 2

Module: 1 General

Subject: A General considerations on pesticides

Number: 2 Pesticide name according to target species

Level: Intermediate

Main point

- Pesticides are usually classified according to their target species of pest. Their general names denote their type, e.g.

Insecticides for control of insects

Larvicides for control of larvae of insects and other species

Fungicides for control of fungi (moulds)

Rodenticides for control of rats, mice and other rodents

Miticides for control of mites

Molluscicides for control of snails and slugs

Herbicides for control of weeds

Avicides for control of birds

Nematocides for control of parasitic nematodes (roundworms, mostly microscopic)

Acaricides for control of mites

Algicides for control of algae

Subsidiary points

Many pesticides are toxic to species other than their target species, including humans. For instance, the pyrethroid permethrin is used against insects but is very toxic to trout, a fish. Furthermore, many insecticides exert their toxic actions by affecting a neurotransmitter, an important messenger in the nervous system, which is also found in humans.

Discussion points

- What are the commonest types of pesticides used in your country?
- Name the pesticides you know of and their uses.
- Look up the pesticides given in the answers to questions 1 and 2 in **Module 1A1** in the WHO Recommended Classification of Pesticides by Hazard or your own Government pesticide list.

Training notes

- Different types of pesticides vary in specificity, the ability of a pesticide to affect only the target species. Herbicides are often more specific than other pesticides, while insecticides rarely distinguish between target pests and beneficial insects.

Visual aids



Module No. 1 A 3

Module: 1 General

Subject: A General considerations on pesticides

Number: 3 Pesticide action on target species

Level: Intermediate

Main point

- Pesticide actions on target species are classified on the basis of their mode of entry or mode of action.

Example: classification according to mode of entry:

- An insecticide that kills a pest by first passing into it through its skin, cuticle or exoskeleton is a contact poison.
- A pesticide that kills a pest by passing into its stomach is a stomach poison.
- Insecticides that primarily enter through breathing openings (spiracles) are called ‘fumigants’.

Example: classification according to mode of action or target:

- the nervous system (e.g. cholinesterase inhibitor, sodium channel modulator);
- growth and development (e.g. insect growth regulator);
- metabolism and energy production; or
- the circulatory system (e.g. anticoagulant).

See also **Module 5** on mode of action.

Subsidiary points

- A fumigant is a pesticide that is (or produces) a gas or vapour which kills pests in soil, stored products or buildings.
- The term ‘fumigant’ applies strictly to pesticides in the form of a gas or a vapour, but when droplets of an aerosol pesticide impinge on flying pests and act as a contact poison, the pesticide is sometimes described as having a fumigant action.

Discussion point

- Give examples of the types of pesticides that might be described as ‘contact’ or ‘stomach’ poisons.

Training notes

- These definitions and those in the next module are to enable participants to understand some of the phrases used on pesticide labels.

Module No. 1 A 4

Module: 1 General

Subject: A General considerations on pesticides

Number: 4 Systemic pesticide

Level: Intermediate

Main points

- Systemic pesticides are absorbed and translocated throughout a plant or animal, in the sap or blood, respectively. They can be absorbed by a pest and kill it without affecting the host.
- They are usually insecticides or fungicides applied to the leaves of plants or to the soil around a plant so that they pass into it through the roots.

Subsidiary points

- Other systemic pesticides are designed to kill the plant itself if it is a weed. When the herbicide is applied to the leaves or to the soil, it is absorbed by the plant and kills the root also.
- Systemic pesticides are not commonly applied to animals because of their toxicity to mammals and difficulty in controlling dosage. The exceptions are ‘pour-on’ preparations, which are applied in a strip to the backs of farm animals to protect them from the effects of fly-strike, by controlling the fly population.

Discussion point

- Give examples of pesticides that you would consider systemic pesticides.

Training note

- Confusion sometimes arises over the use of the word ‘systemic’. When it is used to describe a pesticide, it usually has the meaning given above. In toxicology, however, it can refer to any poison that is absorbed by an organism and interferes with its metabolism.

Module No. 1 A 5

Module: 1 General

Subject: A General considerations on pesticides

Number: 5 Technical product, active ingredient, formulation

Level: Intermediate

Main points

- The ‘active ingredient’ is the constituent of a product that is responsible for the pesticidal effect. The ‘technical product’ is the pesticidal chemical plus impurities associated with its manufacture. The active ingredient is usually mixed with other chemicals to facilitate its use, and the mixture is known as a ‘formulation’. Formulations usually require further dilution before application.
- Formulations are complex chemical mixtures. Only a selection of those in use are shown below.

Solids

- wettable or soluble powders (WP, WS or SP) or water-soluble granules (SG) to be added to water;
 - granules (GR), dusts or dustable powders (DP), often applied as such;
 - pellets or pastes (PA) in ready-for-use baits (RB); and
 - tablets (TB) for smoke, gas or vapour generation.

Insecticides can also be incorporated into materials such as plastics and mosquito coils.

Liquids

- emulsifiable concentrates (EC) to be added to water, emulsion oil-in-water (EW) or oil-miscible liquids (OL);
- liquids (UL) for use in ultra-low-volume (ULV) application equipment;
- fogging concentrates (HN or KN);
- pour-ons (POs) for direct application to skin of animals; and
- shampoos for humans.

Subsidiary points

- Active ingredients exist as solids, liquids or gases. The physical form of the active ingredient is not always the same as that of the formulation in which it is used.
- While formulations are designed mainly to facilitate use and increase the effectiveness of an active ingredient, they can be modified to improve safe handling of the pesticide. For example, the risk of disseminating a solid

formulation can be reduced by formulating it as a granule rather than as a dust.

- The non-pesticidal components of many liquid pesticide formulations, e.g. solvents including xylene, methylene chloride and kerosene, can add to the overall toxicity of a product.
- Gases are released either from tablets by exposure to air (e.g. cyanide) or from cylinders (e.g. methyl bromide). They are not usually formulated, but irritating or odorous agents may be added to warn of their presence.
- The concentration of active ingredient in formulations varies greatly. When a formulation is specified, the concentration should be stated.
- Different formulations have different advantages and disadvantages. They should be chosen according to the circumstances of their use: e.g. WP, EC and ULV do not clog nozzles, but EC and ULV are readily absorbed by the skin; dusts and ULV can drift to non-target areas; GR do not drift but may be eaten by birds.

Discussion points

- Can you give examples of formulations in different physical states that are used in your country?
- Can you provide examples of the types of pesticide formulations available in your country?

Training note

- Although inert ingredients can be very toxic, information on these substances is often not given on the label.

Visual aids



Module No. 1 A 6

Module: 1 General

Subject: A General considerations on pesticides

Number: 6 Household pesticide

Level: Basic

Main point

- A household pesticide is a dilute ready-to-use product for application by the general public and is available over the counter (e.g. aerosol dispensers, mosquito coils).

Subsidiary points

- Also included in this category are insecticide formulations for household treatment of mosquito nets.
- Agricultural pesticides should never be used in households.
- Utmost care should be taken not to expose children to a household pesticide during or after its use.

Discussion points

- Are household pesticides any different from other pesticides?
- What household pesticides are available in your country?
- If pesticides are to be used at home, how can they be stored and applied safely?
- What are the main uses of household pesticides in your country?
- How are mosquito nets used in your country?

Training note

- The discussion should lead to consideration of toxicity and hazard in the next two modules. *See also* **Module 4D5**.

Visual aids



Module No. 1 A 7

Module: 1 General

Subject: A General considerations on pesticides

Number: 7 Toxicity

Level: Intermediate

Main points

- The toxicity of a chemical is its ability to cause a harmful effect in a living organism.
- Toxic effects can vary greatly among species. If a pesticide is to be effective, it must be toxic to the target species.

Subsidiary points

- The toxicity of a formulation usually depends on the concentration of active ingredient in the formulation but can vary with the non-pesticidal constituents or if impurities associated with the active ingredient exceed their average levels, e.g. after long storage.
- Acute toxicity is the adverse effects occurring within a short time of administration of a single dose of a pesticide or immediately after short or continuous exposure or multiple doses over 24 h or less. Acute toxicity is quantified by the LD_{50} value, which is a statistical estimate of the number of milligrams of a chemical per kilogram body weight required to kill 50% of test animals when taken into the body by a single absorption. The letters 'LD' refer to the lethal dose administered to a group of animals. Similar notations can be used for other percentage kills, e.g. LD_{10} or LD_{100} , or for other ways of administering the chemical, e.g. LC_{50} (lethal concentration) for studies of administration by inhalation. In reporting these values, the test species, the sex of the animals and the route by which the chemical was administered should be stated. To assess the probable toxicity of a chemical for humans, rats are usually used as the test species. Because of the number of animals involved, the classical LD_{50} test is being replaced by other tests in which fewer animals are required, e.g. the fixed dose method. Data on acute oral toxicity are used to satisfy hazard classification and labelling requirements, for risk assessment for human health and the environment, and when estimating the toxicity of mixtures.
- Chronic toxicity is the adverse effects occurring as a result of repeated dosing with a pesticide on a daily basis or exposure to the pesticide for a large proportion of an organism's lifespan (usually more than 50%). Studies of exposure for 2 years in rats or mice are used to assess the carcinogenic potential of chemicals.
- Symbols are also used to describe other toxic effects:

TD	Threshold dose: concentration below which an effect is not expected
NOEL	No-observed-effect level: the highest dose administered in a study, under defined conditions of exposure, that produces no detectable changes in the investigated species.

LOEL Lowest-observed-effect level: the lowest dose administered in a study, under defined conditions, at which an effect occurs in the investigated species

Discussion point

- Give examples of non-pesticidal constituents and impurities in formulations that can influence toxicity.

Training notes

- In this module, 'dose' refers to the administered dose or the amount of the chemical to which the test animal has been exposed. It must later be distinguished from the absorbed dose. See **Module 2B1**.
- Toluene, xylene and kerosene are examples of non-pesticidal constituents.
- Examples of impurities include isomalathion in malathion, the concentration of which can increase over time through oxidation.

Note: The lower the LD₅₀ value, the higher the acute toxicity.

Module No. 1 A 8

Module: 1 General

Subject: A General considerations on pesticides

Number: 8 Hazard and risk

Level: Intermediate

Main points

- Hazard is the inherent property of a substance that is likely to have a harmful effect.
- Risk is the probability of an adverse health or environmental effect and the severity of that effect after exposure to a pesticide. Risk = hazard x exposure
- Besides the intrinsic hazard, several other factors can influence toxicity, including route of entry, dose, removal from the body, biological variation.

Subsidiary points

- The International Code of Conduct on the Distribution and Use of Pesticides gives the following definition ‘Hazard’ means the inherent property of a substance, agent or situation having the potential to cause undesirable consequences (e.g. properties that can cause adverse effects or damage to health, the environment or environment).
- The key to the safe use of hazardous chemicals is reduction to a minimum of the possibility of exposure during handling.

Discussion point

- Discuss the hazard and risk to human health depicted in this image.

Training notes

- Transfer of a pesticide to a soft-drink bottle greatly increases the risk of poisoning, as the pesticide might be drunk by mistake.

Module No. 1 B 1

Module: 1 General

Subject: B Classification and labelling

Number: 1 Hazard classes

Level: Intermediate**Main points**

- Pesticides can be classified by toxicity, by hazard, by chemical class or by use. The objective of classification by hazard is to enable persons handling and using the pesticide to take appropriate precautions to minimize exposure. The classification used in many countries is the WHO recommended classification of pesticides by hazard.
- Active ingredients (technical grade) of pesticides are classified as follows:
 - extremely hazardous (Class Ia),
 - highly hazardous (Class Ib),
 - moderately hazardous (Class II),
 - slightly hazardous (Class III) and
 - unlikely to present acute hazard in normal use.

Class		LD ₅₀ for rats (mg/kg body weight)			
		Oral		Dermal	
		Solids	Liquids	Solids	Liquids
Ia	Extremely hazardous	5 or less	20 or less	10 or less	40 or less
Ib	Highly hazardous	5–50	20–200	10–100	40–400
II	Moderately hazardous	50–500	200–2000	100–1000	400–4000
III	Slightly hazardous	Over 500	Over 2000	Over 1000	Over 4000

Subsidiary points

- Classification is necessary because pesticides consist of many chemical compounds with widely varying properties and toxicity.
- Any system for regulating the distribution and use of pesticides must be based on a classification.

Discussion point

- What system of classification is in use in your country?

Training notes

- Exercises could be conducted to determine the hazard class of specific products on the basis of the WHO recommended classification by hazard, following the formula on page 3 and using the **tables on pages 42-45**. This publication is

included in the 'Other sources of information'.

- If the national system differs markedly from the hazard classes given above, the visual aid should be adapted to describe the national system. This applies to all the modules in this course that deal with regulatory matters. The WHO classification is based mainly on acute toxicity. Other classification systems take into account additional hazards, e.g. corrosiveness, inflammability, explosiveness, environmental hazard.
- There is also a globally harmonized system for the classification and labelling of chemicals, which covers all hazardous chemicals. It is a common, coherent approach to defining and classifying hazards and communicating information on labels and safety data sheets. The system gives all countries a structure for classifying and labelling hazardous chemicals. See: http://www.unece.org/trans/danger/publi/ghs/ghs_rev00/00files_e.html.

Module No. 1 B 2

Module: 1 General

Subject: B Classification and labelling

Number: 2 Classification of formulation by hazard

Level: Intermediate

Main point

- The hazard presented by any pesticide formulation, and its classification, depend on the toxicity of the active ingredient, its concentration in the formulation and the physical form of the formulation.

Subsidiary points

- In classifications by physical state, liquid formulations are considered more hazardous than solid formulations.
- Pesticidal gases and vapours are not classified in the WHO classification but are listed in a special table (No. 8). The WHO classification does not provide any criteria for air concentrations on which classification could be based. Most of these compounds are highly hazardous, and limits for occupational exposure have been recommended by national authorities in many countries.

Discussion point

- Why are liquid formulations considered more hazardous than solid ones?

Training notes

- The answer to the question in the discussion point is that liquid formulations are more likely to be ingested in larger quantities than solid preparations and may be absorbed more readily.
- In a few formulations, the hazard presented by solvents can exceed that of the active pesticidal ingredients.
- The WHO recommended classification applies to the toxicity and physical state of the active ingredients (technical products) only. For formulated products, it is highly desirable that, whenever practicable, toxicological data for each formulation to be classified are available from the manufacturer. If such data are not obtainable, the classification can be based on proportionate calculations from the LD₅₀ values of the technical ingredient or ingredients.

Module No. 1 B 3

Module: 1 General

Subject: B Classification and labelling

Number: 3 Importance of label

Level: Basic

Main points

- The first step in the use of any pesticide is to read the label.
- One should never use a pesticide from an unlabelled container.
- A pesticide should not be poured into an unlabelled container unless it is to be diluted and used immediately.

Subsidiary point

- Labels should always be printed in the local language.

Discussion points

- How is hazard shown on labels used in your country?
- What are the most important points to look for on a label?
- Discuss the national pictogram system and whether this is clear and commonly understood.

Training notes

- Colour coding provides rapid information on the potential hazard of products.
- Make a collection of pesticide labels used nationally.
- The importance of the label should be stressed, with examples and guidance on how to read and follow label instructions. (Make sure this is covered in visual aids.)
- Although it is assumed that labels convey information and that the information is easily understood, users of pesticides and emergency workers in developing and developed countries often have poor understanding of such information. The comprehensibility of labels must be adequately covered in the training programme; e.g. each pictogram and hazard statement should be tested and explained.

Visual aids



Module No. 1 B 4

Module: 1 General

Subject: B Classification and labelling

Number: 4 Content of label

Level: Intermediate / Advanced

Main points

The FAO Guidelines on Good Labelling Practice for Pesticides recommend the following as the essential parts of a label, written in the local language:

1. Identification of contents
 - product or trade name
 - type of formulation
 - active ingredient, name
 - net content of the product
2. Safety information
 - a clear warning on the label, covering reading the safety instructions before opening the pack; handling, transport and storage warning symbols; and hazard classification and symbol;
 - a safety text covering:
 - ⇒ product-specific advice,
 - ⇒ good agricultural practice,
 - ⇒ relevant protective clothing,
 - ⇒ precautions when handling the concentrate (if applicable),
 - ⇒ precautions during and after application,
 - ⇒ environmental safety during and after application,
 - ⇒ safe storage,
 - ⇒ safe disposal of product and used container and
 - ⇒ how to clean equipment (if a potential risk exists).
 - Safety pictograms
 - ⇒ Warning
 - First-aid and medical treatment advice
3. Instructions for use
 - how to mix and apply the product and rate of use;
 - when to use the product, including timing and frequency (including maximum number of applications per use season), or when not to use it, e.g. during flowering of the crop;
 - where to use the product: which crops, targets, areas;

- any limitations, such as susceptible crops or varieties, weather conditions, harvest interval;
 - compatibility with other products, where appropriate; and
 - how to avoid harming beneficial insects, such as bees and natural predators, or wildlife
4. Other information
- name, address and telephone number of local distributor;
 - registration number, if any;
 - manufacturer's name and company logo;
 - trade mark acknowledgment;
 - date of manufacture and formulation and batch number; and
 - shelf life.

Subsidiary points

- In some countries, the product label contains the contact number of a poison centre.
- Ideally, pesticide labels should contain information about all the ingredients of the formulation, including solvents such as kerosene, xylene, methylene chloride and isopropyl alcohol.
- The label should contain information on restricted use and a warning against re-use of the container.

Discussion points

- To what extent are the specified labelling requirements being used in your country?
- Comment on locally available pesticide labels (examples provided by trainer).
- Issues of enforcement of label requirements

Training note

- The FAO Guidelines on Good Labelling Practice for Pesticides, which are part of the International Code of Conduct on the Distribution and Use of Pesticides, provide more detail on the points listed above.
- A globally harmonized labelling system is being developed.

Visual aids



Module No. 1 C 1

Module: 1 General

Subject: C Regulatory control of pesticides

Number: 1 Registration of pesticides

Level: Basic

Main points

- Use of pesticides must be controlled to protect human beings and the environment.
- One method of controlling their use is registration, which involves deciding how each pesticide formulation shall be distributed, labelled and used with maximum efficiency and minimum hazard to human beings and the environment.
- The use of certain pesticides is restricted, by specified organizations, for specified uses, under specified conditions.

Subsidiary point

- Pesticide registration authorities are usually part of a government ministry, such as that for agriculture. Regardless of how they are organized, it is essential that other ministries, including those for health, environmental protection, fisheries and forestry, be closely associated in the registration process. In some countries, the pesticide registration authority consists of a committee with representation from all concerned ministries.

Discussion points

- Describe the registration process in your country.
- What agencies are involved in registration?
- Do you know of any unregistered pesticides used in your country?

Training note

- Registration is the process whereby the responsible national government or regional authority approves the sale and use of a pesticide, after an evaluation of comprehensive scientific data to demonstrate that the product is effective for the intended purposes and does not pose an unacceptable risk to human or animal health or the environment under the intended conditions of use.

Visual aids



Module No. 1 C 2

Module: 1 General

Subject: C Regulatory control of pesticides

Number: 2 Code of conduct

Level: Intermediate

Main points

- The control and management of pesticides are supported by national legislation and regulations. This should be backed up by international standards of conduct to promote practices that minimize potential health and environmental risks associated with use of pesticides while ensuring their efficacy.
- The International Code of Conduct on the Distribution and Use of Pesticides (see Other sources of information for the full text) has established standards of conduct for all public and private entities engaged in or associated with the distribution and use of pesticides, particularly where there is inadequate or no national legislation to regulate pesticides. The Code is designed for use within the context of national legislation. It addresses the need for a cooperative effort between governments of pesticide exporting and importing countries, the pesticide industry, international organizations and nongovernmental organizations for effective management of pesticides in agriculture and public health.

Subsidiary point

- The basic function of the Code is to serve as a framework and point of reference for the judicious use of pesticides and to minimize the potential health and environmental risks associated with their use. It includes the life-cycle concept of pesticide management and covers:
 - pesticide management;
 - testing of pesticides;
 - reducing health and environmental risks;
 - regulatory and technical requirements;
 - availability and use;
 - distribution and trade;
 - information exchange;
 - labelling, packaging, storage and disposal; and
 - advertising.

Discussion point

- Discuss the importance of post-registration monitoring and evaluation.

Module No. 1 C 3

Module: 1 General

Subject: C Regulatory control of pesticides

Number: 3 Access to pesticides

Level: Intermediate

Main point

- An effective way of protecting workers and the general public from adverse effects due to the handling of pesticides is to regulate access to hazardous formulations.

Subsidiary points

- Two methods of restricting availability can be exercised by the responsible authority: not registering a product or, as a condition of registration, restricting the availability to certain groups of users in accordance with a national assessment of the hazards involved in use of the product.
- Access to Class Ia (extremely hazardous) and Class Ib (highly hazardous) pesticides could be restricted to permit these products to be sold only to approved pest control organizations for specified operations. The applicators must be fully trained and must use full protective equipment. Some countries require licensing of applicators to ensure that their training has been thorough.

Discussion points

- What regulations are enforced to control access to pesticides in your country?
- How can workers and the general population be placed at risk by misuse of hazardous pesticides?
- What are the limitations to “safe use training” in use of highly hazardous pesticides? Will it equip farmers to use them without unacceptable risks?

Visual aids



Module No. 1 D 1

Module: 1 General

Subject: D International conventions

Number: 1 Rotterdam Convention

Level: Advanced

Main points

The Rotterdam Convention was adopted on 10 September 1998 and entered into force on 24 February 2004.

The objectives of the Rotterdam Convention are:

- to promote shared responsibility and cooperative efforts among Parties in the international trade of certain hazardous chemicals in order to protect human health and the environment from potential harm; and
- to contribute to the environmentally sound use of those hazardous chemicals, by facilitating information exchange about their characteristics, by providing for a national decision-making process on their import and export and by disseminating these decisions to Parties.

Each Party has designated one or more national authorities to act on its behalf in carrying out the administrative functions required by the Convention. For a complete list of designated national authorities, see the Convention website.

The Rotterdam Convention provides countries with the tools and information needed to identify potentially hazardous chemicals and pesticides and to exclude those they cannot manage safely. The two key operational elements of the Convention developed to assist Parties manage chemicals include the prior informed consent procedure and a process for information exchange on potentially hazardous chemicals.

The prior informed consent procedure is based on the principle that a chemical listed in Annex III of the Convention can be exported only with the prior informed consent of the importing party. A decision guidance document is available for each chemical subject to the prior informed consent procedure. Parties are invited to review this information and to make a decision regarding future import of the chemical. Parties are then obliged to respect the import decisions as compiled and circulated by the Secretariat in the PIC Circular.

The prior informed consent procedure of the Rotterdam Convention applies to chemicals and pesticides that have been banned or severely restricted by final regulatory action in two countries in two regions of the world in order to protect human health or the environment, and to severely hazardous pesticide formulations that cause problems under normal conditions of use in a particular country. Severely hazardous pesticide formulations were specifically included as a result of concerns that such products might not be banned or restricted in developed countries where effective worker protection exists, but might represent unacceptable hazards to workers in developing countries or countries with economies in transition where either protective equipment is not available or, where available, cannot be worn

owing to environmental or climatic conditions. Only one developing country Party or Party with economy in transition need make a report for initiation of the process for inclusion of a severely hazardous pesticide formulation in Annex III of the Convention.

The prior informed consent procedure initially covered 22 pesticides, including five severely hazardous pesticide formulations and five industrial chemicals, but many more are expected to be added. For a full list of the chemicals in Annex III of the Convention that are subject to the prior informed consent procedure, consult the Convention website www.pic.int.

The Rotterdam Convention provides an opportunity for information exchange on a broad range of potentially hazardous chemicals. The key elements of the Convention related to information exchange include the following:

- the requirement for a Party to inform other Parties of each national ban or severe restriction of a chemical;
- the possibility for a Party that is a developing country or a country with an economy in transition to inform other Parties that a severely hazardous pesticide formulation is causing problems under the conditions of use in its territory;
- the requirement for a Party that plans to export a chemical that is banned or severely restricted for use within its territory to inform the importing Party that such export will take place, before the first shipment and annually thereafter;
- the requirement for an exporting Party, when exporting chemicals that are either listed in Annex III or are banned or severely restricted on its own territory that are to be used for occupational purposes, to ensure that an up-to-date safety data sheet is sent to the importer; and
- labelling requirements for exports of chemicals covered by the prior informed consent procedure and for other chemicals that are banned or severely restricted in the exporting country.

Hazardous chemical pesticides covered by the Rotterdam Convention are:

Chemical	Category
2,4,5-T	Pesticide
Aldrin	Pesticide
Captafol	Pesticide
Chlordane	Pesticide
Chlordimeform	Pesticide
Chlorobenzilate	Pesticide
DDT	Pesticide
Dieldrin	Pesticide
Dinoseb and dinoseb salts	Pesticide
1,2-Dibromoethane	Pesticide
Fluoroacetamide	Pesticide
Hexachlorocyclohexane (mixed isomers)	Pesticide
Heptachlor	Pesticide
Hexachlorobenzene	Pesticide
Lindane	Pesticide

Mercury compounds, including inorganic mercury compounds alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds	Pesticide
Pentachlorophenol	Pesticide
Monocrotophos (soluble liquid formulations that exceed 600g active ingredient/l)	Severely hazardous pesticide formulation
Methamidophos (soluble liquid formulations that exceed 600g active ingredient/l)	Severely hazardous pesticide formulation
Phosphamidon (soluble liquid formulations that exceed 1000g active ingredient/l)	Severely hazardous pesticide formulation
Methyl parathion (emulsifiable concentrates with 19.5%, 40%, 50% or 60% active ingredient and dusts containing 1.5%, 2% or 3% active ingredient)	Severely hazardous pesticide formulation
Parathion (all formulations, aerosols, dustable powder, emulsifiable concentrate, granules and wettable powders, are included, except capsule suspensions)	Severely hazardous pesticide formulation

Discussion points

- What are the conditions that would allow a developing country to propose inclusion of a severely hazardous formulation in the prior informed consent procedure?
- Submission of a proposal in support of a severely hazardous pesticide at the national level involves two stages: collection of information at field level and transmission of an incident report through the designated national authority to the Secretariat of the Convention. For the collection and transmission of such incident reports, there is a two-part report form. **Part A** must be completed and signed by the designated national authority, and **Part B** gives detailed information on the incident. **Part B** can be replaced by national forms or other documentation, provided the key information on the incident (a clear description, including adverse effects and how the formulation was used), as set out in **Part 1** of **Annex IV** of the Rotterdam Convention, is included.

Training note

- For more information, go to the reading material on the Rotterdam Convention.

Module No. 1 D 2

Module: 1 General

Subject: D International conventions

Number: 2 Stockholm Convention

Level: Advanced

Main points

- The Stockholm Convention is a global treaty to protect human health and the environment from persistent organics pollutants (POPs). POPs remain intact in the environment for a long time, accumulate in body fat, concentrate through food chains, have harmful effects on wildlife and pose a risk for human health. Several effects are associated with exposure to POPs, including carcinogenicity, birth defects, reproductive disorders and disruption of endocrine and immune systems; these are mainly linked to long-term exposure. Because POPs travel far from where they have been used or produced, mainly through the air, they cannot be controlled by one country alone but must be addressed at the international level through measures that will reduce or eliminate their release into the environment.
- The Stockholm Convention entered into force on 17 May 2004. By the end of 2005, more than 110 countries were Parties. It aims to:
 - eliminate the intentional production and use of POPs;
 - minimize releases from unintentional production of POPs, such as dioxins and furans, which are produced by incomplete combustion;
 - ensure that stockpiles and wastes of the listed chemicals are managed and disposed of in an environmentally sound manner; and
 - impose certain trade restrictions.
- The Convention initially covered a list of 12 POPs but has a procedure for adding others. The initial 12 include the nine pesticides listed below, all of which except DDT are slated for immediate or short-term elimination. Parties may register for specific time-limited exemptions in accordance with Annex A of the Convention. The most important exemptions are highlighted in the table below. As stipulated in Annex B of the Convention, DDT may be used for disease vector control in accordance with WHO guidelines when no locally safe, effective, affordable alternative is available. Parties must notify such use and report regularly on the conditions of use. They should develop action plans to ensure that DDT use is limited to disease vector control and should implement strategies, including resistance management, to ensure the continued effectiveness of the alternatives.

Pesticide	CAS No.	Specific use exemptions (initially limited to 5 years)	Acceptable purpose (under regular evaluation)
Aldrin	309-00-2	Local ectoparasiticide; insecticide	
Chlordane	57-74-9	Local ectoparasiticide; insecticide; termiticide; additive in plywood adhesives	
DDT	50-29-3	Intermediate (including in production of dicofol)	Insecticide in disease vector control
Dieldrin	60-57-1	In agricultural operations	
Endrin	72-20-8		
Heptachlor	76-44-8	Termiticide; in wood treatment; in underground cable boxes	
Hexachlorobenzene	118-74-1	Intermediate; solvent in pesticides	
Mirex	2385-85-5	Termiticide A	
Toxaphene	8001-35-2		

- Parties making use of exemptions should take measures to minimize human exposure and release into the environment.
- The Stockholm Convention requires each Party to develop a plan for implementing its obligations under the Convention. An interim financial mechanism with the Global Environment Facility has been set up to assist developing countries and countries with economies in transition in implementing the treaty.

Subsidiary points

- The continued need for DDT for disease vector control will be evaluated regularly by Parties in consultation with WHO.
- The new POPs proposed in 2005 for inclusion in the Convention included the pesticides chlordane and lindane.
- Technical guidelines for environmentally sound management of wastes containing POPs have been developed under the Basel Convention.

Discussion point

- What actions have been taken in your country in relation to the Stockholm Convention?

Training note

- For more information, go to the reading materials on Stockholm Convention available at <http://www.pops.int/>

Module No. 1 D 3

Module: 1 General

Subject: D International conventions

Number: 3 Basel Convention

Level: Advanced

Main points

- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is a global treaty to protect human health and the environment from risks posed by hazardous wastes and their transboundary movement. When hazardous wastes are dumped indiscriminately, spilled accidentally or managed improperly, they can cause severe health problems, even death, and poison water and land for decades. In the late 1980s, a tightening of environmental regulations in industrialized countries led to a dramatic rise in the cost of hazardous waste disposal. Searching for cheaper ways to get rid of the wastes, ‘toxic traders’ began shipping hazardous waste to developing countries and to eastern Europe. When this activity was revealed, international outrage led to the drafting and adoption of the Basel Convention, which entered into force on 5 May 1992. By the end of 2005, 166 countries and the European Community were Parties to the treaty, which has three main objectives: to control the ‘transboundary’ movement of hazardous wastes; ‘environmentally sound management’ of hazardous wastes; and minimization of the generation of hazardous wastes.
- During its first decade (1989–1999), work on the Convention was devoted principally to setting up a framework for controlling the movement of hazardous wastes across international frontiers. A control system based on prior written notification was put into place, so that transboundary movement of hazardous and other wastes can take place only on prior written notification by the State of export to the competent authorities of the States of import, with approval by the States of import. This also applies to the States of transit. Each shipment of hazardous or other waste must be accompanied by a movement document from the point at which transboundary movement begins to the point of disposal. Hazardous waste shipments made without such documents are illegal. In addition, there are outright bans on the export of wastes to certain countries. Transboundary movements can take place, however, if the State of export does not have the capability for managing or disposing of the hazardous waste in an environmentally sound manner.
- The term ‘environmentally sound management of hazardous wastes’ means taking all practical steps to minimize the generation of hazardous wastes and strictly controlling their storage, transport, treatment, re-use, recycling, recovery and final disposal, in order to protect human health and the environment. Environmentally sound management also means addressing the issue through an ‘integrated life-cycle approach’, which involves minimizing the generation of hazardous wastes, actively promoting and using cleaner techniques and production methods and guaranteeing environmentally sound disposal methods.

- The Convention covers all hazardous substances that have become waste and show one or more of the following characteristics (Annex III of the Basel Convention): explosive, flammable, spontaneously combustible, emit flammable gases in contact with water, oxidize, are organic peroxides, poisonous, infectious, corrosive, liberate toxic gases in contact with air or water, are toxic, eco-toxic or capable of yielding hazardous materials.
- Against this background, all obsolete stocks of pesticides that have become waste fall under the scope of the Basel Convention, as further specified in Annex VIII of the Convention, including:

A4030	Wastes from the production, formulation and use of biocides and phytopharmaceuticals, including waste pesticides and herbicides, which are off-specification, outdated ¹ or unfit for their originally intended use
A4040	Wastes from the manufacture, formulation and use of wood-preserving chemicals ²
- In addition, the control mechanism of the Convention as well as the principles of environmentally sound management and minimization of waste generation apply.

Subsidiary points

- The Conference of the Parties adopted in 2002 Technical Guidelines on the Environmentally Sound Management of Biomedical and Healthcare Wastes, which contain sections on state-of-the-art management, treatment and disposal of toxic chemicals. Recently, Parties to the Convention adopted ‘General technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants (POPs)’ (*see also* module 1D2 on the Stockholm Convention). These guidelines contain relevant information about what Parties consider to be environmentally sound management of POPs as wastes. In addition, two complementary specific technical guidelines on the environmentally sound management of POP pesticides as wastes are being drawn up:
 - draft technical guidelines for the environmentally sound management of wastes consisting of, containing or contaminated with the pesticides aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene (HCB), mirex or toxaphene or with HCB as an industrial chemical; and
 - draft technical guidelines for environmentally sound management of wastes consisting of, containing or contaminated with 1,1,1-trichloro-2,2-bis(4-chlorophenyl)ethane (DDT).
- Both guidelines focus on the environmentally sound management of pesticides listed in the titles. They also provide extensive information on the environmentally sound management of obsolete stocks of pesticides in general.
- Fourteen regional centres for training and technology transfer have been established on several continents: in Argentina, El Salvador, Trinidad and Tobago, and Uruguay; China, Indonesia, and the Islamic Republic of Iran; Egypt, Nigeria, Senegal, and South Africa; and the Russian Federation and Slovakia. The centres’ business plans for 2005–2006 are available on the website of the Basel Convention Secretariat, at [http:// basel.int/centres/bussplan/index.html](http://basel.int/centres/bussplan/index.html)
- These centres have an important role in enhancing the capacity of developing countries and countries with economies in transition in implementing the

¹ ‘Outdated’ means unused within the period recommended by the manufacturer.

² This entry does not include wood treated with wood-preserving chemicals.

Convention. They are conducting training programmes, workshops, seminars and pilot projects in the environmentally sound management of hazardous wastes, transfer of environmentally sound technology and minimization of the generation of hazardous wastes. They are collecting information on these subjects and disseminating it, and carrying out joint projects with UNEP, UNIDO, FAO, UNITAR, WHO and the secretariats of the Stockholm and the Rotterdam conventions, industry and nongovernmental organizations.

Discussion point

- What actions have been taken in your country in relation to the Basel Convention?

Training note

- For more information, go to the reading materials on the Basel Convention, available at, and websites of Basel Convention Regional Centres: <http://www.basel.int>
- Argentina: <http://crsbasilea.inti.gov.ar>
- Senegal: <http://www.centredakar.org>
- El Salvador: http://www.marn.gob.sv/convenio_basilea.htm
- Nigeria: <http://www.baselnigeria.org/>
- South Africa: <http://www.baselpretoria.org.za>



Absorption and Effects of Pesticides

Module 2: Absorption and effects of pesticides

Subject A: Routes of entry

No. 1 Through the skin	B
No. 2 Through the mouth	B
No. 3 Through the lungs	B
No. 4 Through broken skin	B

Subject B: Adverse effects

No. 1 Acute and long-term effects	B/I
No. 2 Accumulation in the body	I
No. 3 Relation of dose to exposure and effect	A
No. 4 Cancer	I
No. 5 Reproductive toxicity	I
No. 6 Endocrine disruption	A
No. 7 Neurotoxicity	I
No. 8 Immunotoxicity	I

Educational objectives

A. Basic

Subject A: Should be able to describe the routes of entry of pesticides into the body.

Subject B: Should be able to describe the difference between acute and long-term effects.

B. Intermediate

See basic educational objectives.

Subject B: Should be able to describe how pesticides accumulate in the body, list the effects of pesticides on cancer, reproduction and neurological and immunological systems.

C. Advanced

See basic and intermediate educational objectives.

Subject B: Should be able to describe the relations of dose to exposure and effect; effects of pesticides on cancer, reproduction, endocrine disruption and neurological and immunological systems.

Module No. 2 A 1

Module: 2 Absorption and effects of pesticides

Subject: A Routes of entry

Number: 1 Through the skin

Level: Basic

Main point

- Many pesticide formulations can be absorbed through intact skin. For persons who handle or apply pesticides, this is the commonest route of absorption.

Subsidiary points

- Absorption of most pesticides does not leave any mark on the skin to show that it has taken place.
- Formulations of most pesticides can be absorbed through intact skin for as long as they are in contact, such as when dust clings to the skin, when liquid splashes on to the skin, when the skin is immersed in liquid, or when spray mist or rebound spray lands on the skin and dries on it.
- The pesticide is absorbed more rapidly if the formulation is a liquid, oily or if the skin is warm or sweaty, inflamed or has cuts or abrasions.
- Absorption slows or stops as soon as the pesticide is washed off the skin, depending on how thorough the washing is. Solvents should not be used for washing as they dissolve the natural protection of the skin, making absorption easier. Only water should be used, which is more efficient if used with a mild alkaline soap; a detergent soap should not be used.

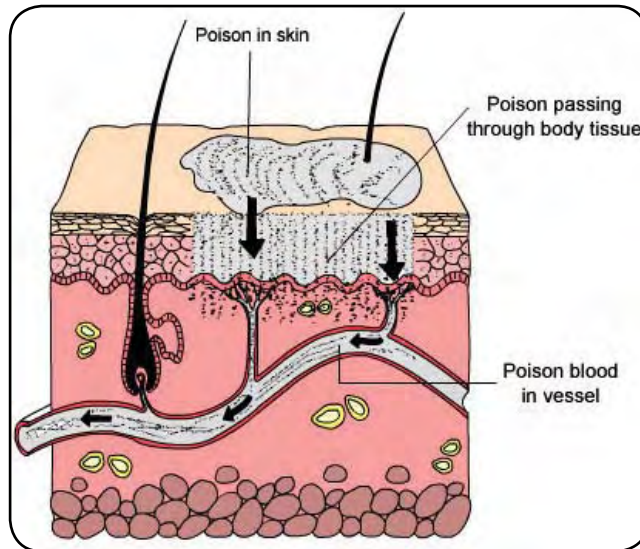
Discussion point

- How can the skin be contaminated during use of pesticides?

Training notes

- A few pesticides or their solvents are not absorbed through intact skin; however, they can irritate the skin or corrode the nails, for instance during mixing of paraquat with the bare hands.
- Experimental studies have shown that paraquat causes injury by irritating and corroding the skin. Contamination of the hands with paraquat or diquat can damage the fingernails.

Visual aids



Module No. 2 A 2

Module: 2 Absorption and effects of pesticides

Subject: A Routes of entry

Number: 2 Through the mouth

Level: Basic

Main points

- Pesticides taken through the mouth are absorbed in the gut.
- Workers and members of their families can take pesticides into the mouth if they drink from any unlabelled container or bottle into which pesticides have been decanted; they mistake the pesticide for water or other drinks; or used or empty pesticide containers are left where children might play with them.

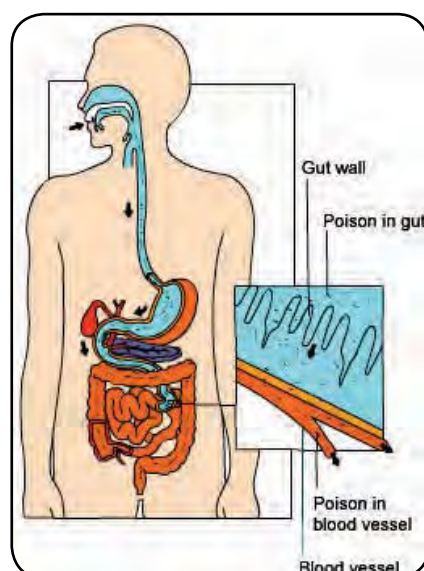
Discussion points

- Are there any other ways in which family members might take in pesticides by mouth?
- Which of these are likely to result in absorption of high doses of pesticides?

Training notes

- Uncovered food can become contaminated during indoor residual spraying in public health operations or during indoor household spraying by residents.
- If food is contaminated by a leaking container during transport or storage, the dosage may be high.
- The absorbed dose is an important determinant of effect.

Visual aids



Module No. 2 A 3

Module: 2 Absorption and effects of pesticides

Subject: A Routes of entry

Number: 3 Through the lungs

Level: Basic

Main point

- Pesticides get into the lungs by inhalation of powders, airborne droplets, vapours or gas. Once taken into the lungs, they may be rapidly absorbed. Light dust and aerosols can also enter the lungs, but only the smallest particles reach the alveoli.

Subsidiary points

- The hazard represented by inhalation of spray droplets is fairly low when dilute sprays are being applied with conventional low-pressure application equipment (most droplets are too large to remain airborne). Instead, they are trapped in the moist lining of the nose and throat, from which they may be absorbed as through the skin or swallowed. When high-pressure or ultra-low-volume or fogging equipment is used, the potential respiratory exposure is increased, as the droplets are smaller. The amount of pesticide absorbed depends on its concentration in the fog, vapour or dust.
- Some pesticides have a strong smell (e.g. malathion), but in most formulations the smell comes from the solvent. In either case, smell is not a reliable indicator of a pesticide in gas, vapour or mist.
- As the temperature increases, the vapour levels of many pesticides increase. It is therefore recommended that pesticides should not be applied when the air temperature is above 30°C.

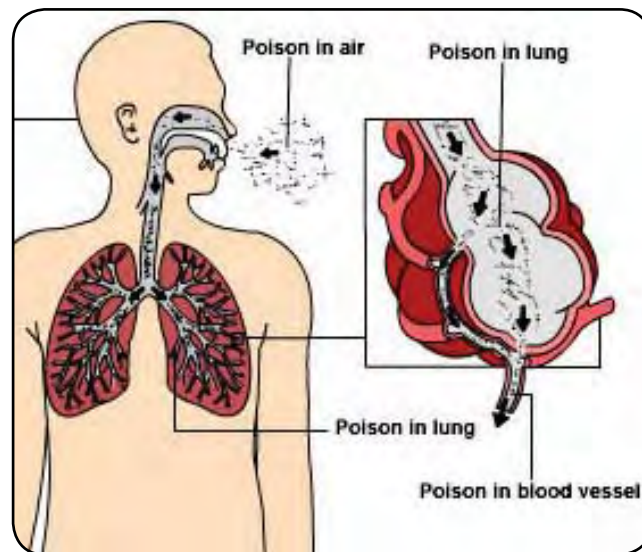
Discussion point

- What are the factors that influence the absorption of pesticides through the lungs?

Training note

- Only particles 1–8µm in diameter can pass into the lungs without being trapped in the nose or mouth, throat or trachea. Particles of this size are too small to be seen.

Visual aids



Module No. 2 A 4

Module: 2 Absorption and effects of pesticides

Subject: A Routes of entry

Number: 4 Through broken skin

Level: Basic

Main points

- Absorption of pesticides through wounds, cracked skin and rashes on exposed skin is greater than that through the same area of intact skin.
- Wounds and rashes should be covered with waterproof dressings as long as the worker continues to be exposed to a pesticide.

Subsidiary point

- A waterproof dressing should be removed or changed for a permeable dressing after work each day. If the work continues the following day, a clean waterproof dressing should be applied.

Discussion point

- Do you know what is meant by a waterproof dressing?

Training notes

- This route of absorption is sometimes referred to as 'inoculation'.

Module No. 2 B 1

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 1 Acute and long-term effects

Level: Basic / Intermediate

Main points

- Rates of absorption into the body differ according to the route of exposure. For instance, absorption is usually higher after ingestion than after skin exposure.
 - Absorption in the lungs is the most efficient route and thus most likely to affect health.
 - Absorption through the skin might be the commonest route, but some pesticides (such as DDT and the pyrethroids) are absorbed to only a limited extent through the skin, except in oily formulations.
 - During occupational exposure, intake through the mouth is less common; once it occurs, however, absorption is difficult to prevent or slow.
- The effects of a pesticide depend on the amount absorbed.
- After absorption, a number of mechanisms exist in the body to eliminate the chemical, including breaking it down in organs such as the liver or excreting it unchanged through the kidneys into the urine.
- Effects occur when the concentration of a toxic chemical in the body reaches a certain threshold; however, different thresholds exist for different effects, and the time they manifest can vary considerably.
- Acute toxicity is an adverse effect occurring within a short time of administration or absorption of a single or repeated dose given within a short time (24h or less).
- Some pesticides can cause long-term effects after exposure to single or multiple doses or repeatedly to low concentrations. Pregnant women and their fetuses are at particular risk; the effects depend on the stage of fetal development.

Subsidiary points

Groups that may encounter health problems as a result of exposure to pesticides include:

- users and applicators,
- bystanders and persons living next to treated areas (from drift),
- farmers working in treated areas,
- processors of treated crops,
- pesticide distributors,
- workers in industrial plants of pesticide manufacturers and formulators,

- pesticide storekeepers,
- consumers of treated crops or contaminated water, and
- consumers of dairy products from livestock fed contaminated crops.
- Many pesticides are acutely toxic to humans, but data on long-term toxicity are often inadequate. Acute effects can persist as long as exposure to a concentration above the threshold continues.
- Some pesticides have long-term effects after a single dose. For example, organic mercurials, which are sometimes used as fungicides for the treatment of seeds for planting, can cause permanent paralysis and brain damage if the treated seeds are eaten.
- The threshold dose for a long-term effect might be lower than that for an acute effect.

Discussion point

- How can multiple, long-term exposures to pesticides occur in the community?

Training notes

- Most of the studies reported in the literature refer to acute effects of pesticides. Data are needed on long-term effects of pesticides in vulnerable populations, such as men and women of reproductive age, pregnant women, children and the elderly.
- Long-term effects can be extrapolated from the results of studies in experimental animals. The acceptable daily intake (ADI) of residues in food and water for various subpopulations can be a helpful indicator of long-term risks.
- ‘Chronic toxicity’ refers to adverse effects that persist over a long period and occur some time after initial exposure.

Module No. 2 B 2

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 2 Accumulation in the body

Level: Intermediate

Main points

- Some pesticides are stored in body tissues. These pesticides are fat-soluble and are excreted slowly. They are released from the fat tissues into the circulation.
- The effects of exposure to a pesticide can manifest as physical signs and symptoms as well as biochemical changes. Clinical effects may be observed when the dose exceeds a threshold. Below the threshold, when clinical effects might not be observed, biochemical changes might still occur. Small doses of pesticides can cause biochemical changes without clinical effects. Continued exposure to these doses can eventually exceed the threshold and result in clinical effects. This is true in particular for organophosphorus pesticides.

Subsidiary point

- DDT and related compounds that accumulate in body fats are a cause of concern. Their accumulation and their persistence in the environment led to their restriction or banning. These effects were particularly significant in some animal species, especially birds.

Discussion point

- Which types of pesticides bioaccumulate in the body?

Training note

- Organophosphorus pesticides affect important enzymes in the body, and small amounts can affect enzymes without clinical symptoms. Repeated small doses can exceed a threshold, resulting in symptoms.

Module No. 2 B 3

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 3 Relation of dose to exposure and effect

Level: Advanced

Main points

- For any toxic chemical, exposure is related to dose.
- If there is no exposure, there can be no effect.
- If exposure is high but absorption is low, clinical effects might not be observed if the threshold dose is not reached.

Subsidiary points

- Persons who manufacture, transport and apply pesticides are most likely to be exposed.
- Under ordinary circumstances, exposure of the public to agricultural pesticides is slight. They should have no access to hazardous pesticides, but occasional exposure to drift and other minor accidental releases does occur. Massive pesticide contamination of food has caused serious poisoning among the public. The handling and storage of all pesticide formulations requires great care, particularly during transport.

Discussion point

- Will aerial spraying of an agricultural pesticide result in significant exposure in nearby communities?

Module No. 2 B 4

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 4 Cancer

Level: Intermediate

Main points

- The registration of pesticides requires the results of a battery of tests for toxicity, including assessment of the potential to cause cancer.
- Published studies on the carcinogenicity of pesticides are reviewed periodically by agencies such as the International Agency for Research on Cancer (IARC).

Subsidiary points

- Tests for carcinogenicity are usually conducted on animals such as rodents, which are exposed to a pesticide for their lifespan.
- Humans do not always react to chemicals in the same way as animals, and the tests do not exclude the possibility that some compounds that do not cause cancer in animals might do so in human, and vice versa.
- It can take up to 20 years after exposure to a chemical before cancer develops in humans.

Discussion point

- Is there a good epidemiological study showing an increase in cancer incidence among pesticide workers in your country?

Training notes

- Some case reports and case–control studies have linked malignancies in children to exposure to pesticides. The types of cancer include leukaemia, neuroblastoma, Wilms tumour, soft-tissue sarcoma, Ewing sarcoma, non-Hodgkin lymphoma and cancers of the brain, colorectum and testes.
- Check the IARC Monographs on the Carcinogenicity of Chemicals to Humans (www.iarc.fr) for evidence of the carcinogenicity of specific pesticides.

Module No. 2 B 5

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 5 Reproductive toxicity

Level: Intermediate

Main points

- The term ‘reproductive toxicity’ is used to describe adverse effects induced (by a substance) on any aspect of mammalian reproduction. It covers all phases of the reproductive cycle, including impairment of male or female reproductive function or capacity and the induction of non-heritable adverse effects in progeny, such as growth retardation, structural and functional effects and death.
- A number of pesticides clearly have the potential to cause reproductive toxicity in animal species, and several (e.g. ethylene dibromide, dibromochloropropane, kepone, carbaryl) have been shown to affect human (mainly male) reproduction after occupational exposure.

Training notes

- Reproductive toxicity includes adverse effects on sexual function and fertility in males and females and any effect that interferes with normal development either before or after birth (also called developmental toxicity). The physiology of the reproductive system is different in men and women, but in both cases reproductive function is controlled by chemicals called hormones.
- There are three main targets for reproductive toxicants. They can act directly on the central nervous system, altering the secretion of hormones (e.g. synthetic steroids); they can act on the gonads (ovary and testis); and they can inhibit or alter spermatogenesis. These toxic effects can result in sterility, decreased fertility, increased fetal death, increased infant death and increased birth defects. Chemicals that cause an increase in birth defects are called teratogens.
- Adverse effects on the developing organism can result from exposure before conception (either parent), during pregnancy or between birth and the time of sexual maturation. Adverse developmental effects can be detected at any time in the life span of the organism. The major manifestations of developmental toxicity include structural abnormality, altered growth, functional deficiency and death of the developing organism.
- Exposure to chemicals during pregnancy can result in defective development. The developing fetus is particularly sensitive to toxic chemicals during certain periods, generally related to the development of particular organ systems or types of cells. In humans, a critical phase for the induction of structural malformations is 20–70 days after conception.

Module No. 2 B 6

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 6 Endocrine disruption

Level: Advanced

Main points

- An endocrine disrupting chemical is an exogenous substance that changes endocrine function and causes adverse effects at the level of the organism, its progeny or subpopulations of organisms.
- These chemicals can block hormone signals affecting estrogenic and thyroid function. They can also block androgen receptors. The effects may be associated with behavioural changes, thyroid gland and fertility problems and cancers of the testes, prostate and breast.
- A battery of tests has been developed to assess the endocrine disrupting properties of pesticides and other compounds.
- Pesticides that have the potential to act as endocrine disrupting compounds are those with estrogen functions, like endosulfan, methoxychlor, dicofol and lindane; and those with thyroid function, like dicofol, pentachlorophenol and dinoseb.

Subsidiary point

- Endocrine-disrupting chemicals can mimic hormones, resulting in a signal stronger than the body's hormone, which might be sent at the wrong time.

Discussion points

- Is there enough evidence to link some pesticides with endocrine disruption?
- Which pesticides are they?

Training notes

- Rabbits treated with vinclozillin had significantly lighter accessory sex glands than untreated animals.

Module No. 2 B 7

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 7 Neurotoxicity

Level: Intermediate

Main points

- Neurotoxicity is an adverse change in the structure or function of the nervous system after exposure to a chemical, biological or physical agent. Adverse changes in the structure or function of the nervous system can result from single or repeated doses of a chemical.
- Neurotoxicity occurs when exposure to natural or man-made neurotoxicants alters the normal activity of the nervous system. This can eventually disrupt or even kill neurons, key cells that transmit and process signals in the brain and other parts of the nervous system.
- Neurotoxicity can result from exposure to pesticides, heavy metals, certain foods and food additives and industrial or cleaning solvents. The modes of action of many classes of pesticide, e.g. insecticides, indicate potential neurotoxicity.
- In view of the fundamental similarities between the vertebrate and invertebrate nervous systems, insecticides designed to attack the insect nervous system (organochlorines, pyrethroids, organophosphoruses and carbamates) are clearly capable of acute and long-term neurotoxic effects in humans.
- Symptoms may appear immediately after exposure or be delayed. They may include limb weakness or numbness; loss of memory, vision or intellect; headache; cognitive and behavioural problems; and sexual dysfunction.

Subsidiary point

- Reversibility of effect is a particularly important factor in the concern associated with a neurotoxic effect. Neurotoxic effects may be irreversible, i.e. cannot return to the state before exposure, resulting in a permanent change in the organism, or reversible, i.e. can return to the pre-exposure condition, allowing the organism to return to its normal state.

Discussion point

- Is there any treatment for neurotoxic effects?

Training notes

- Organophosphates inhibit destruction of a neurotransmitter, so that neurons are stimulated constantly and messages are transmitted repeatedly from one neuron to the next.
- Destruction of neurons results in a break in the communication between the nervous system and the rest of the body. The amount of function lost from damage

to the nervous system depends on the number of neurons permanently damaged and where they are located. Some neurons might be damaged only temporarily and, in time, can return to normal function.

- Permanent damage can result in loss of sensation and paralysis. It can also result in effects such as disorientation, in which a person cannot distinguish left from right or up from down. Because the nervous system controls many functions of the body, almost any function, such as speech, sight, memory, muscle strength and coordination, can be inhibited by neurotoxicants.

Module No. 2 B 8

Module: 2 Absorption and effects of pesticides

Subject: B Adverse effects

Number: 8 Immunotoxicity

Level: Intermediate

Main points

- Immunotoxicity is the ability of a substance to adversely affect the immune system and the immune response of affected individuals.
- Immunotoxic responses can occur when the immune system is the target of a chemical insult. This in turn can result in either immunosuppression and subsequent decreased resistance to infection and certain forms of neoplasia or immune dysregulation which exacerbates allergy or autoimmunity.
- Studies in experimental animals have shown that several pesticides have the potential to modulate the human immune system and also elicit contact dermatitis.
- Exposure to pesticides can result in a variety of interactions with components of the immune system, which range from modulation of functional immune responses to development of hypersensitivity.
- Experimental and clinical data clearly show that occupational exposure to some pesticides (e.g. captan and some carbamate and organophosphorus esters) induces contact hypersensitivity.

Training notes

- Allergies can have many manifestations, including hay fever, asthma, rheumatoid arthritis and contact dermatitis.
- The cause of allergies is a hypersensitivity response which occurs after exposure to some occupational and environmental agents. Antigens that cause allergic responses are called 'allergens'. Instead of initiating the production of typical antibodies, allergens stimulate B lymphocytes to produce sensitizing antibodies, called 'reagins'. When the reagin binds to the allergen, it causes an allergic reaction.
- When the immune system loses the ability to distinguish between the body's own cells and foreign cells, it attacks and kills host cells, resulting in serious tissue damage. This condition is called 'autoimmunity'. Although not as common as immunosuppression or allergy, occupational exposure to certain chemicals has been associated with autoimmune responses.



Personal Protection

Module 3: Personal protection

Subject A: Protection by hygiene

No. 1 Objective of protection	B
No. 2 Washing	B
No. 3 Eating and drinking at work	B
No. 4 Smoking at work	B
No. 5 Chewing at work	B
No. 6 Household pesticides	B

Subject B: Protection of the body

No. 1 Main part of the body	B
No. 2 Head and neck	B
No. 3 Lower legs and feet	B
No. 4 Hands	B
No. 5 Eyes	B
No. 6 Avoiding inhalation	B
No. 7 Washing clothing and equipment	B

Subject C: Protection according to task

No. 1 Responsibilities of supervisors	I
No. 2 Supervision in the field	I
No. 3 Knapsack spraying	B
No. 4 Pressurized hand spraying	B
No. 5 Mechanized spraying	B
No. 6 Dusting	B
No. 7 Mixing pesticide	B
No. 8 Bagging pesticide	B
No. 9 Maintaining equipment	I
No. 10 Acting as a flagman	I
No. 11 Pest control contractors	A
No. 12 Loading pesticide	B
No. 13 Piloting an aircraft applying pesticide	I

Educational objectives

A. Basic

Subject A: Should be able to describe the basic rules for personal protection by hygiene during use of pesticides in general and of household pesticides in particular.

Subject B: Should be able to describe in general how to protect the parts of the body during use of pesticides.

Subject C: According to the tasks of each trainee, should be able to describe the specific personal protection needed during knapsack spraying, pressurized hand spraying, mechanized spraying, dusting, mixing and bagging of pesticide.

B. Intermediate

See basic educational objectives.

Subject C: Should be able to apply the methods set out in subjects A and B to the tasks and to the use of types of equipment listed above, as well as supervising, maintaining equipment and acting as a flagman.

C. Advanced

See basic and intermediate educational objectives.

Subject C: Should be able to apply the methods set out in subjects A and B to specific occupations involving special hazards

Module No. 3 A 1

Module: 3 Personal protection

Subject: A Protection by hygiene

Number: 1 Objective of protection

Level: Basic

Main points

- It is important to avoid absorption of pesticides through skin, lungs, eyes and mouth.
- The objective of personal protection is to keep the exposure of workers handling pesticide as low as possible.
- Personal protection benefits the person who uses it.
- The type of protective clothing will depend on the hazards of the formulation, which are often listed on the label. Advice is often shown as pictograms.

Subsidiary points

- All workers should know the hazard of the work that they are required to carry out.
- It is the responsibility of the employer to provide correct information to workers. If special protective equipment is needed, the employer should provide it, instruct workers in its proper use, check that it is maintained and replace it if faulty.
- Individual items of special personal protection equipment (PPE) should be used only by the person to whom they were issued. The person using the PPE should keep a record of hours used and be trained in cleaning it, unless special maintenance is required. This is important when filters are to be replaced after a set period.
- Pesticides should be applied only with good, well-maintained equipment to reduce leaks and spillages. Although personal protection equipment is important, it is not infallible.

Discussion points

- Are workers aware of the importance of using personal protective equipment while handling pesticides?
- What sort of personal protective equipment is available for use in your country?
- Do local climatic conditions influence the use of protective equipment?

Training notes

1. Personal protective equipment is not the only control option. A hierarchy of control, i.e. a list of control measures, in order of priority, that can be used to eliminate or minimize exposure to hazardous substances, should be applied to

decide the best way to control risks. The steps in a hierarchy control are:

- *Elimination*: Exposure to a chemical can be eliminated by removing it from the work place or by reducing its use; e.g. use of a pesticide can be eliminated by manipulating the environment to remove the pest.
 - *Substitution*: A pesticide might be replaced by a less hazardous one. Choosing appropriate containers helps; e.g. using a less toxic or volatile pesticide or altering the physical form, such as replacing an emulsifiable concentrate by a granular formulation or encapsulated product, will reduce the handling risks.
 - *Isolation*: Pesticide use can be distanced from the rest of the work place or by placing a physical barrier between the process and persons; e.g. use separate areas for storing, mixing and preparing pesticides, with access limited to properly authorized employees, with storage in a separate building or fenced area.
 - *Engineering*: Engineering controls include the choice of application equipment, using pumps to transfer (liquid) pesticides instead of pouring, and changing nozzles to control droplet size or spray pattern.
 - *Administration and work practices*: These controls are planned to manage risks and include work restrictions, taking wind and weather conditions into account and deciding who does the work and who has access to the work and storage areas.
 - *Personal protective equipment*: This should be relied on only when it is not possible to control exposure by one or more of the above measures.
2. The safety precautions for professional spray staff working in the tropics might depend largely on personal hygiene, including washing and changing clothes. A drill for carrying out and supervising personal hygiene, regular washing of protective clothes and cleaning equipment should be organized along the following lines:
- Spray staff should be given at least two uniforms to allow for frequent changes.
 - Washing facilities with sufficient water and soap should be made available in the field at appropriate locations.
 - All work clothes should be removed at the end of each day's operations and a shower or bath taken.
 - Work clothes must be washed regularly, the frequency depending on the toxicity of the formulation used.
 - Particular attention should be given to washing gloves, as wearing contaminated gloves can be more dangerous than not wearing gloves at all.
 - Spray operators must wash before eating.
 - Eating and smoking during work must be strictly forbidden.
 - When relatively toxic insecticides are being used, the hours of work must be limited so that exposure is not excessive; transport should be arranged to ensure minimal delay between the end of the day's operations and return to base for washing.
3. For some pesticides, washing with soap can increase dermal absorption from contaminated skin. This underlines the importance of avoiding exposure.

4. Some countries require that the equipment used should be designed to minimize exposure and thus reduce the use of personal protective equipment, e.g. use of low-level induction hoppers to make filling a sprayer safer.

Module No. 3 A 2

Module: 3 Personal protection

Subject: A Protection by hygiene

Number: 2 Washing

Level: Basic

Main points

- Spray operators should always have a ready supply of water available, so that any pesticide can be washed off the skin immediately.
- Hands, arms and face should always be washed after spraying and especially before eating, drinking, smoking, travelling back to base or urinating.
- A thorough bath or shower should be taken the end of a work day.
- Hand spray operators should wash their hands and arms each time the pump is refilled.
- If the skin is contaminated with pesticide, it should be washed immediately with copious amounts of clean water, preferably with soap if the formulation is oily.

Subsidiary points

- Clean water should be used for washing. If the water supply at the application site is not adequate, water should be stored in a clean drum.
- If practicable, the water used for hand and arm washing should be collected and disposed of in the same manner as the water used for washing equipment or use it for mixing (see **Module 4F2**).

Discussion points

- Is there any difficulty in arranging for the supply and disposal of water for washing?
- Why is it necessary to collect the wash water?

Training notes

- A mild alkaline soap is preferable for removing pesticides from the skin.
- Detergents should be avoided, as the surfactant they contain can increase skin absorption.

Visual aids



Module No. 3 A 3

Module: 3 Personal protection

Subject: A Protection by hygiene

Number: 3 Eating and drinking at work

Level: Basic

Main points

- Workers should not eat or drink while handling pesticides.
- Workers should wash their hands, arms and face with clean water, preferably with soap, before eating or drinking.
- If food is brought to the field, it should be kept in a container with a tightly fitting lid.
- In very hot climates, workers must drink at intervals. A supply of drinking-water should be readily available but well protected from exposure to the pesticide. Workers should wash their hands, arms and face with clean water and soap before drinking.

Discussion point

- Why should you not eat or drink while working with pesticides?

Visual aids



Module No. 3 A 4

Module: 3 Personal protection

Subject: A Protection by hygiene

Number: 4 Smoking at work

Level: Basic

Main points

- Workers handling any pesticide should not smoke while at work.

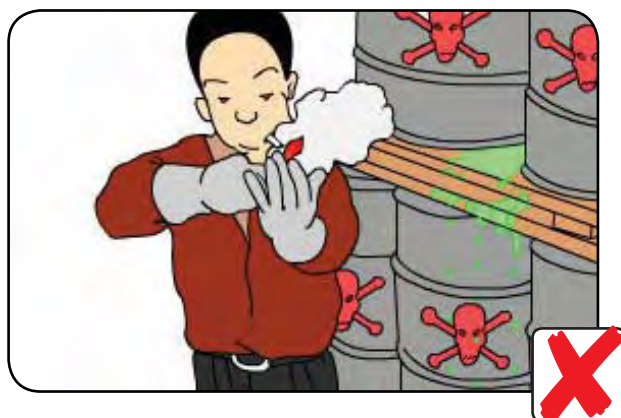
Discussion points

- If a worker smokes at work, by which route is the pesticide likely to be absorbed?
- What are the hazards associated with smoking?

Training notes

- When a cigarette contaminated with pesticide is smoked, not only can the pesticide be absorbed through the skin of the lips and mouth but other hazardous compounds might be formed when the pesticide is partly burnt in the cigarette and inhaled.

Visual aids



Module No. 3 A 5

Module: 3 Personal protection

Subject: A Protection by hygiene

Number: 5 Chewing at work

Level: Basic

Main points

- Workers handling pesticides should not chew while at work.

Discussion points

- What are the chewing materials commonly used by workers in your country?
- What are the hazards of chewing materials containing tobacco or betel nut?

Training note

- This module is intended for use in countries where betel nut and other materials are chewed.

Module No. 3 A 6

Module: 3 Personal protection

Subject: A Protection by hygiene

Number: 6 Household pesticides

Level: Basic

Main points

- If pesticides are needed at home, only approved household pesticides should be used.
- Household pesticides should be sold to the general public in properly labelled containers.
- These simple precautions should be followed during use of pesticides at home:
 - Store pesticides away from children and domestic animals, ideally locked away.
 - Store pesticides separately from food, medicines or personal hygiene products.
 - Read and follow the directions for use on the label.
 - Cover all food, crockery and cooking and eating utensils before spraying.
 - Use vaporizers and mosquito coils only in well-ventilated rooms.
 - Always wash hands with water and soap after using pesticides.
 - Do not use unlabelled or unregistered pesticides

Subsidiary points

- ‘Household pesticides’ sometime includes pesticides sold for use in gardens. These may be concentrated formulations, which must be diluted before use. These pesticides should not be used on any crop or for any pest that is not mentioned on the label, and only the recommended concentrations should be applied. Concentrates might be hazardous, and the precautions on the label should be taken.
 - Care must be taken not to spray any food crops during the pre-harvest interval, i.e. the time immediately before harvesting, which is specified on the label. Particular care must be taken with respect to crops with several harvests, e.g. tomatoes.
 - Some pesticides can affect non-target species, such as fish and bees. The most serious contamination of water arises during cleaning of equipment and containers, when small amounts of concentrate can affect a large volume of water. Water used to rinse containers should be used to dilute a sprayer load.
 - The pesticides sold for domestic use must be the least hazardous. The precautions specified on the label must be taken.

Discussion points

- What types of household pesticides are available in your country?
- What types of chemicals occur commonly in these products?
- Are there unlabelled household pesticides in your country?
- What precautions should you take when spraying pesticides at home?

Visual aids



Module No. 3 B 1

Module: 3 Personal protection

Subject: B Protection of the body

Number: 1 Main part of the body

Level: Basic

Main points

- The main part of the body should be protected by covering as much skin as possible with suitable material to prevent pesticides from contaminating the skin: overalls or a shirt with long arms and trousers (not shorts). These cover about 85% of the skin.
- Clothing made of washable cotton without holes is adequate for many pesticides (check the label). It should be worn with the front zipped or buttoned up to the neck while working. The label may state that a chemical resistant suit is required, for example for pesticides formulated in solvents other than water. This can be a problem in a hot climate: beware of heat stress.
- If clothing becomes soaked with pesticide during application, absorption will increase, and the clothing should be changed immediately. A plastic apron or tabard is useful for protecting cotton overalls. Rubber or polyvinyl chloride (PVC) aprons protect the clothing from spills of liquid concentrates.
- Care must be taken to avoid contaminating any pockets with pesticide, especially in trousers, as the skin around the groin is very absorptive.

Subsidiary point

- Pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided, especially in the case of small-scale users in tropical climates. Preference should be given to pesticides that require inexpensive personal protective and application equipment and to procedures appropriate to the conditions under which the pesticides are to be handled and used.

Training note

- Wearing protective gear in a hot climate can cause heat stress. The signs may be similar to pesticide poisoning: e.g. fatigue, headache, nausea, dizziness, fainting, thirst, altered behaviour. When this occurs get medical help. The person affected should be kept cool and quiet and drink and have his/her skin sponged with cool water. Heat stress can be avoided by working at the coolest time of the day, in the shade, drinking water, using a fan, resting, choosing the coolest possible protective gear.

Discussion points

- Describe the type of clothing worn in your country during application of pesticides.

- What are the advantages and disadvantages of each type of clothing, and which is the best?
- Comment on the video.

Visual aids



Module No. 3 B 2

Module: 3 Personal protection

Subject: B Protection of the body

Number: 2 Head and neck

Level: Basic

Main points

- The head and neck must be protected during use of pesticide sprays. Overalls may have an integral hat.
- The head should be protected with a hat, as hair can filter spray droplets. Hats also protect operators from the sun. Hats should be of impermeable material with a broad brim to protect the face and neck and should be able to withstand regular cleaning or be replaced regularly.

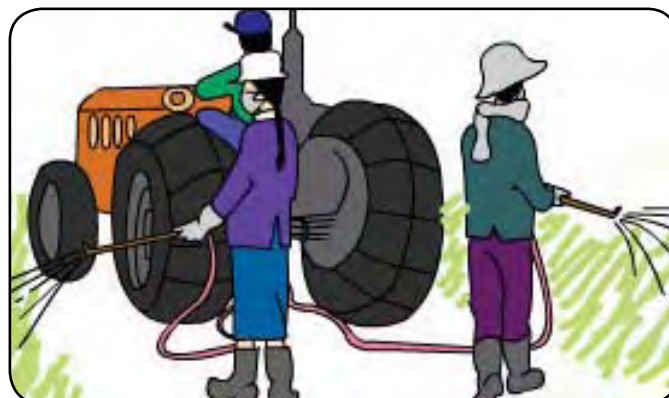
Subsidiary points

- Pest control operators applying highly hazardous liquid formulations should wear a full head covering made of impermeable material and incorporating a transparent panel. This should be worn loose over the shoulders and not tucked into clothing.
- An independent air supply is needed for fumigation.
- Hard hats might be needed for some tasks.

Discussion points

- What are the best ways to avoid ingesting pesticides through the mouth during spraying?
- When should the mouth be covered during spraying?

Visual aids



Module No. 3 B 3

Module: 3 Personal protection

Subject: B Protection of the body

Number: 3 Lower legs and feet

Level: Basic

Main points

- The skin of the lower legs and feet can be contaminated during pesticide application, especially during spraying, or walking through vegetation that has recently been sprayed.
- Pesticides must not be applied by persons with bare feet or wearing open sandals.
- The best protection is PVC boots, which are impermeable. Trouser or overall legs should be worn outside the boots to prevent splashes of pesticides from entering the boots.
- Walking through recently sprayed areas should be avoided, if possible.

Subsidiary points

- If boots are not available, other shoes that cover the feet can be worn, provided that they are in good condition, and the legs of the overalls or trousers cover the tops of the shoes.
- For some tasks, especially in forestry, safety boots with a steel toe inset might be needed.
- After work, the outer surface of the boots should be washed with water. If the boots or shoes are made of canvas or have been splashed, the insides should also be washed and boots stood upside down to dry.
- Each person should have his or her own footwear.

Discussion point

- Why should trousers not be tucked into boots?

Visual aids



Module No. 3 B 4

Module: 3 Personal protection

Subject: B Protection of the body

Number: 4 Hands

Level: Basic

Main points

- Hands must be protected by gloves during handling of concentrate (depending on packaging), while applying hazardous formulations and when washing or maintaining pesticide application equipment.
- Gloves should be in good condition, without holes, and be long enough to reach the forearm.
- As mechanics may not wear gloves while repairing spray equipment, they need special instructions about washing out equipment and making sure no pesticide is left in pumps, tubing and other machine parts and about washing their hands after touching such equipment. Supervisors should inform mechanics or technicians if the technical product used in the equipment is more than slightly hazardous and should tell them to handle contaminated parts with gloves, until they can be decontaminated.

Subsidiary points

- Gloves with holes should be changed immediately. Leather or fabric gloves should never be used. PVC or rubber gloves or gauntlets should be used when handling concentrates. PVC gloves should not be used to handle pyrethroids, which can be absorbed by PVC; rubber gloves should be used to handle concentrates with an organic solvent base. Impervious gloves must be cleaned regularly, inside and out.
- Gloves should be washed at least daily or whenever removed, inside and out. They should be washed before removal to avoid contamination while taking them off.
- The wearing of gloves in no way reduces the need to wash the hands before eating, drinking, chewing or smoking. The skin of the hands may become contaminated when gloves are put on or taken off.
- Disposable gloves wear out very quickly and are not suitable unless they are more than 0.4 mm thick. If used, they must be disposed of safely, in the same way as plastic bags that have contained pesticides (*see Module 4F4*)

Discussion point

- Comment on the video.

Training notes

- Ideally, sleeves should be worn outside the tops of gloves, in the same way as trousers should be worn over boots, and for the same reasons. This is often impracticable, however, as the ends of sleeves are too narrow.
- The danger of splashing with hazardous formulations can be minimized by wearing gauntlet gloves. In the tropics and in many developing countries, few workers can afford suitable gloves; however, damaged gloves are worse than none.

Visual aids



Module No. 3 B 5

Module: 3 Personal protection

Subject: B Protection of the body

Number: 5 Eyes

Level: Basic

Main points

- Always protect the eyes when mixing or loading pesticides or when spraying at high levels.
- The three ways of protecting the eyes are:
 - Use of a visor, a curved sheet of transparent plastic attached to a hat or headband that covers the whole face. This is quite comfortable to wear and necessary with Class 1 pesticides or when mixing large quantities or spraying foliage at a level above the operator's chest
 - Use of goggles that fit tightly around or over the eyes. This is quite uncomfortable.
 - Use of safety spectacles when neither of the above is available.

Subsidiary points

- All eye protection equipment must be kept clear and the outside washed and wiped with a soft rag if the vision becomes blurred.
- The equipment and the rag should be carefully washed at the end of work each day.
- Plastic visors and goggles should not be placed on rough surfaces, as plastic can easily be scratched.
- Badly scratched or damaged equipment must be replaced as soon as possible before it starts to induce eye strain.

Discussion point

- Comment on the video.

Visual aids



Module No. 3 B 6

Module: 3 Personal protection

Subject: B Protection of the body

Number: 6 Avoiding inhalation

Level: Basic

Main points

- An independent air supply is needed for fumigation.
- A respirator should be worn to avoid inhalation of dusts, vapours and gases. Workers applying vapours and gases must have special training
- During spraying of slightly hazardous formulations, a lightweight disposable face mask covering the mouth and nose may be used. Such masks must be replaced when they are contaminated and disposed of at the end of each day's spray operation.
- During application of more volatile or toxic pesticides, a mask with filters should be used.
- Extra precautions should be taken during use of a moderately or severely hazardous formulation. The risk of inhalation is greater when a fine spray is applied inside buildings or when there is no wind and the operator walks into the spray. Outdoors, the wind usually carries small inhalable droplets away from the operator, but care must be taken to ensure that others (bystanders) are not downwind of the spray.

Subsidiary points

- Respirators must:
 - be fitted with the proper type of canister, which must be replaced regularly in accordance with the instructions on the canister;
 - fit closely around the mouth and nose;
 - be washed daily after removal of the canister and dried;
 - be kept in a clean plastic bag when not in use;
 - be inspected regularly; and
 - be worn only by persons trained in their use.
- Respirators can be worn for only short periods in hot climates.

There are different types of filter-cartridges for organic vapours and dusts and for combination filters. Certain filters are not suitable for protection against toxic dusts.

Discussion points

- Why is it important to avoid inhaling pesticides?
- Why should a mask be used instead of a cloth over the mouth?

- Comment on the video.

Training notes

Practical exercise: putting on and taking off protective gear could be included in the training programme

Visual aids



Module No. 3 B 7

Module: 3 Personal protection

Subject: B Protection of the body

Number: 7 Washing clothing and equipment

Level: Basic

Main points

- Proper personal protection is not complete unless all equipment and work clothing is washed at the end of each working day. Dirty water should be disposed of very carefully to avoid contamination of local sources of drinking-water or streams and rivers where fish and other organisms could be adversely affected
- After equipment and clothes have been washed, they should be rinsed in clean water and spread or hung out to dry.
- Work clothes should never be washed with domestic clothing.

Subsidiary points

- The water used for washing will often be contaminated with pesticide and must therefore be disposed of properly (*see* **Module 4F2**). If the washing has been done properly, rinse water can be disposed of like any other waste water.
- Clothing and equipment should never be washed in running water, as the stream or river might be used lower down for drinking or swimming. Fish close to the washing point can also be affected or killed.

Discussion points

- How do you protect your hands when washing contaminated clothing?
- What danger is associated with not washing work clothes?

Training note

- For disposal of wash water, *see* **Module 4F2**.

Visual aids



Module No. 3 C 1

Module: 3 Personal protection

Subject: C Protection according to task

Number: 1 Responsibilities of supervisors

Level: Intermediate

Main points

During pesticide application, all persons responsible for the operation must know:

- the hazard classification of the formulation being used;
- the precautions that must be followed by the applicators;
- whether any special protective clothing and equipment should be provided; and
- the facilities required for hygienic protection of applicators and for care and maintenance of the equipment.

Subsidiary points

- The basic precautions outlined in **Module 3B** must be observed.
- Pesticide application must always be planned with care, even if the pesticide presents a low hazard.
- Applicators who have worked with a pesticide of very low hazard for a long time without any problems can become careless. If a pesticide with a higher hazard is later substituted without all those handling it being informed or warned, careless use can lead to serious exposure.
- Properly maintained and calibrated application equipment must be used.

Discussion points

- What are the minimum precautions to be followed?
- Comment on the video.

Visual aids



Module No. 3 C 2

Module: 3 Personal protection

Subject: C Protection according to task

Number: 2 Supervision in the field**Level: Intermediate****Main points**

- Field supervisors must set an example to workers. They can then insist that the workers follow safe practices.
- Supervisors must ensure that workers wear all the protection needed for the operation, even during training sessions.
- In the field, the supervisor must always wear appropriate protection.
- The supervisor is responsible for seeing that washing water is available; workers wash before drinking, eating, chewing or smoking; and clothing and protective equipment are washed at the end of each day.
- The supervisor should check application equipment frequently to see that it is operating efficiently and is not leaking. Damaged and leaking equipment should never be used.

Subsidiary point

- Supervisors should also follow all the rules of hygiene for their own protection, especially washing before eating.

Visual aids

Module No. 3 C 3

Module: 3 Personal protection

Subject: C Protection according to task

Number: 3 Knapsack spraying

Level: Basic

Main points

- A common fault that workers commit is to spray in front of themselves and then walk through the wet vegetation. The wand must always be held so that the spray is applied at the side of the sprayer, with the wind blowing away and at right angles in the direction of walking.
- The body and feet must be protected. A blocked nozzle should never be cleared by blowing through it. It should be replaced by a clean nozzle, and the blocked nozzle should be soaked before cleaning. A bicycle pump can be used if necessary to blow air through, or a soft brush. Never use a wire or hard item that can damage the nozzle
- Ultra-low-volume (ULV) spraying, and all knapsack spraying, should be done downwind.

Subsidiary points

- Motorized or hand-pumped knapsack sprayers are usually used for low-level spraying. The equipment chosen should meet national or international (e.g. WHO and FAO) quality standards.
- Hose connections should be checked regularly to prevent leaks wetting the back of the clothing. If this happens, the wet clothing must be changed immediately, and the worker should shower or bathe as soon as possible.

Discussion point

- Have you experienced any problems with spray equipment?

Training notes

- Details of body and foot protection are given in subject B of this module.
- The protection to be provided should be modified if more than slightly hazardous formulations are to be applied.

Module No. 3 C 4

Module: 3 Personal protection

Subject: C Protection according to task

Number: 4 Pressurized hand spraying

Level: Basic

Main points

- Pressurized hand sprayers are usually used to spray residual pesticides in and around houses for controlling pests of public health importance and for applying larvicides to water. Regular protection must be worn for the body and feet.
- As the spray is sometimes directed upwards, under the eaves of a house, a wide-brimmed hat is needed.
- A blocked nozzle should never be cleared by blowing through it.

Subsidiary point

- Before a house is sprayed, all food, cooking utensils and bedding must be covered or moved outside.

Discussion point

- What parts of a pressurized sprayer need regular checking and maintenance?

Training note

- A residual pesticide is a formulation sprayed onto a surface and intended to retain its activity for weeks or months.

Visual aids



Module No. 3 C 5

Module: 3 Personal protection

Subject: C Protection according to task

Number: 5 Mechanized spraying

Level: Basic

Main points

- Mechanized sprayers are used mainly for applying pesticides to ground crops, at a high level to trees and to generate fogs and mists in cities to control pest insects.
- Both driving and loading a mechanized sprayer can be hazardous, depending on the formulation used. Fire extinguishers might be essential with some equipment, such as thermal foggers
- All workers must wear body and foot protection, and loaders must wear visors, plastic gloves and plastic aprons.
- For high-level application, full waterproof protection, including a hat and a visor, is needed if the operator is not in a fully enclosed cab.

Subsidiary points

- During fogging or misting, workers should cover their mouths and noses, and operators of fogging equipment should have proper masks.
- When moderately or highly hazardous pesticides are used, a respirator might be needed.

Training notes

- Some points made in the modules on loading aircraft (**3C12**) are also relevant to loaders of mechanized sprayers, and some of the points on piloting agricultural aircraft (**3C13**) are applicable to operators working in cabs.

Visual aids



Module No. 3 C 6

Module: 3 Personal protection

Subject: C Protection according to task

Number: 6 Dusting

Level: Basic

Main points

- Dusting involves application of a pesticide in a powder formulation, by a hand-operated or motorized distributor. In this application, dust clings to the clothing and to sweaty skin, and therefore the body and feet must be protected, and a light disposable dust mask should be worn.

Subsidiary points

- Workers should apply dust in a way that avoids direct contact with the dust clouds.
- The application line should be chosen so that the wind blows away from the operator.
- Granule formulations reduce the risk of exposure by inhalation, but friction among the granules during transport results in some dust. Precautions should be taken accordingly.
- In many countries, gels are used, as they are easier and safer to handle.

Discussion point

- In this module, use of a slightly hazardous dust formulation is assumed. If the formulation is more hazardous, more comprehensive protection will be needed for the head, hands, eyes and lungs.

Module No. 3 C 7

Module: 3 Personal protection

Subject: C Protection according to task

Number: 7 Mixing pesticide

Level: Basic

Main points

- Mixing of pesticides involves dilution of a concentrated formulation to prepare a solution for application. It does not mean mixing two separate pesticide formulations, which is an unacceptable practice unless it is clearly stated on the label that the two formulations are compatible.
- The hazard to the mixer is greater than that to the applicators. Therefore the mixer needs more protection of the body, feet, hands and eyes.
- A plastic apron should be worn when the mixture is poured into the application equipment.
- A paddle or stirrer should be used for mixing. The bare hands should never be used.

Subsidiary points

- Water must be available for washing pesticide splashes off the skin and eyes.
- The mixer must also wear protection when disposing of empty concentrate containers.

Discussion point

- What precautions and practices should be observed by workers when mixing pesticides?

Visual aids



Module No. 3 C 8

Module: 3 Personal protection

Subject: C Protection according to task

Number: 8 Bagging pesticide

Level: Basic

Main points

- In large-scale vector control campaigns, a solid formulation must sometimes be weighed and bagged in quantities suitable for transport to the field for dilution at the point of application. Each amount weighed should be sufficient for one pump charge. This procedure should be carried out under the supervision of a qualified person.
- Bagging must be carried out in well-lit, well-ventilated conditions.
- The identity of the chemical product must be displayed on the bag.
- The body, feet and hands should be protected, and a light dust mask should be worn.
- Use of prepared soluble sachets or tablets is preferred as it minimizes the risks.

Subsidiary points

- The bagging area should be kept clean. The floor should be dampened before spilled pesticide is swept up. Dry sweeping should not be allowed at any time.
- The outside of bags should not be touched with contaminated gloves.
- Each bag must be securely closed with a tie to prevent any spillage.
- Bags must be labelled, and a careful count must be made of the number of bags taken each day to the field. At the end of the day, all bags should be accounted for, and the empty bags should be taken back to the base for disposal.

Training note

- Disposal of contaminated soil, unwanted pesticide and empty bags is described in **Module 4**, *Subject F*.

Module No. 3 C 9

Module: 3 Personal protection

Subject: C Protection according to task

Number: 9 Maintaining equipment

Level: Intermediate

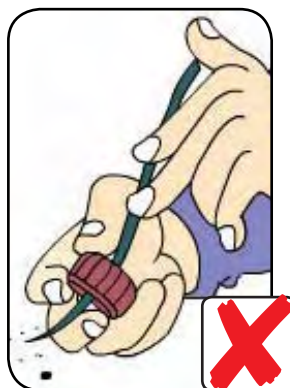
Main points

- Maintenance technicians service not only pesticide application equipment but also vehicles and other machinery associated with the equipment. Some parts can be heavily contaminated with pesticide. Technicians are often forgotten workers, although they might be at greater risk than some applicators.
- The main hazards for maintenance technicians arise from exposure to residues of pesticide formulations in tanks and hoses and to parts coated with dried pesticide residues. Dried residues might present a higher risk than the original formulation if they are handled or heated.
- The supervisor should inform technicians if the technical product of the pesticide used in the equipment is more than slightly hazardous.
- Technicians should handle highly contaminated parts with gloves until the parts can be decontaminated.

Subsidiary points

- Technicians should wash their work clothes daily after servicing pesticide application equipment and should follow the other rules of hygiene.
- Liquid residues and washings should be collected and given to pesticide applicators for environmentally sound disposal. They should not be poured down drains.

Visual aids



Module No. 3 C 10

Module: 3 Personal protection

Subject: C Protection according to task

Number: 10 Acting as a flagman

Level: Intermediate

Main points

- Although it is not recommended, flagmen are sometimes employed during aerial pesticide spraying. They do not apply pesticides but hold a flag at the point where the aircraft should begin its next spraying run. In this position, flagmen are at serious risk of being sprayed by the aircraft as it begins its run. If this happens several times during a day, flagmen can have substantial exposure. Flagmen should always move upwind to avoid spray drift. Priority should be given to use of a global positioning system.
- The alternatives to use of flagmen include positioning of balloons or flags on poles between aircraft runs and use of a global positioning system. Nevertheless, all workers on the ground during aerial application must have basic body, foot and head protection.

Subsidiary point

- If the formulation being applied presents more than a slight hazard, lung protection is also required.

Discussion points

- Is there a specific type of personal protection that can reduce the health risks to flagmen?
- Why is use of flagmen not recommended?

Module No. 3 C 11

Module: 3 Personal protection

Subject: C Protection according to task

Number: 11 Pest control contractors

Level: Advanced

Main points

- Pest control operators are engaged contractually to control pests in warehouses, food premises, homes, farms and other places where a particular problem might arise. They may use highly hazardous pesticides.
- Pest control contractors must be licensed, and they must ensure that operators are licensed as required and undergo full training and re-training.
- Pest control operators must be aware of the hazard classification of the pesticides to be handled and use suitable protective equipment.
- The manufacturer's instructions must be followed, without any short cuts.
- The label indicates the type of protection needed, and this should always be used.
- Work clothes should not be washed with domestic clothing.
- Protective equipment should be washed at the work place.

Subsidiary points

- Pest control operators have a particular responsibility to dispose of unwanted pesticide and used containers in an environmentally sound manner and in accordance with existing national policies.
- Pest control operators must not give samples of the pesticides they use in the course of their work to friends or other persons.

Discussion points

- Does your country have regulations that control the commercial use of pesticides?
- Do pest control operators in your country have to take a course in techniques and protection before being allowed to work? If not, would this be useful?

Module No. 3 C 12

Module: 3 Personal protection

Subject: C Protection according to task

Number: 12 Loading pesticide

Level: Basic

Main points

- Loading pesticide from a drum or other container in which it has been mixed into the hopper of an aircraft or a mechanized applicator can be hazardous. Heavy exposure can occur if a hose is punctured or bursts during loading or if it leaks at its joints at either end. Lesser but more frequent and substantial exposure can occur each time the hose is disconnected from the inlet to the hopper.
- Loaders should have a high standard of protection at all times, with body, foot and hand protection and a plastic apron. Eye protection with a visor is needed. Head protection might be needed if the loading point is high.
- The label should be consulted for guidance about personal protective equipment.

Subsidiary points

- Sufficient water for washing should be provided in the loading area.
- Clothing that becomes soaked must be removed immediately, and the worker should wash contaminated skin or shower as soon as possible.
- Care must be taken not to overfill hoppers, causing spillage.
- Persons loading aircraft must clearly understand their task in order to avoid overloading.
- Loading sites must be selected with care to avoid exposure of humans, animals and water courses to pesticides spilled at the time of loading or later.

Training notes

- Loaders risk massive exposure, so that full protection (as outlined above) should be used during loading of any pesticide formulation, diluted or not. If necessary, loaders who are handling pesticides, and especially organophosphorus compounds, for many days should be monitored.
- Non-pesticidal components of formulation can also be hazardous or locally irritating if massive exposure occurs.

Module No. 3 C 13

Module: 3 Personal protection

Subject: C Protection according to task

Number: 13 Piloting an aircraft applying pesticides

Level: Intermediate

Main points

- The pilot of an aircraft applying pesticides must have full, relevant training in the risks and hazards of pesticides. He or she must know the type of pesticide and the hazard classification of the formulation.
- The pilot must ensure that flagmen, non-target crops and surrounding areas are not over-sprayed.
- The pilot must avoid all contact with the pesticide, as far as possible, by:
 - wearing appropriate body and foot protection;
 - avoiding contaminated dust in the cockpit by not walking in the mixing area or in other places where the pesticide might have been spilled;
 - keeping the ventilators in the deck area of the cockpit closed while flying the aircraft to avoid suspending tramp dust in the air entering the cockpit; and
 - taking care not to fly back through recently sprayed areas, but flying upwind of the previous track.

Subsidiary points

- Pilots should follow the rules for protection by hygiene.
- Pilots should take particular care when working with organophosphorus compounds, as many have local effects on the eyes, even when exposure is so low as to produce no other adverse effects. Impairment of visual accommodation might result in blurred vision and inability to judge distances correctly. The eyes should be washed with clean water.
- Maintenance engineers should be warned that an aircraft has been used for applying pesticides and advised to take precautions in handling contaminated parts. The outside of the aircraft can be contaminated if it has not been washed.
- Pilots should not load their own planes; if there is no alternative, they must take care to use all the protective measures required for loaders on every occasion.



Protecting the Environment and the General Public

Module 4: Protecting the Environment and the General Public

Subject A: Necessity to protect the environment and the general public

No. 1 Adverse effects on the environment	B
No. 2 Adverse effects on the general public	B
No. 3 Specially sensitive areas and resources	B/I

Subject B: Unintentional pesticide release or exposure

No. 1 Sources	B
No. 2 Environmental pathways and fate of pesticides	I

Subject C: Judicious use of pesticides, integrated pest and vector management and food safety

No. 1 Integrated pest and vector management	B
No. 2 Food safety	B/I

Subject D: Protective measures during transport, storage and distribution

No. 1 Transport by truck or boat	B
No. 2 Storage (general)	B
No. 3 Storage in a warehouse	I
No. 4 Security of storage	I
No. 5 Household storage and use of pesticides	B
No. 6 Distribution of pesticides	I

Subject E: Protecting the environment and the general public during and after application

No. 1 Timing of application to avoid movement of pesticides and exposure of animals and people	B
No. 2 Choosing the pesticide and application equipment, reading the label, using the correct amount	B
No. 3 Protective measures during handling	B
No. 4 When a spill occurs	B
No. 5 Exclusion from sprayed crops	B

Subject F: Protective measures during disposal of pesticide containers, wash water, leftovers and spills

No. 1 Disposal of containers	B
No. 2 Disposal of wash water	B
No. 3 Preventing stocks of excess pesticide	B
No. 4 Disposal of pesticides and contaminated wastes	B
No. 5 Inappropriate disposal practices	I
No. 6 Disposal of obsolete pesticides	I

Educational objectives

A. Basic

Subject A: Should be able to explain why the environment and general public should be protected from pesticides; to describe the adverse effects that pesticides can have on the environment; to explain how pesticides can affect the general public; to list areas and resources that are particularly sensitive to pesticides

Subject B: Should be able to explain when pesticides can be released and affect the environment and the general public.

Subject C: Should be able to describe how adverse effects on the environment and general public can be prevented by using integrated pest or vector management.

Should be able to explain how pesticide residues get into food and how to prevent the concentrations of residues from exceeding the maximum allowed levels.

Subject D: Should be able to list protective measures for the environment and the general public during transport by truck or boat, storage of pesticides and household use of pesticides.

Subject E: Should be able to list protective measures for the environment and the general public before, during and after application of pesticides, in particular,

Before: timing of application, choice of pesticides, interpreting the label, preparing the correct amount, choosing correct application equipment

During: mixing, filling and washing equipment and what to do when a spill occurs

After: preventing re-entry into the sprayed area.

Subject F: Should be able to describe how to diminish disposal problems by preventing accumulation of excess pesticides and describe protective measures for the environment and the general public during disposal of containers, wash water, pesticides and contaminated wastes.

B. Intermediate

See basic educational objectives.

Subject A: Should be able to describe how to protect areas and resources that are particularly sensitive to pesticides.

Subject B: Should be able to explain how pesticides move out of the target area and how to prevent this.

Subject C: Should be able to describe integrated pest and vector management and list reasons for adopting these procedures.

Should be able to explain the meaning of ‘maximum residue limits’ and ‘acceptable daily intakes’ and describe what the JMPR does.

Subject D: Should be able to describe protective measures for the environment and the general public during storage of pesticides in a warehouse and during distribution of pesticides.

Subject F: Should be able to explain why certain disposal practices are inappropriate and describe where to find guidelines on disposal of obsolete pesticides.

Note to the trainer

New modules on national requirements for the transport and storage of pesticides and protection of water sources might have to be introduced into this module.

Module No. 4 A 1

Module: 4 Protecting the environment and the general public

Subject: A Necessity to protect the environment and the general public

Number: 1 Adverse effects on the environment

Level: Basic

Main points

- Pesticides are used to kill living organisms that are pests. They are toxic and can also adversely affect non-target organisms, including aquatic organisms, such as edible fish and seaweed; and terrestrial organisms, including beneficial insects like honey bees, silk worms, butterflies and other pollinators vital for food crops, and poultry and other farm animals (as well as human beings).
- Pesticides can also affect local ecosystems by disrupting natural ecological balances, for example by decimating a certain species on which the survival of others depends.
- Pesticides can also affect predatory insects and other animals, resulting in initiation or increase of secondary pest infestations (*see* section on integrated pest management, 4C1). For example, certain fungicides kill earthworms, which help to maintain a good soil structure, paradoxically leading to more attacks of plant disease than before treatment.
- Relevant instructions for the protection of non-target species are provided on the labels of pesticide products, and these must be strictly adhered to by users and applicators in order to minimize effects on the environment (and humans).

Subsidiary points

- In order to handle and apply a pesticide with the least impact on the environment, both the toxicity and the fate of the pesticide once it has been released to the environment must be understood.
- Before a chemical can be used as a pesticide, it must first be tested to determine its toxicity and behaviour in the environment. Depending on the results, industry and regulatory authorities will decide on how and what it can be used for and the information that must be given on the label.
- Low levels of pesticides in the environment can affect many different kinds of living creatures, including humans. For example, studies on predatory birds, aquatic mammals (e.g. dolphins and whales) and laboratory rodents have shown effects on reproduction, the endocrine and immune systems and cancer induction.

Discussion points

- Do the trainees use pesticides that are highly toxic to aquatic organisms?
- Are the areas usually treated with pesticides close to surface water?

- Are there areas in the region or country where beneficial insects are kept?
- Do the labels on the pesticides used by the trainees contain instructions relevant to environmental protection?

Training notes

- A water-soluble pesticide that is highly toxic to fish must never be used close to waterways.
- A pesticide that affects beneficial bees or silk worms should never be used in areas where these insects are kept.
- One example of an adverse effect of insecticide use is decimation of predatory insects that eat mosquito larvae in rice fields. While mosquito larvae are also affected, the predator populations will require much longer to recuperate, giving mosquitoes time to multiply and transmit diseases like malaria.
- Another example is use of DDT, which almost eliminated predatory birds in several regions in the 1970s. These birds play a role in containing rodents and other small animal pests, such as quelea weaver birds which eat crops in Africa.
- The trainer should show samples of labels warning against environmental hazards and giving instructions relevant to environmental protection. Trainees should be asked to bring labels of the pesticides they are using.

Visual aids



Dangerous/harmful to fish



Do not contaminate lakes, rivers, ponds or streams

Module No. 4 A 2

Module: 4 Protecting of the environment and the general public

Subject: A Necessity to protect the environment and the general public

Number: 2 Adverse effects on the general public

Level: Basic

Main points

- Unintentional exposure of the general public to pesticides can occur in various ways, to various degrees. Exposure can occur at any point in a pesticide's life cycle, from production, transport, use and storage through disposal. Exposure can be accidental, occupational, environmental or due to misuse.
- Contamination of food with pesticides, mistaking pesticides for food or drink and mixing pesticides with food are examples of accidental poisoning. Outbreaks of poisoning have occurred after accidental contamination of food with pesticides.
- Misuse is improper or incorrect use of pesticides, which can lead to poisoning of people and animals. Agricultural pesticides should never be used or kept in dwellings. Incorrect application of pesticides results in high concentrations of pesticide residues.
- Exposure can be acute or long-term. Exposure to a pesticide can occur over a short period or can be continuous or repeated. Passive non-occupational exposure could result from contamination of food, water, soil or air with pesticides. Living on a farm or in an agricultural area where pesticides are frequently and heavily used confers a high risk for exposure.
- Children and pregnant women are particularly vulnerable. A pregnant woman's intake and body burden of pesticides is transferred across the placenta.

Subsidiary point

- While pesticide workers are adults and are usually healthy, the community also includes the very young, the very old and the sick, all of whom are more likely to be affected by doses of pesticide that would have no effect on healthy adult workers. It is important that exposure of pregnant women to any toxic chemical be avoided as far as possible.

Training notes

- Infants and children can be especially sensitive to the health risks posed by pesticides, because their internal organs are still developing and maturing; in relation to their body weight, infants and children eat and drink more than adults, possibly increasing their exposure to pesticides in food and water; and certain behaviour, such as playing on the floor or lawn or putting objects in the mouth, increases a child's exposure to pesticides used in homes and yards.

Discussion points

- Do you know the extent of pesticide poisoning in your country?
- Have pesticides adversely affected the community (especially women of reproductive age and children) and animals or the environment here?

Visual Aids



Module No. 4 A 3

Module: 4 Protecting of the environment and the general public

Subject: A Necessity to protect the environment and the general public

Number: 3 Specially sensitive areas and resources

Level: Basic / Intermediate

Main points

Areas and resources that should be protected in particular are those:

- where people live and stay, in particular children;
- that constitute feeding resources for wildlife and domestic animals;
- near water courses and sources of drinking-water;
- of high biodiversity and protected areas or nature reserves; and
- that harbour endangered plants and animals.

Subsidiary points

- Farmers and other applicators must take care that dwellings, schools, hospitals and other places where people live or work are not exposed to drifts from spraying.
- During spraying of houses to control vectors or pests, care should be taken in the choice of the pesticide; people, food, feed and animals should be removed; and kitchen areas and absorbent surfaces where pesticides may persist should be avoided.
- Farmers and other applicators must take care not to contaminate surface and groundwater. Particular care is required in areas with a high groundwater level or porous soil.
- Great care should be taken in choosing pesticides to be added to water to control a pest or vector.
- Some areas have a wide variety of plants, animals and microorganisms. Biological diversity is important for human well-being and should be protected from adverse effects from pesticides and other environmental pressures. Its importance can be illustrated by the fact that many medicines originate from wild plants, such as *Artemisia annua*, which is the source of a drug now used against malaria.

Training notes

- Protecting biological diversity, genetic resources, species and ecosystems is an aim of the Convention on Biological Diversity, adopted at the 1992 Earth Summit.
- More than 100 000 protected areas have been established all over the world, covering 11.5% of the Earth's land surface. Certain areas have been recognized as natural world heritage sites.
- Species of plants and animals that are in danger of extinction are listed on the IUCN Red List, see <http://www.redlist.org/>, and in the appendices of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), which aims at ensuring that international trade in specimens of wild animals and plants does not threaten their survival.
- Some countries have laws concerning listed endangered species and their habitats (the areas they need for survival) and protected areas or national parks, which limit use of pesticides.
- Reef-building corals can be affected by pesticides. Corals play an important role in protecting the coast in tropical countries.

Module No. 4 B 1

Module: 4 Protecting the environment and the general public

Subject: B Unintentional pesticide release or exposure

Number: 1 Sources

Level: Basic

Main points

- Exposure can occur at any time in a pesticide's life cycle, from production, transport, storage, mixing, sprayer filling, application and cleaning of equipment to disposal of leftover pesticide, wash water and containers. Pesticides can move out of the area in which they are used or stored.
- Everyone who handles pesticides has a duty to ensure that no other person or animal is affected by the pesticides and that adverse environmental effects are prevented.
- Labels must be read and their instructions followed.

Module No. 4 B 2

Module: 4 Protecting the environment and the general public

Subject: B Unintentional pesticide release or exposure

Number: 2 Environmental pathways and fate of pesticides

Level: Intermediate

Main points

- Pesticides do not stay in the target area but move through the environment via air or water. They can also be transported from the area with objects, plants and animals.
- A pesticide that is water-soluble is likely to end up in surface and ground-water.
- A pesticide that is soluble in fat will tend to accumulate in body tissues, at increasing concentrations through the food-chain (bioaccumulation).
- Some pesticides evaporate at normal temperatures and can then be transported through the air.
- Pesticides are transformed through chemical and biological processes to other substances, some slowly (persistent) and others more rapidly. The resulting compounds are often less toxic, but they can also be more toxic than the original substance.
- Persistent organic pollutants (POPs) are highly persistent and bioaccumulate. Many organochlorine pesticides have been classified as POPs. They are of particular concern because they are transported through the air and have become widely distributed in the environment, even in human milk. Their use is being eliminated in many countries (*see* Stockholm Convention). DDT (a POP) should be used only indoors for disease vector control.

Subsidiary points (*see also* **Module 4E**)

- Movement with the air

Certain formulations, such as dusts and ultra-low-volume formulations, drift easily to other areas, especially on windy days. Low-pressure and coarse nozzles produce large droplets which drift less. Pesticides sprayed close to the ground are less likely to move off target.

The direction of the wind should be checked; pesticides should not be blown into vulnerable areas. It is better to choose days or times of the day when there is less wind.

Some pesticides are very volatile (**the label should be checked!**), and their volatility can be increased by high temperature and low humidity. Containers should remain sealed until pesticides are used.

- Movement with water

Pesticides will, to a lesser or greater extent, end up in water through runoff. Pesticides that are water-soluble can easily be transported as runoff or through drains by rain or irrigation water to surface water, or by leaching to groundwater. Water must not be polluted during any stage of the life cycle, especially during mixing, applying and disposing of pesticides or pesticide containers or wash water (*see Subjects D, E and F*).

When a date for spraying pesticides is being decided, account must be taken of the weather conditions. Contaminated water runs off and pollute streams and lakes more easily if the ground is waterlogged or frozen or if it is compacted by trampling or heavy machinery. Both rain and excess water from irrigation soon after spraying can cause pesticides to run off to surface water or to be absorbed by the soil and move into groundwater.

Leaching depends on geology and the soil. An impermeable (clay) soil can seal off groundwater, but gravel or coarse sandy soils or limestone will let pesticides through. Organic matter in soil holds water and pesticides.

Pesticides should not be sprayed around wells or at other places where groundwater comes close to the surface. Drinking-water must be protected!

Pesticides can also be carried away by rivers and streams and can eventually reach oceans.

- Movement with objects, plants or animals

Sprayed soil can be carried from a treated area in the form of mud clinging to tyres or blown away as dust when it is dry.

Exposed clothes and equipment are contaminated and should be kept away from places where people can come into contact with them.

Food and animal feed, animals and people should be removed before spraying is begun.

Module No. 4 C 1

Module: 4 Protecting the environment and the general public

Subject: C Judicious use of pesticides, integrated pest and vector management and food safety

Number: 1 Integrated pest and vector management

Level: Basic

Main points

- Pest and disease vectors can be managed by various methods, the use of pesticides being only one. The control method chosen should be adapted to local conditions, and pesticides should be used only when absolutely necessary. This is one of the main principles of integrated pest management.
- The FAO definition of IPM is: Integrated pest management means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations, keep pesticide use and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. Integrated pest management emphasizes the growth of a healthy crop, with the least possible disruption to agro-ecosystems, and encourages natural pest control mechanisms. Integrated pest management can be applied to both agricultural and non-agricultural settings, such as the home, garden and workplace.
- The WHO definition of IVM is: Integrated vector management is a process for managing vector populations in such a way as to reduce or interrupt transmission of disease. Characteristic features of integrated vector management include methods based on knowledge of factors influencing local vectorbiology, disease transmission and morbidity; use of a range of interventions, often in combination and synergistically; collaboration within the health sector and with public and private sectors that impact on vectors; engagement with local communities and other stakeholders; and a public health regulatory and legislative framework.
- Examples of non-pesticide control options that can be part of integrated pest and vector management include:

In agricultural pest control

- Cultural practices, including crop rotation, crop diversity, timing of planting, sanitation and creation of buffer zones;
- biological control agents, including microbiological agents (viruses, bacteria and fungi) and other insects or spiders that prey on the pest (This technique can be part of both integrated pest management and integrated vector management.);
- host plant resistance or crop tolerance.

In disease vector control

- environmental management, including water sanitation, to eliminate breeding sites;
- screening of houses and bed nets;
- biological control (e.g. larviciding with bacterial products);
- traps; and
- community surveillance and action.

In control of household pests

- screening;
- use of traps and baits, including in combination with attractants such as pheromones;
- biological control; and
- surveillance.

Subsidiary points

The advantages of integrated pest and vector management approaches are avoidance of:

- Adverse health and environmental effects, as pesticides can have adverse effects on non-target species and humans (see **Module 4A**).
- Pesticide resistance. Target organisms can become resistant to pesticides and no longer be affected by them. Pesticide resistance can lead to a ‘pesticide treadmill’, whereby more and more pesticides are needed.
- Decimating natural enemies and unleashing secondary pest infestation. Natural enemies, in particular predatory insects and spiders, are also killed by pesticides, so that the pest species, which often recovers more quickly than the predators, can multiply more easily. Other pest species that were not a problem before pesticide application because they were controlled by natural enemies can start to create havoc, resulting in secondary pest infestation.
- Loss of the effectiveness of pesticides as important means for securing food supplies and managing vector-borne diseases. The development of resistance in insects can be reduced by limiting the use of pesticides to situations in which they are absolutely needed and by practices that involve pesticide resistance management.

Discussion points

- Does your country have a policy on pesticide use and integrated pest and vector management?
- What experience do the trainees have in integrated pest and vector management?
- Are there farmer field schools in your country?
- What non-pesticide techniques are used?
- To what extent are pesticides used? For what purpose?

Training notes

- An example of the ‘pesticide treadmill’: In Central America, spraying of cotton increased from eight applications a season in the 1950s to an average of 28 in the 1960s. Despite this, there was a decline in yields. Applying such large amounts of pesticides can have disastrous effects on the environment and on people living in it.
- Secondary pests and resistance occurred in the 1970s in the Sudan when the cotton whitefly, a minor pest in the past, became a major one after DDT was sprayed against jassids attacking the cotton plants. The spraying also resulted in resistance of malaria mosquitoes to DDT and dieldrin, seriously hampering malaria control efforts.
- Integrated vector and pest management are described in: Reducing and eliminating the use of persistent organic pesticides. IOMC, 2002 (UNEP ILO FAO WHO UNIDO OECD) <http://www.chem.unep.ch/pops/pdf/redelipops/redelipops.pdf>
- See also the Global integrated pest management facility: http://www.fao.org/ag/AGP/AGPP/integrated_pest_management/gipmf/index.htm

Module No. 4 C 2

Module: 4 Protecting the environment and the general public

Subject: C Judicious use of pesticides, integrated pest and vector management and food safety

Number: 2 Food safety

Level: Basic

Main points

- Pesticides can be used during the production of food in various ways, such as to control the growth of weeds and to prevent crop damage by pests. In some instances, residues of pesticides can remain in or on food after harvesting and storage. Occasionally, residues also result from environmental or other indirect sources. Residues of old pesticides, like DDT, are an example of such environmental contamination.
- The levels of residues present are usually very low and are expressed in milligrams per kilogram of crop, food or commodity (mg/kg or part per million).
- Maximum residue limits are established to ensure that the total consumption of residues from all food uses will not exceed the acceptable daily intake (ADI).
- Unacceptably high levels of residues in food can occur when the amount of pesticide applied exceeded the recommended dosage or the interval between spraying and harvesting was not respected.

Subsidiary points

- Pesticide residues can be present in fresh or tinned fruit and vegetables, processed food and drink made from the crop or fresh or processed animal products (from animals fed a crop treated with pesticide).
- Milk and meat from animals that have eaten contaminated feed can contain high levels of pesticides. Domestic animals have been contaminated by pesticides when they were not removed during spraying operations.
- A particularly dangerous practice is fishing by using pesticides. Both the fish and the environment are contaminated.

Level: Intermediate

Main points

- Maximum residue limits are established for all types of food. Depending on the pesticide and the food commodity, the allowable residues can range from a fraction of a part per million to several parts per million. They are based on the maximum amount of residue remaining in food (at the point of sale) when the pesticide was applied according to its registered use pattern.

- The ADI is an estimate made by the Joint Meeting on Pesticide Residues (JMPR) of the amount of pesticide, expressed on a body weight basis, that can be ingested daily over a lifetime without appreciable health risk (standard weight = 60 kg). The JMPR is an international expert scientific group administered jointly by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO), which has met regularly since 1963.

Subsidiary points

- JMPR serves as a scientific advisory body to FAO, WHO and their member governments and to the Codex Committee on Pesticide Residues (CCPR), which advises the Codex Alimentarius Commission.
- All countries need access to reliable assessments of the risks of chemicals in food, but relatively few have the expertise and funds to carry out separate risk assessments on large numbers of chemicals. JMPR performs a vital function in providing a reliable source of advice, and some countries use information from JMPR in formulating their own regulatory programmes. In the same way, CCPR provides advice, based on the evaluations of JMPR, on appropriate standards for pesticide residues in food.

Discussion points

- Are pesticide residues monitored in your country?
- Does your country have legislation on pesticide residues?
- Have there been export problems due to residues in your country?

Training notes

- Extensive scientific data are required in order to register pesticides designed for use in the production of food and feed crops. Companies that wish to have a product approved for use on foods must put it through years of testing to derive sufficient information to demonstrate its value and safety. The data required include:
 - a comprehensive range of studies providing detailed information on the toxic effects of the pesticide, including the capacity to cause reproductive effects or cancer;
 - information on its physical and chemical properties;
 - information on the lowest effective amount to be applied, the frequency and the time of application;
 - studies on plant and animal metabolism, i.e. how the pesticide is broken down in the body and in plants;
 - the analytical method used to detect and analyse residues in foods and feeds; and
 - studies to determine how much pesticide residue could occur on food.

Module No. 4 D 1

Module: 4 Protecting the environment and the general public

Subject: D Protective measures during transport, storage and distribution

Number: 1 Transport by truck or boat

Level: Basic

Main points

- Containers of pesticides should never be carried in the same truck, boat or compartment as food or animal feed or general consumer goods such as clothing or the driver or passengers. If the container leaks, the food might be contaminated by the pesticide.
- Liquid formulations are more hazardous, as foodstuffs may absorb liquid leaks and the pesticide might penetrate the foodstuffs. Highly volatile pesticides can also be a source of contamination.
- Utmost care must be taken that containers are not damaged before or during transport.
- If possible, pesticides should be kept in a locked compartment; otherwise, a close watch should be kept over them.
- As food might not even show or smell that it has been contaminated, others will not know unless you inform them or the authorities. It is better to safely dispose of any contaminated food.

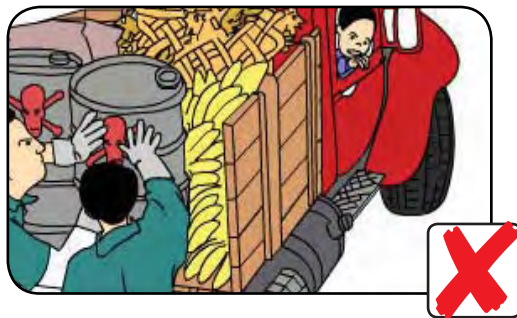
Subsidiary points

- When small quantities of pesticides are transported for personal use with food or other supplies, separate compartments should be used.
- Even if a pesticide has been carried correctly without food in a truck or boat, the vehicle might carry food the next day. When pesticides have been carried, the deck of the truck or boat should be examined after unloading for any evidence of leakage. If the container has leaked, the deck must be decontaminated immediately.
- Decontamination is carried out by scrubbing the deck with water and using sand, cat litter, sawdust, newspapers or old cloth to absorb the water. (For disposal, see **Module 4F4**.) The feet, hands and face must be protected appropriately during decontamination.
- The truck or boat should have a non-absorbent surface. If the surface is made of wood, for instance, a layer of plastic should be placed under the pesticides.
- If the boat has more than one deck, pesticides should not be carried in a compartment above one containing food. If leakage occurs, all compartments below should be examined for contamination.

Training notes

- For disposal methods, see **Module 4F4**.
- Transportation of dangerous goods and wastes is regulated in most countries.
- Companies that transport hazardous materials should be certified and their personnel trained.
- See the United Nations recommendations on the transport of dangerous goods. Model regulations. 2005. 14th edition. http://www.unece.org/trans/danger/publi/unrec/rev14/14files_e.html

Visual aids



Module No. 4 D 2

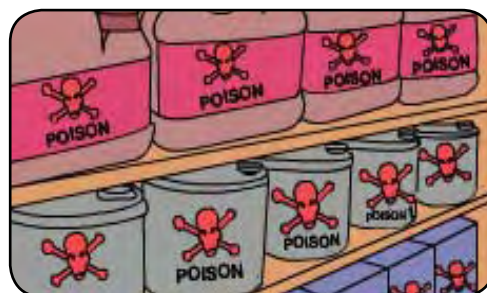
Module: 4 Protecting the environment and the general public

Subject: D Protective measures during transport, storage and distribution

Number: 2 Storage (general)

Level: Basic**Main points**

- Pesticides should be bought only as needed.
- Pesticide stocks should be locked up, away from living quarters, livestock housing or food supplies. Buildings in which pesticides are stored should be sited well away from any water source that might be contaminated by spillage. (see **Modules 4A3, 4B2.**)
- Pesticide containers in use should be kept out of reach of children. Children should never be allowed to play with empty pesticide containers.
- Pesticides should be kept in their original, labelled containers. They should not be placed in bottles or other containers.

Visual aids

Module No. 4 D 3

Module: 4 Protecting the environment and the general public

Subject: D Protective measures during transport, storage and distribution

Number: 3 Storage in a warehouse

Level: Intermediate

Main points

- No more pesticides should be stored than can be used within the coming year.
- Large quantities of pesticides must be stored separately in well-ventilated, secure warehouses, of sound construction. Pesticides should be well protected from water and moisture. The floor should be made of non-absorbent material (e.g. sealed concrete), which is easy to clean if spills occur.
- Warehouses should not be located near sensitive areas (see **Module 4A3**), in particular in flood-prone areas.
- Drums should be placed so that their labels are clearly visible but should not be stacked more than two if being handled manually.
- Leaking containers or drums must be placed in a separate area on a bed of sawdust or other absorbent material, or put in larger, impermeable containers marked with the product's name or, if possible, label, until their contents can be transferred to a sound container of the same kind, with appropriate labelling. The product should be used as soon as possible; if it is not usable, it should be disposed as toxic waste (see **Module 4F4**).
- Stocks should be well organized to prevent cross-contamination of products and should be used strictly in order of date of manufacture.
- Drums that have been stored for more than 2 years should not be used until their contents have been tested for quality. The manufacturer should be asked for help.

Subsidiary points

- For disposal of contaminated sawdust or other absorbent material, see **Module 4F4**.
- Floors of pesticide warehouses should never be swept dry; instead, damp sawdust or industrial vacuum cleaners should be used.
- Clean water should be available for washing for persons working in warehouses. All workers should wear proper personal protection.

Discussion points

- What is the proper personal protection for a person working in a warehouse?
- How might children in the community be informed of dangers and encouraged to be wary of storage areas?

Training notes

- Minimum protection should be worn on the body, feet and hands and, ideally, the face and all exposed skin.
- For disposal of empty containers, see **Module 4F1**.
- See FAO 1996 Pesticide storage and stock control manual.

http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/V8966E/V8966E0.htm

Visual aids



Module No. 4 D 4

Module: 4 Protecting the environment and the general public

Subject: D Protective measures during transport, storage and distribution

Number: 4 Security of storage

Level: Intermediate

Main points

- The area in which pesticides are stored should be marked with ‘danger’, ‘no entry’ and ‘no smoking’ signs. All pesticide storage areas must be securely fenced to prevent unauthorized access. All doors and gates should be securely locked or padlocked.
- The address of the person(s) holding the keys should be fixed to the gate or door for emergencies such as fire or break in.
- All personnel should be well briefed on emergency procedures in case of fire, flood or accidental spillage.
- Suitable fire extinguishers should be provided and fire detection systems installed.

Subsidiary points

- The supervisor should ensure that sound emergency procedures are in place. He or she should also be responsible for the location of keys, evacuation, material safety data sheets (MSDS) of pesticides in the store and other measures required by national law.
- Non-water fire suppression systems are preferable. If the fire suppressant is water, the warehouse should have its own collection system. Floor drainage should not lead to the sewer or storm sewer or directly to surface water.

Discussion points

- In the event of fire or break-in, what authorities should be informed, and who should do this?

What kind of information on an MSDS is helpful for security?

Training note

MSDS

For a product containing several ingredients it is useful to find its composition by looking up the material safety data sheet or MSDS. CIEN gives instructions on how to find the MSDS in the training manual unit 15 p 17

http://www.epa.gov/cien/downloads/p_unit_15.pdf (accessed 17 November 2005)

See also: WHO International Chemical Safety Cards <http://www.who.int/ipcs/publications/icsc/en/index.html> (accessed 17 November 2005)

Visual aids



Module No. 4 D 5

Module: 4 Protecting the environment and the general public

Subject: D Protective measures during transport, storage and distribution

Number: 5 Household storage and use of pesticides

Level: Basic**Main points**

- Household pesticides should be bought only as needed.
- Pesticides should not be used in any way other than that described on the label.
- Care must be taken not to contaminate food in preparation or storage.
- Unused pesticides should be kept in a locked cupboard but not in the same cupboard as drugs or food.
- Spillages in the home should be cleaned up quickly, with precautions to protect exposed parts of the body and particularly the hands. Children should be kept away from spillages.
- Pesticide containers in use should be kept out of reach of children. Children should never be allowed to play with empty pesticide containers.
- Pesticides should be kept in their original containers. Do not put them in bottles or other containers.

Subsidiary points

- It is especially important to lock up all pesticide concentrates that require dilution before use. These are usually intended for use against garden pests.
- Pesticides should be stored only in properly labelled containers. The original packaging should be used whenever possible.
- If a child or an adult eats or drinks a pesticide, the person responsible for treatment will need to know the name of pesticide. The package should not be destroyed; it should be given to the person providing medical management.

Visual aids

Module No. 4 D 6

Module: 4 Protecting the environment and the general public

Subject: D Protective measures during transport, storage and distribution

Number: 6 Distribution of pesticides

Level: Intermediate

Main points

- The Code of Conduct requires that governments develop regulations for the sale of pesticides and in particular prohibit the repackaging of pesticides into food or drink containers.
- Persons involved in the sale of pesticides should be adequately trained and hold appropriate government licenses (where such licenses exist), so that they can give buyers sound advice on risk reduction and efficient use.
- The manufacturers should provide a range of pack sizes so that pesticides do not have to be repacked into unlabelled containers or, worse, empty drink bottles.
- Advertising should not mislead the buyer, especially regarding the 'safety' and effectiveness of the product, or indicate use other than that specified on the approved label.

Subsidiary points

- According to FAO, small vendors of pesticides are themselves often ignorant of the danger of the products they sell, because they have little or no training about their potential adverse effects. They may therefore fail to protect both themselves and staff working for them in their stores, rarely providing protective gear at the work place. Often, leftover pesticide is simply spilled into the street or in a backyard.
- Some pesticide distributors offer credit systems to farmers in order to distribute and promote the sale of pesticides. Competing pesticide distributors have extension agents, whose sole purpose is to sell pesticides. In the process, pesticides might be misused and accumulate in the environment.
- Pesticide containers are as dangerous as the pesticides themselves. In many countries, farmers are advised by pesticide distributing agents to bury the containers. They must never be used for domestic purposes, such as for water or food storage.

Discussion points

- Is there a system for licensing pesticide vendors in your country?
- Is advertising of pesticides regulated in your country?
- Is there legislation in your country forbidding the repackaging of pesticide in unsuitable containers?

- Imagine you have a shop. A farmer comes to you, saying his plants have white leaves, probably due to mildew, caused by a fungus. He asks you for an insecticide he saw advertised, the real strong one, with the red label. On the basis of what you learnt in previous chapters, what would you advise on the choice of pesticide, its transport and its storage?

Training note

- The Code referred to is the FAO 2003 International code of conduct on the distribution and use of pesticides (revised version), which is on the CD (complete) as **Other Sources of Information**.

Visual aids



Module No. 4 E 1

Module:	4	Protecting the environment and the general public
Subject:	E	Protecting the environment and the general public during and after application of pesticides
Number:	1	Timing of application to avoid movement of pesticides and exposure of animals and people

Level: Basic

Main points

- Weather conditions will determine whether pesticides move out of the target area (see **Module 4B2**). Efforts should be made to time spraying operations so that:
 - the temperature is not too high and the humidity not too low;
 - the wind speed is not too high;
 - the wind is blowing away from vulnerable areas;
 - no rain is forecast; and
 - no irrigation is planned.
- People, especially children, and livestock, must be kept out of the area during spraying. A time must be chosen when they are unlikely to be present.
- A warning must be issued to neighbours who might be affected.

Subsidiary point

- Account should be taken of the time of the day that beneficial insects usually forage.

Training note

- For guidelines on good practice before, during and after application of pesticides see:
 - FAO 2001 Guidelines on good practice for ground application of pesticides. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/006/y2767e/y2767e00.htm
 - FAO 2001 Guidelines on good practice for aerial application of pesticides. http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/006/Y2766E/Y2766E00.htm

Visual aids



Module No. 4 E 2

Module: 4 Protecting the environment and the general public

Subject: E Protecting the environment and the general public during and after application

Number: 2 Choosing the pesticide and application equipment, reading the label, using the correct amount

Level: Basic

Main points

- Relevant instructions on how a chemical should be used are provided on the label of the product, and these must be strictly adhered to by users and applicators to limit effects on the environment and humans. For example, a water-soluble pesticide that is highly toxic to fish must never be used close to waterways. Other pesticides adhere strongly to soil particles and are not likely to move out of the soil into water (e.g. paraquat).
- A pesticide should be chosen for the intended purpose, for vector control or for the crop it is to be sprayed on.
- When several chemicals can be used, the one least hazardous to people and the environment should be chosen, if possible (considering possible resistance).
- No more than recommended amount of pesticide should be used, the dose rate and the number of treatments permitted per season given on the label should never be exceeded.
- In order to apply the correct amount of pesticide to the target area, the application equipment has to meet certain standards, be in good working order and be correctly calibrated. Pesticide applicators should be trained to use equipment correctly.
- Not all the effects of pesticides are known or listed. Therefore, the precautionary principle should be applied: always minimize release into the environment.

Subsidiary points

- The choice and maintenance of pesticide application equipment are essential to minimize risks to people and the environment. Leaks should be prevented by changing sealing washers and nozzles regularly, as well as over aged rubber hoses and cracked containers. Mandatory checks for equipment, training distributors and repair workshop operators are also necessary. There are new techniques in pesticide application which allow more exact dosing and increase accuracy.
- Many countries have legislation on the certification of equipment. FAO and WHO have issued guidelines on this subject (see references below).
 - Ref: The FAO website on pesticide application technology: www.fao.org/ag/ags/subjects/en/farmpower/equipment/pesticide.html;
 - The WHO publication: equipment for vector control whqlibdoc.who.int/publications/1990/9241544031.pdf

- See also WHO website on equipment and application;
<http://www.who.int/whopes/equipment/en/>
- Many national authorities require that the operators of pesticide application equipment be trained and certified in order to ensure correct use. FAO has also issued guidelines on this point.

Training notes

- Trainers could include a practical exercise on calibration of sprayers.

Visual aids



Module No. 4 E 3

Module: 4 Protecting the environment and the general public

Subject: E Protecting the environment and the general public during and after application

Number: 3 Protective measures during handling

Level: Basic

Main points

- Places where pesticides are mixed, sprayers are filled and sprayers and other equipment are washed can be major sources of environmental contamination, in particular of water. These operations should never be done near water or other vulnerable areas (*see above*).
- When water is used for mixing pesticide, it is particularly important to avoid ‘back-siphoning’, ensuring that the pesticide does not contaminate the water source being used by keeping the hose above the pesticide and by using a valve.
- The site should ideally have a roof to avoid rain coming in, but it is also important that no water drains into the area.
- Unprotected and unwashed spraying equipment left in the rain can also be a source of pollution.
- All the water used for washing protective clothing and equipment should be collected in drums, and disposed of as contaminated wash water. These items should never be washed in a river or stream.

Subsidiary points

- Serious environmental contamination is most likely to occur during mixing and at the end of a day’s work. The supervisor should allow sufficient time at the end of the day to allow the mixing site to be cleaned and for workers to wash. If equipment is taken back to the base for cleaning, it should be treated as a pesticide container during transport.
- Adequate disposal facilities must be available for empty containers and unwanted pesticides at the operational base or at some other site approved for the disposal of chemical wastes.
- The best practice is to perform these operations on an impermeable surface (smooth concrete) with a bund to collect all wash water in a tank and to dispose of the wash water safely (*see section on disposal of wash water*).

Training notes

- “Portable bunds” (plastic sheet with a rim and a collection system) are available commercially for collecting spills and wash water.
- An alternative is to let the wash water flow into a ‘biobed’, preferably lined (*see 4F2 on wash water for an explanation of what a biobed is*).

- If these operations cannot be conducted according to the best practice described above, they should be performed in the field, on grass or uncompacted soil, away from surface and groundwater, and the location should be moved frequently. Microbial action in the soil can break down the pesticides. The soil type should not allow water to move rapidly into groundwater (see **Module 4B**).

Discussion point

- What are some of the ways in which the environment has been polluted by pesticides in your country?

Visual aids



Module No. 4 E 4

Module: 4 Protecting the environment and the general public

Subject: E Protecting the environment and the general public during and after application

Number: 4 When a spill occurs

Level: Basic

Main points

- When a spill occurs, the persons who deal with it should put on personal protective equipment and get help if necessary.
- Other people and animals should be told to leave the area. Persons other than the workers and animals should in fact already have been excluded from an area in which pesticides are being handled.
- The spill should be contained. If a small container is leaking, it should be placed in a larger, impermeable container. Movable bunds should be used to stop the spill from spreading, or a dike of soil can be made with a shovel. The spill should be prevented from moving to water or drains.
- It is good practice to be prepared and have a spill kit ready, with a brush, shovel, tin, plastic bags, ties, bunds, absorbent material and protective gear.
- The spill should be absorbed with sand, cat litter, saw dust, cloth, vermiculite or newspapers.
- The sweepings and contaminated brushes and cloths should be placed in an impermeable marked container, kept in a safe place and disposed of as described in **Module 4F4**.
- Spills of dry material should be swept up and bagged for re-use if possible. Otherwise, it should be disposed of as described in section **4F4**. If it risks becoming airborne, it should be covered with damp sand.
- If the surface is non-absorbent, it should be cleaned with water and detergent and these soaked up with absorbent material such as sand.
- Major spillages on the ground can be cleaned up by digging out the contaminated soil and putting it in bags, which should be disposed of as described in **Module 4F4**.

Visual aids



Module No. 4 E 5

Module: 4 Protecting the environment and the general public

Subject: E Protecting the environment and the general public during and after application

Number: 5 Exclusion from sprayed crops

Level: Basic

Main points

- After pesticides have been applied in agriculture, no unprotected person should enter the sprayed area until there is no risk that they might be exposed to pesticides.
- The product label should be checked for information concerning the re-entry time after application of the pesticide. If no information exists, the treated areas should be avoided at least until the spray has dried on the crop.
- All treated areas must be clearly marked with flags or other markings understood by the local population to mean an exclusion area.
- All such markings should be removed as soon as the exclusion period has ended.

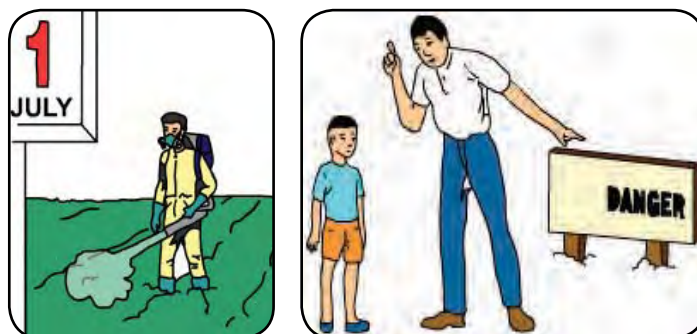
Discussion points

- What regulations exist in your country to prevent people from entering a sprayed area?
- For how long should unprotected persons not be allowed to enter a sprayed area?

Training note

- Signs in sprayed areas might prevent entry of unprotected people but do not necessarily protect exposure of poultry or livestock, which may wander into contaminated areas to eat or graze.

Visual aids



Module No. 4 F 1

Module: 4 Protecting the environment and the general public

Subject: F Protective measures during disposal of pesticide containers, wash water, leftovers and spills

Number: 1 Disposal of containers

Level: Basic

Main points

- Containers should be emptied completely into the tank, then immediately rinsed three times with clean water at 20% of container volume, the rinsings being poured into the tank.
- The instructions on the disposal of the container should be on the label.
- Ideally, containers should be designed to be refilled or recycled and returned to the distributor or manufacturer to be used again. Non refillable containers should be crushed or punctured after triple rinsing so that they cannot be reused. If they cannot be returned, they must be treated as toxic waste and be disposed of only in approved, appropriately constructed and maintained toxic waste disposal sites.
- Empty containers awaiting disposal should be marked and stored in a safe place.

Subsidiary points

- Container rinsings need not become pesticide waste because they can be added to the pesticide tank during mixing.
- Pesticide bags should not be burned, as open burning of bags releases toxic products.
- Even apparently empty containers contain pesticide residues that cannot be completely removed. They must therefore never be used for any purpose other than storage of the pesticides that they originally contained. Using empty pesticide containers for fuel and chemicals, and especially food or water, is dangerous.

Discussion points

- What types of facilities are available for collection and safe disposal of containers in your area?
- Is it possible to take back empty containers safely to your supplier so they can be re-used?

Visual aids



Module No. 4 F 2

Module: 4 Protecting the environment and the general public

Subject: F Protective measures during disposal of pesticide containers, wash water, leftovers and spills

Number: 2 Disposal of wash water

Level: Basic

Main points

- Wash water from rinsing of containers, equipment and spill clean-up is best used as a diluent for pesticides, as long as this use is allowed on the label. The solvent should be the correct one, and the maximum dose for the area should not be exceeded. When wash water is used for dilution, it should be regarded as water. When this is not possible or when the wash water contains dirt or detergent, it should be disposed of as contaminated wash water and treated as toxic waste. It should then be collected, to be disposed of safely by the national authorities.
- Wash water should be collected in a clearly marked drum with a tight lid and kept safely until it can be used. If the drum is transported, it should be treated in all respects as a pesticide container. It is important to check the legislation in your country on the disposal of wash water.
- Care should be taken that wash water cannot reach sensitive areas, in particular water courses or groundwater. In areas where groundwater is not threatened, small quantities of wash water can be allowed to soak away in a 'biobed'. A 'biobed' consists of a pit in the ground containing a mixture of straw, soil and compost, which is turfed over.
- Adding a layer of sawdust can often help to inactivate pesticides. Lime is also helpful for some insecticides. Some pesticides are either inactivated as they soak through the subsoil or absorbed onto soil particles, so that they will not travel far.

Subsidiary points

- If a formulation has tended to be lumpy, problems can arise from lumps present in wash water and subsequently in the water used for dilution. These can be avoided if the wash water is allowed to stand for some hours before the water is used, and the drum is emptied slowly, or if the wash water is passed through a sieve as it enters the wash water storage drum. The retrieved filtrate should be treated as pesticide waste (see **Module 4F4**).
- This method of disposal of wash water can also be used when the water supply for dilution is inadequate at the application site and has to be carried from the base. This often means that no water is available for washing at the application site. In such cases, water is first used for washing and then for the final dilution of the day, leaving only a small quantity for the final wash after work.
- Examples of liquids that can be disposed of in a biobed are water used for washing out equipment, water used for washing hands and protective clothing

and water used for drum decontamination.

- The pit should be dug more than 100 m away from streams, wells or houses. The water should be allowed to soak away slowly, and the pit should be refilled slowly so that no water overflows.
- Another solution is to spread the wash water on areas of grass or non-compacted soil, but no more than once a year.

Discussion points

- What are the benefits and practicalities of dealing with wash water from equipment by disposing of it on treated areas?
- Can other people be warned and kept away during these processes?

Module No. 4 F 3

Module: 4 Protecting the environment and the general public

Subject: F Protective measures during disposal of pesticide containers, wash water, leftovers and spills

Number: 3 Preventing stocks of excess pesticide

Level: Basic

Main points

- The need for disposal should be avoided by ordering only the quantities required. The equipment should be calibrated accurately. The amount of pesticide needed for application should be calculated carefully and only that amount should be mixed.
- All that has been mixed should be used, without exceeding the maximum dosages on the label.
- Pesticides in their original containers that cannot be used should be returned to the seller or manufacturer.

Subsidiary points

- Disposal of unwanted pesticide almost always involves expenditure. The amount required should be determined carefully, to keep stocks as low as possible.
- All pesticides have a limited shelf life. If the life of the pesticide formulation has expired or if there has been any change in the physical form or colour of the formulation, the relevant agencies in the country should be contacted.
- **Reference:** Guidelines on organization and operation of training schemes and certification procedures for operators of pesticide application equipment, 2001. <ftp://ftp.fao.org/docrep/fao/005/y2686e/y2686e00.pdf>

Training note

- Trainers could include a practical exercise on calibration of sprayers.

Visual aids



Module No. 4 F 4

Module: 4 Protecting the environment and the general public

Subject: F Protective measures during disposal of pesticide containers, wash water, leftovers and spills

Number: 4 Disposal of pesticides and contaminated wastes

Level: Basic

Main points

- Materials that should be treated as toxic waste include unused or outdated pesticides; materials used in cleaning up spills (contaminated sawdust, cloth, newspaper etc.); contaminated protective equipment and clothing; and contaminated soil. They should be disposed of only in approved, appropriately constructed and maintained toxic waste disposal sites.
- One option is incineration at high temperature, which will vary with the formulation, at proper, approved incineration facilities that meet international standards. This might, however, mean sending wastes to a country with appropriate facilities.
- New, less hazardous techniques for disposal are being designed, which should be investigated first.
- Pesticides, empty containers and contaminated materials should never be poured down drains or emptied into rivers, streams, lakes, drainage channels or any other water body; dumped in landfills or other general waste collection sites; buried; burned; used for any purpose other than those stated on the label; or given to any other person or organization, unless it is legal to dispose of it in this way and for the other party to receive it.

Subsidiary points

- Most pesticide users are not equipped to dispose of pesticides and related waste materials safely. No attempt should be made to treat or dispose of obsolete pesticides or pesticide wastes at the end-user level. The safe management and disposal of pesticide-related waste should be provided and coordinated by regulatory authorities, pesticide distributors and suppliers.
- In developing countries with limited resources, it is imperative that pesticide suppliers and their distribution networks be involved in the design and implementation of toxic waste collection schemes and facilities for the management of bulk quantities of toxic waste.
- Other organizations that support and advise pesticide users, such as extension and health promotion services, nongovernmental organizations, agricultural colleges and schools, also have important roles to play.

Discussion points

- What priorities in the methods of disposal depend on the facilities available in different countries?
- What is the danger of perforating aerosol containers?
- How can you inform communities in which dangerous disposal sites are located? Are signs needed around burial and disposal sites?
- What specific actions for disposal can be undertaken in your country?
- What types of pesticide should not be incinerated at low temperatures?
- Can you seek advice from trusted authorities or agencies about working safely and efficiently?

Training notes

- Priorities in methods of disposal depend on the facilities available in different countries.
- High-temperature incineration in dedicated hazardous waste incinerators is the currently recommended method for disposal of obsolete pesticides.
- Reference on the disposal of small quantities of pesticides:
 - FAO 1999 Guidelines for the management of small quantities of unwanted and obsolete pesticides. http://www.fao.org/documents/show_cdr.asp?url_file=/docrep/X1531E/X1531E00.htm

Visual aids



Module No. 4 F 5

Module: 4 Protecting the environment and the general public

Subject: F Protective measures during disposal of pesticide containers, wash water, leftovers and spills

Number: 5 Inappropriate disposal practices

Level: Intermediate

Main points

- Pesticides should never be poured down drains or emptied into rivers, streams, lakes, drainage channels or any other water body, nor should they be poured onto soil where groundwater is near the surface. Even a few millilitres of pesticide can kill fish and other aquatic organisms and contaminate large volumes of drinking- or irrigation water. Removing pesticides from water is an expensive and complex task and in some cases is not possible.
- Waste pesticides, empty containers and contaminated materials should not be dumped in landfills or other general waste collection sites. Most waste disposal sites are not designed to prevent toxic materials from leaking into the ground or being washed out by rain into water bodies.
- Waste pesticides, empty containers or contaminated materials should not be burned. Burning of pesticides and pesticide containers can release highly toxic fumes that can harm people and animals who inhale or come into contact with them. Many of the materials from which pesticide containers are made also release toxic fumes when burned. Pesticides burned in open fires often leave toxic residues as a result of incomplete combustion. Burning on open fires or in stoves is therefore not recommended for the destruction of pesticide-related waste and empty containers.
- The burial of pesticide-related waste is not an appropriate option. Burying pesticide containers can result in leakage of pesticides into the surrounding soil, which can contaminate aquifers, rivers, lakes and even the sea. Pesticides in water can damage or destroy aquatic life and affect people and livestock if the water is used for drinking, irrigation or washing. When pesticides and their containers are continually buried on the same site, the area can become severely contaminated and unusable. If several different sites are used as burial sites, a far larger land area could eventually become contaminated.

Visual aids



Module No. 4 F 6

Module: 4 Protecting the environment and the general public

Subject: F Protective measures during disposal of pesticide containers, wash water, leftovers and spills

Number: 6 Disposal of obsolete pesticides

Level: Intermediate

Main points

- Obsolete pesticides are pesticides that can no longer be used for their intended purpose or any other purpose. They may include pesticides in the form of liquids, powder or dust, granules or emulsions; empty and contaminated pesticide containers of all forms and kinds (i.e. metal drums, plastic containers, paper cartons, jute and other bags); heavily contaminated soil; and buried pesticides.
- In many countries, obsolete pesticides are a problem. FAO has issued guidelines for their disposal. Local authorities should be contacted for advice on disposal (see reference below).

Subsidiary points

- Common reasons that pesticides become obsolete are:
 1. Use of the product has been prohibited or severely restricted for health or environmental reasons (e.g. through banning, withdrawal of registration or policy decision by relevant government agencies).
 2. The product has deteriorated as a result of improper or prolonged storage and can no longer be used according to its label specifications and instructions for use, nor can it easily be reformulated to become usable again.

The product is not suitable for its intended use and cannot be used for other purposes, nor can it easily be modified to become usable.

- High-temperature incineration in dedicated hazardous waste incinerators is the currently recommended method for disposal of obsolete pesticides. This method is outlined in the joint FAO, UNEP and WHO Disposal guidelines. As such sophisticated incinerators do not exist in developing countries, pesticide waste must be re-packaged in new United Nations-approved containers, where they exist, which must be transported overland to a major port and then by sea to a country where there are dedicated hazardous waste destruction facilities. Shipment has to comply with the International Maritime Dangerous Goods Code and the Basel Convention on Restriction of Transboundary Movement of Toxic Waste. FAO has estimated that the cost of disposal is US\$ 3000–4500 per tonne, depending on a number of factors.

Discussion points

- Do you have stockpiles of obsolete pesticides in your country? If so, why?
- Can you get advice on disposal from appropriate authorities or agencies to work safely and efficiently?

Training notes

- Some of the reasons we have obsolete pesticides include:
 - banning of pesticides that are still in store;
 - aggressive pesticide sales, promotion and distribution by the chemical industry;
 - prolonged storage of products with a short shelf-life;
 - difficulty in forecasting pest outbreaks;
 - inappropriate assessment of pesticide requirements;
 - insufficient application capacity;
 - inappropriate formulations or substandard containers;
 - excessive donations not received when needed most (late arrival of donations or delivery out of season) or uncoordinated with similar donations from other sources, tantamount to dumping;
 - inadequate storage facilities;
 - lack of staff trained in storage management (i.e. poor stock-taking and lack of records);
 - ineffective distribution or poor marketing system for pesticides (government or private sector or both);
 - lack of awareness of the inherent dangers of pesticides; and
 - misuse of pesticide containers (e.g. for a variety of domestic uses: water containers, food storage, pot plants).

Reference: FAO 1996. Disposal of bulk quantities of obsolete pesticides in developing countries.

http://www.fao.org/waicent/faoinfo/agricult/agp/agpp/pesticid/disposal/index_en.htm

For wastes containing persistent organic pesticides:

General Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with Persistent Organic Pollutants (POPs) 2005

http://www.basel.int/pub/techguid/pop_guid_final.pdf

Draft Technical guidelines for environmentally sound management of pesticides wastes arising from the production of Aldrin, Chlordane, Dieldrin, Endrin, Heptachlor, Hexachlorobenzene (HCB), Mirex and Toxaphene 2005

<http://www.basel.int/techmatters/pesticides/guidelines/pest-guid-150705.doc>

Visual aids





Chemical Groups and Modes of Action of Pesticides

Module 5: Chemical groups and modes of action of pesticides

Subject A: General points

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No. 2 Modes of action of pesticides	I
No. 3 Mixing pesticide in the field	I
No. 4 Manufactured mixtures of pesticide	A

Subject B: Insecticides

No. 1 Organophosphorus compounds	I
No. 2 Carbamate compounds	I
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No. 4 Pyrethroid compounds	I

Subject C: Rodenticides

No. 1 Warfarin	I
No. 2 Warfarin derivatives	I
No. 3 Calciferol	I
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No.5 Metal phosphides	I
No.6 Chloralose	I
No.7 Thallium	I

Subject D: Other pesticides

No. 1 Paraquat and diquat	I
No. 2 Glyphosate	I
No. 3 2,4-Dichloroacetic acid	I
No. 4 Pentachlorophenol and related compounds	I
No. 5 Metals	I
No. 6 Thiocarbamate fungicides	I
No. 7 Methyl bromide	I
No. 8 Chloropicrin	I
No. 9 Sulfuryl fluoride	I

Educational objectives

A. Basic

Subject A: Should be able to describe the difference between common names and proprietary names of pesticides.

B. Intermediate

See basic educational objectives.

Subject A: Should be able to describe the general mode of action of pesticides; describe their classification into a few chemical groups; define synergism; describe the possible effects of mixtures manufactured and prepared in the field on efficacy and toxicity; and identify whether such mixing is prohibited in the country of the trainee.

Subjects B, C & D: Should be able to describe the modes of action of those pesticides that they use or that might be used in their area in the immediate future, name those that are extremely or highly hazardous, have cumulative effects, are stored in the body or are potentially carcinogenic, and list the approved and trade names of these pesticides.

C. Advanced

See basic and intermediate educational objectives.

Subject A: Should be able to list the types of components of manufactured mixtures and indicate the range of tests required for mixtures from manufacturers.

Subjects B, C & D: Should be able to list the chemical groups of pesticides and describe their mode of action. Should be able to list the approved and trade names of pesticides in use or otherwise available in the area in which they work, name those that are extremely or highly hazardous, have cumulative effects, are stored in the body or are potentially carcinogenic.

Module No. 5 A 1

Module: 5 Chemical groups and modes of action of pesticides

Subject: A General points

Number: 1 Names of pesticides

Level: Basic

Main points

- A registered pesticide has two names. The common name is that given it by international organizations or national standards. The proprietary name is the name given it by the manufacturer, also known as the trade name.
- Both names must appear on the label, but the proprietary name is usually more prominent. Nevertheless, it is the common or approved name that is important, especially when poisoning occurs, as it gives clues to the chemical group to which the compound belongs, which indicate the treatment needed. Examples:
 - Chlorpyrifos-methyl is the active component of Reldan.
 - Carbaryl is the active component of Sevin.
 - Coumachlor is the active component of Ratilan.

Subsidiary points

- Proprietary names are written with a capital first letter, as in the above examples. Common or approved names are written with a lower-case first letter.
- Common or approved names always refer to the same chemical compound, except for some minor national differences. Proprietary names for the same compound may differ between countries. Some refer to mixtures in which the constituents are different, or they may be reallocated to a pesticide replacing one that has become obsolete.

Discussion point

- Do the labels of pesticide products sold in your country contain both proprietary and common names?

Training note

- Apart from the examples given above, only common or approved names are used in this course.
- The trainer should obtain a list of trade names used in the country and the active ingredients the products contain.

Module No. 5 A 2

Module: 5 Chemical groups and modes of action of pesticides

Subject: A General points

Number: 2 Modes of action of pesticides

Level: Intermediate

Main points

- Many body systems are necessary for life. Some are common to all species, but others differ with the class of animal or plant and between species in a single class.
- Pests include organisms from many classes, such as plants, germs, moulds, insects, spiders, mites, worms, fish, birds and mammals.
- Pesticides kill by interfering with one or more essential body systems in the pest. When a similar system exists in humans, the risk of human toxicity is increased. When the system exists only in the pest or plant and not in humans, the risk for toxicity is generally lower.
- Most pesticides belong to a few chemical groups, each of which has its different effects on certain body systems.
- Small differences in the chemical structure of compounds in a group result in greater toxicity, so that some chemicals are more selective than others in their action on certain pests.

Discussion point

- What animal pests are most likely to share essential body systems with humans?

Module No. 5 A 3

Module: 5 Chemical groups and modes of action of pesticides

Subject: A General points

Number: 3 Mixing pesticide in the field

Level: Intermediate

Main point

- Two or more formulations should not be mixed in the field unless the label of each clearly states that they are compatible and the mixture is recommended by the pesticide registration authorities. Mixing two active ingredients of the same chemical group is unlikely to increase the efficacy of the more potent compound, and the toxicity is likely to be at least additive. Synergy between active or other ingredients may occur.

Subsidiary point

- If the toxicity of a mixture of two or more active ingredients is unknown, the hazard is also unknown. Therefore, if such home-made mixtures must be used, the precautions to be taken should be those for a hazard one class higher than the hazard class of the more hazardous active ingredient.

Discussion points

- Are any mixtures made in the field locally?
- What is the hazard class of a pesticide mixture of unknown toxicity when the active ingredients of each product belong to Class II and Class III?

Training note

- The practice of mixing pesticide formulations in the field is prohibited in some countries.

Module No. 5 A 4

Module: 5 Chemical groups and modes of action of pesticides

Subject: A General points

Number: 4 Manufactured mixtures of pesticides

Level: Advanced

Main points

- Mixtures made by formulators are of two types, one of which is the active ingredient in a formulation containing non-pesticidal synergists, such as piperonyl butoxide; and mixtures of two or more active ingredients in a formulation. In the first type, the synergist is included to increase the toxicity of the active ingredient for the target species. In the second type, if the active ingredients belong to the same chemical class, the toxicity is usually additive. If the active ingredients belong to different chemical classes, each will exert its own effects, and the resulting toxicity of the mixture is likely to be that of the more toxic constituent.
- Unintended synergy between active and other ingredients can occur. Manufacturers should always confirm that this does not occur and should carry out a full range of tests for acute toxicity on all mixtures of both types. Registration authorities should insist on these data, and formulators should not be allowed to change the composition of mixtures without the permission of the registration authority.

Training note

- Toxicology studies required for registration of pesticide products include: acute toxicity (oral, dermal, inhalation), skin and eye irritation, skin sensitization tests and information on dermal absorption. When the formulation contains toxicologically relevant, non-active substances, the available data should be taken into consideration. Information on human exposure to the product, including operators, should also be provided.

Module No. 5 B 1

Module: 5 Chemical groups and modes of action of pesticides

Subject: B Insecticides

Number: 1 Organophosphorus compounds

Level: Intermediate

Main points

- The main target of organophosphorus compounds in the body is the enzyme cholinesterase. This enzyme is essential for the passage of nerve impulses between cells.
- Organophosphorus compounds are not stored in the body for long periods, but their effects can accumulate over weeks.
- Examples of organophosphorus technical products with hazard classes:
 - parathion (Ia)
 - dichlorvos (Ib)
 - diazinon (II)
 - fenitrothion (II)
 - fenthion (II)
 - malathion (III)
 - chlorpyrifos methyl (U)U: Unlikely to pose an acute hazard in normal use

Subsidiary points

- The degree of inhibition of red cell or whole blood cholinesterase indicates the probability of the onset of symptoms and the outcome. Inhibition of plasma cholinesterase is only an indicator of exposure to an inhibitor.
- Inhibition of the enzyme may be fully reversible, partially reversible or irreversible. The rate and degree of spontaneous reactivation depend on the nature of the compound.
- Reactivation of red cell or whole blood cholinesterase is usually slow without treatment; therefore, the effects of low long-term exposure can accumulate, until symptoms occur.
- Organophosphorus pesticides are known to affect a range of transmitters that are implicated in many long-term health effects (e.g. peripheral neuropathy).

Discussion point

- What are the common or approved and trade names of the chemicals most commonly used in your country?

Training notes

- In this and the following modules, only a selection of pesticides is discussed. The modules should be modified in accordance with local use.
- Information on hazard classes is given in this section to allow comparison of a toxicological range of chemical groups, but information on the hazard of formulations, which depends on concentration, is not given. (For definitions of classes, see **Module 1B2**)

Module No. 5 B 2

Module: 5 Chemical groups and modes of action of pesticides

Subject: B Insecticides

Number: 2 Carbamate compounds

Level: Intermediate

Main points

- Carbamate compounds act similarly to organophosphorus compounds, by inhibiting cholinesterase, affecting the passage of nerve impulses between cells.
- Cholinesterase inhibition may be faster but is usually shorter than with organophosphorus compounds. In general, cholinesterase is reactivated within minutes or hours. Nevertheless, some carbamates are highly acutely toxic and can cause severe poisoning and death.
- Carbamates are not stored in the body, and the effect does not accumulate.
- Examples of carbamate technical products with hazard classes:
 - aldicarb (Ia)
 - methomyl (Ib)
 - bendiocarb (II)
 - carbaryl (II)
 - fenothiocarb (III)
 - propoxur (II)

Subsidiary point

- The effect of carbamates on red cell cholinesterase is transient, and inhibition is difficult to measure. The concentration in a blood sample can change, even while the sample is being processed.

Discussion point

- What are the common or approved and trade names of the carbamates most commonly used in your country?

Training note

- Carbamate insecticides must not be confused with thiocarbamate and dithiocarbamate compounds, which do not inhibit cholinesterase.

Module No. 5 B 3

Module: 5 Chemical groups and modes of action of pesticides

Subject: B Insecticides

Number: 3 Organochlorine compounds

Level: Intermediate

Main points

- Organochlorine compounds stimulate the nervous system in the brain. Large doses over a long period can affect liver function. These compounds are stored in body fat. Most are also persistent in nature and affect non-target wildlife in ways that are not seen in humans. For this reason, use of some compounds is restricted or banned in many countries, as some belong to the group of persistent organic pollutants.
- Examples of organochlorine technical products with hazard classes:
 - chlordane (II)
 - DDT (II)
 - endosulfan (II)
 - hexachlorocyclohexane (HCH) (II)
 - γ -HCH (lindane) (II)
 - aldrin (O)
 - dieldrin (O)
 - endrin (O)
 - heptachlor (O)
 - O: Obsolete as pesticide, not classified

Subsidiary points

- Stimulation of the central nervous system accounts for all the acute symptoms and determines the treatment. Induction of liver enzymes in humans occurs only after heavy continuous exposure.
- The levels in human fat are related to intake.
- According to IARC, DDT is possibly carcinogenic to humans (Group 2B).

Discussion points

- For what use are organochlorines permitted in your country?
- Is your country a signatory to the Stockholm Convention?

Training notes

- These compounds were banned because of their persistence in the food chain and because of some special effects, such as the thinning of bird egg shells.
- The Stockholm Convention pertains to persistent organic pollutants (POPs). See **Module 1D2**.
- The Basel Convention and its technical guidelines are described in **Module 1D3**.

Module No. 5 B 4

Module: 5 Chemical groups and modes of action of pesticides

Subject: B Insecticides

Number: 4 Pyrethroid compounds

Level: Intermediate

Main points

- Pyrethroid compounds act on nerves, prolonging stimulation. They pass easily through the cuticle of insects. They are highly bioactive and often used at high dilution.
- Pyrethroids are rapidly broken down and excreted from the body. They are not stored in the body, and their effects do not accumulate.
- Examples of pyrethroid technical products with hazard classes:

bioallethrin (II)	cyhalothrin (II))
cypermethrin (II)	deltamethrin (II)
fenvalerate (II)	permethrin (II)
allethrin (III)	resmethrin (III)

Subsidiary points

- Pyrethroid compounds are sometimes referred to as natural insecticides, although most of the available preparations are synthetic.
- In rats exposed to high doses of pyrethroids, two patterns of symptoms are observed:
 - Type I:** the C-S syndrome, associated with pyrethroids with an α -cyano substituent. Symptoms include choreoathetosis, salivation and seizures.
 - Type II:** the T syndrome, associated with pyrethroids with no cyano substituents. Symptoms include tremors, aggressive sparring and enhanced startle response.
- The paraesthesia (a feeling of tingling or burning in the skin) reported after exposure to some pyrethroids is due to lengthening of the refractory period of dermal nerve endings. It remits spontaneously after a few hours.

Discussion point

- What pyrethroids are commonly used in your country?

Training note

- These compounds are chemical derivatives of an ingredient of the pyrethrum plant.

Module No. 5 C 1

Module: 5 Chemical groups and modes of action of pesticides

Subject: C Rodenticides

Number: 1 Warfarin

Level: Intermediate

Main point

- Vitamin K is an essential element in the synthesis of several blood coagulation factors. Warfarin inhibits the coagulation process and consequently affects blood coagulation mechanisms. This anticoagulant effect causes bleeding into the skin and other parts of the body.

Subsidiary points

- Warfarin does not act immediately. It is usually eliminated quickly, although its effect lasts longer. Several doses are needed to kill a rat.
- Rats in many regions have developed genetic resistance to warfarin.

Discussion points

- Under what trade names is warfarin sold in your country?
- What is the percentage of active ingredient in the formulation available in your country?
- Some formulations come in the form of coloured pellets. Can this increase the risk for accidental poisoning in children?

Training notes

- Technical-grade warfarin is in hazard Class Ib. Most formulations contain only low percentages of the active ingredient, reducing the possibility of severe human toxicity.

Module No. 5 C 2

Module: 5 Chemical groups and modes of action of pesticides

Subject: C Rodenticides

Number: 2 Warfarin derivatives

Level: Intermediate

Main points

- Warfarin derivatives were developed to counteract genetic resistance to warfarin in rats. They have the same anticoagulant action as warfarin, but only a single dose is required to kill a rat. They also inhibit vitamin K production and affect the clotting factors for blood. They are therefore more hazardous than warfarin to humans and other animals if eaten accidentally.
- Examples of warfarin technical products with hazard classes:

brodifacoum (Ia)	chlorphacinone (Ia)
difenacoum (Ia)	diphacinone (Ia)

Subsidiary point

- Although there is a specific antidote, the hazard class of these compounds indicates that they must be handled with care.

Discussion point

- Under what trade names are these compounds sold in your country?

Training note

- A single ingestion of a ‘superwarfarin’ rodenticide, such as difenacoum or brodifacoum, can result in anticoagulation effects for up to 7 weeks. Most formulations also contain low percentages of active ingredient, thus reducing the risk for human toxicity.

Module No. 5 C 3

Module: 5 Chemical groups and modes of action of pesticides

Subject: C Rodenticides

Number: 3 Calciferol

Level: Intermediate

Main points

- Calciferol-related compounds affect the metabolism of calcium and phosphorus and cause severe metabolic disturbance.
- Examples of calciferol technical products and hazard classes:
 - cholecalciferol (Ib)
 - ergocalciferol (Ib)
- All animals can be affected by cholecalciferol, but rats and mice by virtue of their size are affected by lower doses than other target organisms.

Discussion point

- Which of these compounds are available in your country and under what trade names are they sold?

Module No. 5 C 4

Module: 5 Chemical groups and modes of action of pesticides

Subject: C Rodenticides

Number: 4 Fluoroacetates

Level: Intermediate

Main points

- Fluoroacetates are highly toxic compounds which interfere with the normal functioning of the Krebs (or tricarboxylic or citric acid) cycle.
- Fluoroacetate is converted by cell enzymes to fluorocitrate, which effectively inhibits the energy-producing activity of cells.
- Examples of fluoroacetate technical products and hazard classes:
 - Sodium fluoroacetate (Ia)
 - Fluoroacetamide (Ib)

Discussion points

- Which of these compounds are available in your country, and under what trade names are they sold?
- How frequently do you encounter human poisoning from fluoroacetate in your country?
- What regulations exist in your country for its use?

Module No. 5 C 5

Module: 5 Chemical groups and modes of action of pesticides

Subject: C Rodenticides

Number: 5 Metal phosphides

Level: Intermediate

Main points

- Metal phosphides (e.g. aluminium, magnesium, zinc) have irritant and corrosive actions on the alimentary tract and are hydrolysed by stomach acid to highly toxic phosphine gas.
- An example of a technical product, with hazard class, is zinc phosphide (Ib).
- WHO has not classified all metal phosphides (gaseous or volatile fumigants). The classification of other phosphides is recommended by national authorities according to exposure limits.

Discussion points

- What are the trade names of metal phosphides sold in your country?
- Describe the formulations available in your country.

Module No. 5 C 6

Module: 5 Chemical groups and modes of action of pesticides

Subject: C Rodenticides

Number: 6 Chloralose

Level: Intermediate

Main points

- Doses of chloralose (hazard class II) are stimulating or depressive; higher doses have a narcotic action.
- Chloralose is commonly used to control birds.

Discussion points

- Under what trade names are these compounds sold in your country?
- Describe the formulations available in your country.

Module No. 5 C 7

Module: 5 Chemical groups and modes of action of pesticides

Subject: C Rodenticides

Number: 7 Thallium

Level: Intermediate

Main points

- Thallium (hazard class Ib) is a cumulative cellular toxin which affects the nervous system, causing polyneuritis. It has an affinity for sulfhydryl groups, and blocking of sulfhydryl cross-linking in keratin causes loss of hair and abnormalities in nail growth.
- It is odourless and tasteless, and its use as a rodenticide is no longer recommended.

Discussion point

- Is thallium banned in your country?

Module No. 5 D 1

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 1 Paraquat and diquat

Level: Intermediate

Main points

- These bipyridyl derivatives are herbicides, which are inactivated on contact with soil.
- They are weakly corrosive to the eyes, and locally prolonged or repeated contact can affect the skin, fingernails and the lining of the nose, causing bleeding. They are absorbed through the skin when contact is prolonged.
- Oral ingestion of less than a mouthful can cause severe corrosive damage to the mouth, oesophagus and stomach. Kidney and liver failure may occur rapidly. If this does not cause death, paraquat affects the lungs, which is usually fatal within a few weeks.

Subsidiary point

- Paraquat reacts biochemically in the body, and the molecule exerts a toxic action on cells at the reaction sites.

Discussion point

- Under what trade names are these compounds available in your country?

Training notes

- Paraquat has been the cause of significant mortality. In many instances, it has been taken deliberately.
- Diquat does not present the same problems. Its effects on the liver and kidney are similar, but no late effect is seen on the lungs.

Module No. 5 D 2

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 2 Glyphosate

Level: Intermediate

Main points

- Glyphosate is an organophosphorus herbicide with no cholinesterase inhibitory activity.
- It kills green plants non-selectively.

Subsidiary points

- Glyphosate is one of the non-selective herbicides for which genetically resistant crops have been developed.

Discussion points

- Under what trade names are these compounds available in your country?
- How different is glyphosate from paraquat as a herbicide?

Module No. 5 D 3

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 3 2,4-Dichlorophenoxyacetic acid (2,4-D)

Level: Intermediate

Main point

- 2,4-D is a systemic herbicide used to control many types of broadleaf weeds. It is used in cultivated agriculture, forest management and gardens and to control aquatic vegetation

Discussion point

- Under what trade names are these compounds available in your country?

Module No. 5 D 4

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 4 Pentachlorophenol and related compounds

Level: Intermediate

Main points

- Pentachlorophenol causes uncoupling of mitochondrial oxidative phosphorylation cycles in tissues, increasing the basal metabolic rate, body temperature and breathing rate.
- Occupational exposure has also given rise to chloracne (a characteristic acne-like skin disease) and effects on the liver, including jaundice. These effects are due to pentachlorophenol contamination with dioxins.
- These compounds are slowly excreted in urine over about 1 week; therefore, accumulation in the body tends to occur with repeated exposure.
- Examples of technical products and hazard classes:
 - Dinoterb (Ib)
 - DNOC Dinitro-ortho-cresol)(Ib)
 - Pentachlorophenol (Ib)
 - Dinocap (III)
 - Dinoseb (O)
- According to IARC, pentachlorophenol is possibly carcinogenic to humans (Group 2B).

Discussion points

- Under what trade names are these compounds available in your country?
- What are their uses, if they are still available?

Training note

- These pesticides are used as herbicides, fungicides, weed killers, molluscicides and wood preservatives.

Module No. 5 D 5

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 5 Metals

Level: Intermediate

Main points

- Several metals are or have been used as pesticides.
 1. Arsenic salts have been used as rodenticides, herbicides and larvicides. Inorganic arsenic compounds react with sulfhydryl groups of cellular proteins, thereby inhibiting cellular oxidative processes.

Examples of technical products and hazard classes:

Calcium arsenate (Paris green) (Ib)

Lead arsenate (Ib)

Dimethyl arsine acid (III)

Arsenous oxide (O)

Arsenic and arsenic compounds are highly toxic and carcinogenic for humans (IARC Group I). **They should not be used.**

2. Organic mercury salts are used as a fungicide on seeds.

An example of a technical product, with hazard class, is phenyl mercury acetate and nitrate (Ia).

Mercury in any form denatures membranous and intracellular proteins, generally inactivating enzymes and causing metabolic disruption. The nervous system is the principal target tissue for the effects of organic mercury salts.

These compounds are highly toxic and should be used only if there is no other possible substitute. Mercury compounds, including inorganic mercury compounds, alkyl mercury compounds and alkyloxyalkyl and aryl mercury compounds, are subject to the prior informed consent procedure (Rotterdam Convention). *See Module 1D1.*

3. Organic tin compounds, particularly diethyl, tetramethyl and tetraethyl compounds, have severe toxic effects on the central nervous system. They may also have serious effects on the liver and spleen. They are active against snails at very low concentrations in water.

Examples of technical products and hazard classes:

Azocyclotin (II)

Bis(tributyl)tin oxide (O)

Cyhexatin (III)

Fenbutatin (U)

4. Copper salts such as copper sulfate are gastric irritants and produce corrosion of the gastric and intestinal epithelium.

Examples of technical products and hazard classes are:

Cuprous oxide (Ib)

Copper sulfate (II)

Copper oxychloride (III)

Oxine copper (U)

Subsidiary points

- Thallium sulfate and zinc phosphide are rodenticides.
- Aluminium phosphide is a fumigant. It reacts in the same way as zinc phosphide.

Discussion point

- Under what trade names are metals marketed as pesticides in your country?

Module No. 5 D 6

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 6 Thiocarbamate fungicides

Level: Intermediate

Main points

- Thiocarbamate fungicides can cause sensitization in susceptible individuals. In rats, these fungicides can cause fetal malformations after a single high oral dose, which also causes maternal toxicity. The breakdown products of residues on crops may be more toxic than the parent compound itself.
- Alcohol is contraindicated after exposure to dithiocarbamates.
- Examples of thiocarbamate technical products and hazard classes:
 - Mancozeb (U)
 - Maneb (U)
 - Zineb (U)

Subsidiary points

- Unlike carbamates, dithiocarbamates do not inhibit acetylcholinesterase.
- Maneb and zineb have been responsible for chronic skin lesions.

Module No. 5 D 7

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 7 Methyl bromide

Level: Intermediate

Main points

- The toxic mode of action of methyl bromide is not well understood. The proposed mechanisms are a direct cytotoxic effect of the intact molecule or effects of metabolites.
- The toxicity to the central nervous system appears to be due to methyl bromide itself or the methyl moiety and not to either formation of methyl alcohol or the bromide in inorganic form. (The concentrations of the latter are generally below those required for toxicity). One of the probable mechanisms is reaction with sulfhydryl groups in various enzymes.

Subsidiary points

- Methyl bromide is heavier than air and diffuses (spreads) readily
- Liquid or concentrated vapour can become trapped inside boots or behind adhesive bandages, rings or contact lenses.
- It can penetrate rubber and neoprene protective clothing.

Discussion point

- Does methyl bromide affect the ozone layer?

Training note

- Methyl bromide is banned under the Montreal Protocol on substances that deplete the ozone layer.

Module No. 5 D 8

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 8 Chloropicrin

Level: Intermediate

Main points

- Chloropicrin is a strong irritant and corrosive agent.
- It disrupts normal enzyme function by binding to enzyme sulfhydryl groups.
- Irritation can occur from ingestion, inhalation and dermal or ocular exposure. When inhaled, it tends to damage the lower respiratory tract because of its low solubility in water.

Subsidiary points

- Chloropicrin is heavier than air and diffuses (spreads) readily.
- Small amounts of chloropicrin are often added to other toxic odourless fumigants in order to signal recent fumigation.
- It can penetrate rubber and neoprene protective clothing.

Module No. 5 D 9

Module: 5 Chemical groups and modes of action of pesticides

Subject: D Other pesticides

Number: 9 Sulfuryl fluoride

Level: Intermediate

Main points

- Sulfuryl fluoride is an odourless, colourless gas and not very reactive. It is used mainly in its gaseous state as a fumigant insecticide. When heated to decomposition, it emits very toxic fumes of fluorine and sulfur oxides.
- Its toxicity may be due to release of fluoride and direct effects on cells

Subsidiary points

- Sulfuryl fluoride is heavier than air and diffuses (spreads) readily.
- It can penetrate rubber and neoprene protective clothing.



First Aid Treatment of Pesticide Poisoning

Module 6: First aid for Pesticide Poisoning

Subject A: Signs and symptoms

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No. 3 Carbamate poisoning	I
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Subject B: Treatment

No. 1 General principles	I
No. 2 Organophosphorus poisoning	I
No. 3 Carbamate poisoning	I
No. 4 Organochlorine poisoning	I
No. 5 Pyrethroid poisoning	I
No. 6 Anticoagulant rodenticide poisoning	I
No. 7 Calciferol derivative poisoning	I
No. 8 Fluoroacetate poisoning	I
No. 9 Chloralose poisoning	I
No.10 Thallium poisoning	I
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No.13 2,4-Dichlorophenoxyacetic acid poisoning	I
No.14 Pentachlorophenol poisoning	I
No.15 Poisoning by metals	I
No.16 Thiocarbamate fungicide poisoning	I
No.17 Methyl bromide poisoning	I
No.18 Chloropicrin poisoning	I
No.19 Sulfuryl fluoride poisoning	I

Subject C: Local treatment of splashes of pesticides

No. 1 In the eye	B
No. 2 On the skin	B

Educational objectives

A. Basic

Subject A: Should be able to identify the early symptoms of poisoning by pesticides to which they are exposed, and the local effects of pyrethroids.

Subject C: Should be able to describe how to treat splashes of pesticide on the skin and in the eye.

Should be able to give the common name(s) of the pesticide(s) used to the person responsible for first aid.

B. Intermediate

See basic educational objectives

Subject A: Should be able to identify the symptoms and signs of poisoning by each of the chemical groups to which applicators may be exposed.

Subject B: Should be able to describe the management and treatment of persons exposed to any of the chemical groups used by applicators.

Notes to trainers

1. The modules contain only brief notes on the resuscitation of patients who are unconscious, pulseless and not breathing. This subject is important but is best taught by practical demonstrations. Alternatively, new modules can be prepared with expert assistance, illustrated with a series of photographs showing the techniques (See Other sources of information-Management of poisoning).
2. Trainers may wish to prepare and distribute a list of local medical facilities or doctors to whom poisoning cases could be sent.

Module No. 6 A 1

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 1 General information

Level: Basic

Main points

- Pesticides can affect the body in two ways: by causing a local reaction at the point of contact with exposed skin and the eye, or, after absorption, by causing a systemic reaction.
- Local reactions vary, from direct irritation after a single contact to allergic reactions, usually after multiple contacts with the same compound.
- Pesticide poisoning can mimic the signs and symptoms of other common diseases. It is important to establish the history of exposure.
- Pesticide poisoning is likely only when the person is known to have had been exposed recently to a pesticide. The person might be wearing soaked clothing or be known to have swallowed a pesticide, either accidentally or deliberately.
- All cases should be seen by a doctor as soon as possible. It is important that the doctor know to which pesticide the person was exposed. If the container is available, it should be sent with the poisoned person for the doctor to see. The label might include important notes on the treatment of poisoning, which should be followed. Otherwise, the trade and approved names of the pesticide should be copied from the label.

Subsidiary points

- The poisoned person should be checked for breathing and a pulse. If necessary, resuscitation should be started immediately, with all possible precautions to prevent contamination. Someone else should be asked to find the name of the pesticide, as antidotes can be used for some types of pesticide poisoning.

Discussion point

- Have you ever seen a person poisoned by pesticides? If so, what actions were taken?

Visual aids



Module No. 6 A 2

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 2 Organophosphorus poisoning

Level: Intermediate

Main points

- Poisoning by organophosphorus insecticides is one of the commonest forms of pesticide poisoning. It requires immediate treatment.
- Onset occurs about 0.5-24h after exposure. Initially, the person feels sick and complains of headache, general weakness or tiredness.
- Later, the person begins to sweat and salivate (water at the mouth); he or she may vomit, have diarrhoea and complain of stomach cramps; the pupils become very small, and the person may mention blurred vision; the muscles twitch, and the hands shake; breathing becomes bubbly, and the person may have a fit and become unconscious.

Subsidiary point

- All cases should be seen by a doctor as soon as possible.

Module No. 6 A 3

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 3 Carbamate poisoning

Level: Intermediate

Main points

- Carbamate insecticides have the same action as organophosphorus compounds, but they act much faster and recovery is much faster.
- Persons who are applying these compounds and do not take the proper precautions may feel so ill after a while that they have to stop working. Soon after exposure ends, they will start to feel better, unless they are still absorbing pesticide from contaminated skin or clothing.
- Onset occurs as early as 0.5h after exposure. Initially, the person feels sick and may vomit and complains of headache and dizziness, tiredness and tightness in chest.
- Later, the person may begin to sweat and salivate and mention blurred vision, and the muscles may twitch. Rarely, a person may have a fit and become unconscious

Module No. 6 A 4

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 4 Organochlorine poisoning

Level: Intermediate

Main points

- The signs and symptoms of poisoning are due to excitation of the nervous system.
- Initially, the person complains of headache and dizziness and may appear worried and become excited.
- Later, the person may vomit and show weakness in the arms and legs; the hands may shake; the person may become disoriented in time and space, and fits may follow.

Subsidiary point

- Although poisoning by organochlorine pesticides is uncommon, ingestion might cause significant injury.

Module No. 6 A 5

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 5 Pyrethroid insecticide poisoning

Level: Intermediate

Main points

- Skin symptoms usually develop within 4–6h after exposure, which are felt as tingling on exposed skin, especially around the mouth and nose. The tingling is persistent and uncomfortable but not painful and usually does not last beyond 24h.
- After ingestion, there may be prominent digestive symptoms, such as nausea, vomiting and epigastric pain.
- In cases of severe poisoning, patients may develop fits and become unconscious. Death occurs from respiratory paralysis.

Discussion point

- What health problems have you experienced while applying pyrethroid insecticides?

Training notes

- Persons who are known to have asthma may experience respiratory difficulties when exposed to pyrethroids. Other patients may experience allergic reactions such as rash and angioedema.

Module No. 6 A 6

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 6 Anticoagulant rodenticide poisoning

Level: Intermediate

Main points

- The onset is usually slow. There are signs that the blood will not clot, such as easy bruising and prolonged bleeding from minor injuries or painful swelling of a large joint after no apparent injury.

Subsidiary points

- The signs and symptoms of acute poisoning after a large dose are not likely to be apparent immediately. After a single large dose or a few weeks of repeated ingestion of small doses, bleeding gums, pale skin, swelling and tenderness of the joints, bruising, blood in the urine and faeces and abdominal pain may occur 2 or 3 days later. In some severe cases, death may ensue.

Module No. 6 A 7

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 7 Calciferol derivative poisoning

Level: Intermediate

Main points

- The onset is usually slow. Initially, there is loss of appetite and nausea with abdominal pain. There may be headache in the back of the head and a sensitive scalp
- Later, there is mental confusion and loss of memory

Module No. 6 A 8

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 8 Fluoroacetate poisoning

Level: Intermediate

Main points

- There may be a delay after exposure of 6h or more, during which minor symptoms are seen, including vomiting, tingling of the nose and numbness of the face.
- The serious symptoms can be broadly divided into effects related to the brain, which include tremor, hallucination, fits and laboured breathing, and those related to the heart, leading to irregular beats preceding a heart attack. All cases of ingestion should be managed in hospital.

Module No. 6 A 9

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 9 Chloralose poisoning

Level: Intermediate

Main points

- Significant ingestion has resulted in sedation, unconsciousness, laboured breathing, fits and dizziness from drop in blood pressure.

Module No. 6 A 10

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 10 Thallium poisoning

Level: Intermediate

Main points

- Symptoms are usually delayed 12–24h in cases of acute poisoning and reach a maximum stage or phase of intoxication by the second and third week after exposure.
- Transient nausea and vomiting are generally seen first, followed by general numbness with painful tingling within 1–5 days. Tingling can occur as early as 12–13h after massive ingestion.
- Movement disorders may develop and in severe cases may lead to shock and respiratory failure.
- Hair loss occurs 2–3 weeks after exposure.

Module No. 6 A 11

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 11 Paraquat and diquat poisoning

Level: Intermediate

Main points

- Ingestion can cause an immediate burning sensation in the mouth and throat, which may be followed by nausea, vomiting and stomach pain. After some hours, inflammation and ulceration of the mouth, throat and the gut may occur.
- Repeated use without skin or face protection can cause malformation of the fingernails and nosebleeds.
- If these compounds are accidentally or deliberately drunk, they are very dangerous.

Subsidiary points

- Both these compounds are highly toxic if drunk, but paraquat causes the most deaths.
- Paraquat is corrosive, and significant ingestion can cause damage and bleeding to the mouth, throat and gut.
- Lung damage may occur after a week or so, even if the person seems to be recovering from the first wave of symptoms. Once lung damage has occurred, poisoning is very difficult to treat, and lung damage accounts for the high mortality among these cases some weeks after ingestion.

Module No. 6 A 12

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 12 Glyphosate poisoning

Level: Intermediate

Main points

- Glyphosate can be acutely toxic to humans and animals. Severe poisoning is usually due to ingestion of large amounts. Symptoms of exposure include irritation, oedema and erosion of the oropharynx and gastrointestinal tract.
- Gastrointestinal manifestations may include nausea, vomiting, diarrhoea and abdominal pain.
- Respiratory effects include difficulty in breathing, hypoxia and symptoms related to acute lung injury.
- Some patients may appear relatively stable for the first 8–12h and later develop hypotension and respiratory distress.

Subsidiary points

- Secondary dysfunction may occur in the liver, central nervous system and kidneys.
- Some cases are complicated by aspiration pneumonia.
- Oral and gastric irritation occur immediately after ingestion.

Discussion point

- Can you correlate the ingested amount with the severity of poisoning?

Training note

- It is difficult to correlate the amount ingested with the severity of poisoning; however, in general, severity follows a dose-related trend.

Module No. 6 A 13

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 13 2,4-Dichlorophenoxyacetic acid poisoning

Level: Intermediate

Main points

- Tachycardia, muscle weakness, and muscle spasms occur shortly after ingestion and may progress to profound muscle weakness and coma.
- Massive rhabdomyolysis and severe and intractable hypotension have been reported, resulting in death within 24h.
- Hepatitis and renal injury have been reported.

Subsidiary point

- Peripheral neuropathy with painful paraesthesia and muscle stiffness have been reported after inhalation or dermal exposure.

Module No. 6 A 14

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 14 Pentachlorophenol poisoning

Level: Intermediate

Main points

- Symptoms of acute poisoning include stomach pain, headache, profuse sweating, depression, nausea and weakness. Less commonly, fever, rapid heart rate and breathing, chest pain and thirst occur.
- The patient may develop fits and become unconscious.
- Other effects include irritation of the skin, mucous membranes and respiratory tract (including painful irritation of the nose and intense sneezing after inhalation), contact dermatitis and chloracne.

Training note

- Chloracne in humans is characterized by pale yellow cysts located mainly on the face and trunk.

Module No. 6 A 15

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 15 Poisoning by metals

Level: Intermediate

Main points

Arsenic salts

In acute poisoning, symptoms usually begin within the first few hours after ingestion. A garlic-like odour of the breath, gastric content and faeces might be indicative. Gastrointestinal disturbances (vomiting, stomach pain, diarrhoea) are the main clinical effects.

Organic mercury salts

Ingestion produces a burning sensation and metallic taste in the mouth, excessive salivation and thirst, acute stomach pain, vomiting and diarrhoea (may be blood stained). Collapse, fits, unconsciousness and death may follow. Unlike acute inorganic mercury, organic mercury salts cause marked nervous symptoms (e.g. staggering, tingling, difficulty in seeing, delirium) after acute poisoning. If death is not immediate, swelling, loosening of the teeth and tissue death in the area of the jaw can develop within 24 h. Kidney failure may develop within a few days.

Organic tin compounds

Ingestion causes excessive salivation, sore throat, coughing and drowsiness. If exposure is heavy, the central nervous system may be depressed and the patient may become unconscious. Severe eye irritation may occur, and watery eyes may be the earliest sign. Contact with the skin will result in moderate irritation leading to discolouration. Repeated or prolonged contact may lead to irritant contact dermatitis. Tributyltin oxide is a potent skin irritant and has a delayed effect, burns from splashes not showing for at least 1h. In some cases, dermatitis and rashes have appeared 8–10h after exposure.

Evidence from tests in animals and studies on exposed workers indicates that repeated or prolonged exposure to this chemical could result in cumulative effects, producing loss of body weight as well as adverse liver, kidney and central nervous system effects and possible respiratory depression, occasionally fatal.

Copper salts

The symptoms after mild intoxication generally comprise nausea, vomiting, diarrhoea and excess salivation (sialorrhoea). In severe cases, blood in the vomitus and faeces, rupture of red blood cells, yellowing of the skin, liver injury, decreased urine output, low blood pressure, unconsciousness and death have been reported. Tea-coloured

urine has been observed. Prolonged or repeated exposure to copper dusts can irritate the mucous membranes, causing runny nose and atrophic changes. Nasal ulceration and perforation have also been reported. Long-term ingestion of copper can lead to diarrhoea, progressive wasting, prostration, red extremities, hypotonia, photophobia, peripheral oedema and liver abnormalities.

Repeated inhalation of copper sulfate mists (e.g. Bordeaux mixture) can induce a condition known as 'vineyard sprayer's lung'. Granulomas occur in the liver and lungs of affected individuals. The disease is asymptomatic until later stages. The symptoms include weakness, malaise, loss of appetite and weight, cough and greenish-brown sputum.

Module No. 6 A 16

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 16 Thiocarbamate fungicide poisoning

Level: Intermediate

Main points

- A disulfiram-like reaction (flushing, sweating, headache, weakness, rapid heart rate and low blood pressure) may be seen when ethanol is ingested after exposure to large amounts of thiocarbamates.
- Some thiocarbamate fungicides may be formulated with hydrocarbon-based solvents, which can have toxic effects.

Module No. 6 A 17

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 17 Methyl bromide poisoning

Level: Intermediate

Main points

- Inhalation or aspiration can result in cough and shortness of breath, which is the most frequent cause of early death. Other signs and symptoms may include blurred or double vision, low blood pressure, profound weakness, dizziness, slurring of speech, memory loss, confusion, delirium, euphoria, disorientation, agitation and hallucinations.

Module No. 6 A 18

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 18 Chloropicrin poisoning

Level: Intermediate

Main points

- Inhalation or aspiration may result in shortness of breath, which is the most frequent cause of early death. Headache, anxiety, dizziness and lethargy may occur after exposure. Inhalation and ingestion result in nausea and vomiting, epigastric pain and possible gastric burns.

Module No. 6 A 19

Module: 6 First aid for pesticide poisoning

Subject: A Signs and symptoms

Number: 19 Sulfuryl fluoride poisoning

Level: Intermediate

Main points

- Inhalation or aspiration may result in shortness of breath, which is the most frequent cause of early death. Weakness, restlessness, seizures and central nervous system depression may occur.

Module No. 6 B 1

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 1 General principles

Level: Intermediate

Main points

- If the person giving first aid knows the chemical class of the pesticide, treatment can be started for some types of poisoning. Otherwise, the general rules for treatment based on signs and symptoms should be applied. Persons giving first aid must observe all possible precautions to prevent contaminating themselves.
- If either respiration and pulse is absent, resuscitation should be started. If the person is unconscious, the airways must be cleared by pulling the chin upwards and backwards. False teeth must be removed.
- The person should be placed on the side or front downwards, with the head turned to one side. If the person is to be transported, this posture should be maintained, to prevent vomitus from entering the lungs. Nothing should be given by mouth to an unconscious patient.
- Further exposure to the pesticide should be prevented by immediately removing any contaminated clothing and washing the skin with soap and water.
- All poisoning cases should be referred to a medical doctor. Some pesticides might not elicit signs for several hours after exposure. It is important to seek medical advice.

Training notes

- Practical training on giving first aid might be considered. See 'Other sources of information'.

Visual aids



Module No. 6 B 2

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 2 Organophosphorus poisoning

Level: Intermediate

Main points

- There are two antidotes for organophosphorus pesticide poisoning. One of these, atropine, can be given immediately by a trained person in consultation with a doctor.
- Treatment should be started immediately, in the following sequence:
 1. Respiration should be checked and the airways cleared.
 2. Artificial respiration should be given if needed.
 3. Atropine should be given, at 1–2mg, by syringe or by auto-injector into the thigh or upper arm.
 4. The person should be decontaminated to stop exposure by removing clothing and washing the body as necessary.
- Subsequent doses of atropine may be given in consultation with a doctor until the face flushes, the tongue becomes dry, the pupil of the eye dilates, or the pulse beats at 100–140 beats per min.

Note: Caution must be taken when giving atropine to an elderly patient.
- The patient should be transported to a medical facility quickly, especially if atropine intervention is not available in the field. During transport, treatment should be continued if atropine is available, and the person should be observed continuously. The help of others should be enlisted if necessary.

Subsidiary point

- When organophosphorus pesticides are being used on a large scale, suitable supplies of atropine should be available in the field, and some staff should be trained to administer it in consultation with a doctor.

Module No. 6 B 3

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 3 Carbamate poisoning

Level: Intermediate

Main points

- Carbamate poisoning can be severe or fatal. The symptoms are similar to those of organophosphate poisoning and should receive prompt treatment with atropine when needed, in consultation with a doctor.
- It is important that the person giving first aid should know the type of compound in use on the day the poisoning occurred.
- After exposure has been terminated, contaminated clothing should be removed and the skin washed.

Module No. 6 B 4

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 4 Organochlorine poisoning

Level: Intermediate

Main points

- There is no specific antidote for organochlorine poisoning. The first aim of treatment is to prevent further exposure, by removal of clothing and washing of the skin with soap and water.
- Breathing must be watched; if breathing fails, artificial respiration should be given.
- The person must be kept as quiet as possible. Excitability must be controlled. Patients who have fits must be gently restrained.
- Observation must be continued until the person has been transported to medical care.

Module No. 6 B 5

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 5 Pyrethroid poisoning

Level: Intermediate

Main points

- The skin should be washed with copious amounts of water for 10–15 min, and the eyes should be irrigated with water. Medical advice should be sought.

Subsidiary point

- The skin irritation and tingling are self-limiting and can be alleviated with topical vitamin E cream.

Module No. 6 B 6

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 6 Anticoagulant rodenticide poisoning

Level: Intermediate

Main points

- A person who has ingested an anticoagulant rodenticide should be referred to a medical doctor, as a blood test is necessary for diagnosis. The doctor can also give a specific antidote, vitamin K1.

Module No. 6 B 7

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 7 Calciferol derivative poisoning

Level: Intermediate

Main points

- A person who has ingested calciferol derivative rodenticides should be referred to a medical doctor, as a blood test is necessary for diagnosis.

Module No. 6 B 8

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 8 Fluoroacetate poisoning

Level: Intermediate

Main points

- A person who has ingested fluoroacetate rodenticides should be referred to a medical doctor, as a blood test is necessary for diagnosis.

Module No. 6 B 9

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 9 Chloralose poisoning

Level: Intermediate

Main points

- A person who has ingested chloralose rodenticides should be referred to a medical doctor, as a blood test is necessary for diagnosis.

Module No. 6 B 10

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 10 Thallium poisoning

Level: Intermediate

Main points

- A person who has ingested thallium rodenticides should be referred to a medical doctor for management.

Module No. 6 B 11

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 11 Paraquat and diquat poisoning

Level: Intermediate

Main points

- These compounds are very dangerous if drunk accidentally or deliberately. If there is likely to be any delay in getting the patient to hospital, uncontaminated fine earth or clay should be found, made into a watery mix with it and given to the patient to drink as much as possible.
- Medical attention should be sought immediately.

Module No. 6 B 12

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 12 Glyphosate poisoning

Level: Intermediate

Main points

- These compounds are very dangerous if drunk accidentally or deliberately.
- Medical attention should be sought.

Module No. 6 B 13

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 13 2,4-Dichlorophenoxyacetic acid poisoning

Level: Intermediate

Main points

- These compounds are very dangerous if drunk accidentally or deliberately.
- Medical attention should be sought.

Module No. 6 B 14

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 14 Pentachlorophenol poisoning

Level: Intermediate

Main points

- The mouth should be rinsed and contaminated clothing removed. The skin should be washed with plenty of water, and water should be given to drink.
- Medical attention should be sought.

Module No. 6 B 15

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 15 Poisoning by metals

Level: Intermediate

Main points

- Arsenic salts: The mouth should be rinsed, and the patient made to rest while medical attention is sought.
- Organic mercury salts: The mouth should be rinsed. Vomiting should not be induced. Medical attention should be sought.
- Organic tin compounds: Medical attention should be sought.
- Copper salts: Vomiting should not be induced. Plenty of water should be given to drink. Medical attention should be sought.

Module No. 6 B 16

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 16 Thiocarbamate fungicide poisoning

Level: Intermediate

Main points

- Clothing should be removed, and the affected skin areas should be washed with water.
- Medical attention should be sought.

Module No. 6 B 17

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 17 Methyl bromide poisoning

Level: Intermediate

Main points

The patient should be moved to fresh air and monitored for respiratory distress.

Adequate protection and self-contained breathing apparatus should be worn when entering a contaminated area.

Module No. 6 B 18

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 18 Chloropicrin poisoning

Level: Intermediate

Main points

- The patient should be moved to fresh air and monitored for respiratory distress.
- Adequate protection and self-contained breathing apparatus should be worn when entering a contaminated area.

Module No. 6 B 19

Module: 6 First aid for pesticide poisoning

Subject: B Treatment

Number: 19 Sulfuryl fluoride poisoning

Level: Intermediate

Main points

- The patient should be moved to fresh air and monitored for respiratory distress. Oxygen and assisted ventilation should be administered as required.
- Adequate protection and self-contained breathing apparatus should be worn when entering a contaminated area.

Module No. 6 C 1

Module: 6 First aid for pesticide poisoning

Subject: C Local treatment of splashes of pesticide

Number: 1 In the eye

Level: Basic

Main points

- Pesticides splashed into the eye are rapidly absorbed. The eye may also be directly irritated by the pesticide or by other ingredients in the formulation. Persistent irritation and other eye symptoms for several hours after proper washing might indicate eye injury. Medical assistance should be sought.
- The only first aid needed for any chemical splash in the eye is plenty of clean water. The eye must be washed out immediately, and the washing must be continued for at least 10–15 min. The water can be applied from an eye-wash bottle. If this is not available, a teapot can be used. The water may be cold or tepid but not hot.
- No other chemicals should ever be added to the water as antidotes or neutralizers.
- The eyelids might have to be held open gently during washing. The person giving first aid may need an assistant to do this. Alternatively, the person who was splashed might have to hold the eye open under a slowly running tap.

Subsidiary point

- Organophosphorus compounds splashed into the eye can cause blurring of vision, which may last several hours.

Module No. 6 C 2

Module: 6 First aid for pesticide poisoning

Subject: C Local treatment of splashes of pesticide

Number: 2 On the skin

Level: Basic

Main points

- Most pesticides are readily absorbed through the skin, either through soaked clothing or directly from splashes on the skin. Any soaked clothing should be removed at once. Splashes on the skin should be washed off with soap and water.
- No other chemicals should ever be added to the water as neutralizers.
- If the splash has been large, the wash water from the first wash should be disposed of in the same way as other contaminated wash water.
- If a large area of skin has been contaminated, the worker should shower.
- If the pesticide formulation is a moderate or greater hazard, the worker should not risk any further exposure on that working day and should be advised to report any symptoms to a medical centre.

Subsidiary point

- The rules given above apply to splashes of any chemical on the skin.



Medical Treatment of Pesticide Poisoning

Module 7: Medical treatment of pesticide poisoning

Subject A: History, signs and symptoms

No. 1 History	A
No. 2 Organophosphorus poisoning	A
No. 3 Carbamate poisoning	A
No. 4 Organochlorine poisoning	A
No. 5 Pyrethroid poisoning	A
No. 6 Anticoagulant rodenticide poisoning	A
No. 7 Calciferol derivatives poisoning	A
No. 8 Fluoroacetate poisoning	A
No. 9 Zinc phosphide poisoning	A
No. 10 Chloralose poisoning	A
No. 11 Thallium poisoning	A
No. 12 Paraquat and diquat poisoning	A
No. 13 Glyphosate poisoning	A
No. 14 2,4-Dichlorophenoxyacetic acid poisoning	A
No. 15 Pentachlorophenol poisoning	A
No. 16 Arsenic poisoning	A
No. 17 Organic mercury poisoning	A
No. 18 Organotin poisoning	A
No. 19 Copper salt poisoning	A
No. 20 Thiocarbamate poisoning	A
No. 21 Methyl bromide poisoning	A
No. 22 Chloropicrin poisoning	A
No. 23 Sulfuryl fluoride poisoning	A

Subject B: Treatment

No. 1 General principles	A
No. 2 Organophosphorus poisoning	A
No. 3 Carbamate poisoning	A
No. 4 Organochlorine poisoning	A
No. 5 Pyrethroid poisoning	A
No. 6 Anticoagulant rodenticide poisoning	A
No. 7 Calciferol derivatives poisoning	A
No. 8 Fluoroacetate poisoning	A

No. 9 Zinc phosphide poisoning	A
No. 10 Chloralose poisoning	A
No. 11 Thallium poisoning	A
No. 12 Paraquat and diquat poisoning	A
No. 13 Glyphosate poisoning	A
No. 14 2,4-Dichloroacetic acid poisoning	A
No. 15 Pentachlorophenol poisoning	A
No. 16 Arsenic poisoning	A
No. 17 Organic mercury poisoning	A
No. 18 Organotin poisoning	A
No. 19 Copper salt poisoning	A
No. 20 Thiocarbamate poisoning	A
No. 21 Methyl bromide poisoning	A
No. 22 Chloropicrin poisoning	A
No. 23 Sulfuryl fluoride poisoning	A

Educational objectives

A. Advanced

Subject A: Should be able to explain why it is important when examining a patient to identify the active ingredient involved (and other components with toxicological properties); to find out (and later record) the history of exposure to pesticides and in particular whether exposure has stopped; and to start treatment as soon as a diagnosis is reached.

. Should be able to compare the symptoms and signs of poisoning observed with those associated with all the chemical groups used in the area (medical officers) in order to determine the diagnosis. (*See note below.*)

Subject B: Should be able to apply (medical officers) or describe (pesticide registration officers) the general principles of the management of cases of poisoning. Should be able to prescribe (medical officers) or describe (pesticide registration officers) specific treatment of cases of poisoning by some chemical groups.

Notes to trainers

Depending on the level of training of primary health care workers, it may be more appropriate for the trainer to use **Module 6**.

Module No. 7 A 1

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 1 History

Level: Advanced

Main points

- Pesticide poisoning can mimic several other conditions, and a diagnosis of pesticide poisoning is not easy. A history of exposure is essential. Important points to be established are:
- Has the patient been exposed to a pesticide?
- If so, to which pesticide and to which chemical group does it belong? If a package or name of the pesticide has arrived with the patient, further information will be available from a poisons centre. The label may also include a brief indication of the line of treatment.
- By what route did the patient absorb the pesticide?
- For how long was the patient exposed, and when did exposure cease? Has exposure in fact ceased? Is the patient still wearing contaminated clothing, or is the stomach full?
- What was the time between exposure and the onset of symptoms?

Subsidiary points

- Once it has been established that a pesticide is the probable cause, time should not be lost in obtaining a detailed history. If an insecticide was being used, treatment with an initial dose of atropine should be started if the patient has cholinergic symptoms or signs. This may be lifesaving. All the details mentioned above should be recorded on the case history sheet as soon as possible.

Module No. 7 A 2

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 2 Organophosphorus poisoning

Level: Advanced

Main points

- After ingestion, the onset of symptoms is usually rapid, within a few minutes to 1–3h. The clinical effects vary according to the amount ingested. All the symptoms and signs can occur in various combinations and can manifest at different times, ranging from a few minutes to many hours, depending on the chemical, dose and route of exposure.
- There may be a delay of several hours after exposure before the signs and symptoms become evident. The delay tends to be longer with more lipophilic compounds, which also require metabolic activation.
- Symptoms may increase in severity for more than 1 day and may last for several days. In severe cases, respiratory failure is a dominant effect.
- The signs and symptoms of acute organophosphorus poisoning are an expression of the effects caused by excess acetylcholine (cholinergic syndrome); they may occur in various combinations and can manifest at different times. The signs and symptoms can be classified into muscarinic effects, nicotinic effects and central nervous system effects.
- According to the degree of the severity of poisoning, the following signs and symptoms can occur:
- Mild: anorexia, headache, dizziness, weakness, anxiety, substernal discomfort, fasciculations of the tongue and eyelids, miosis and impairment of visual acuity
- Moderate: nausea, salivation, bronchorrhoea, lachrymation, abdominal cramps, diarrhoea, vomiting, sweating, hypertension and muscular fasciculations.
- Severe: miosis or mydriasis, non-reactive pupils, dyspnoea, respiratory depression, pulmonary oedema, cyanosis, loss of sphincter control, convulsions, hypotension, coma, bradycardia or tachycardia, cardiac ischaemia, cardiac dysrhythmia, hypokalaemia and hyperglycaemia. Acute pancreatitis has also been observed. Muscular paralysis may involve the respiratory muscles.
- Some organophosphorus pesticides cause delayed peripheral neuropathy.
- An ‘intermediate syndrome’ has been described, which occurs after initial improvement, 1–8 days after poisoning. Muscle weakness leading to paralysis and sudden respiratory arrest occur.

Subsidiary points

- In the absence of a reliable history, the diagnosis of organophosphorus poisoning may be initially clinical, as it is based on the clinical features given above. A foul smell (much like garlic) may be present in the breath, faeces or vomitus or in contaminated clothing, if sulfur-containing insecticides have been ingested.
- A favourable response to atropine is a more useful diagnostic aid than a cholinesterase assay, as treatment must often be initiated before laboratory results become available.
- The laboratory tests include a complete blood cell count, serum electrolyte levels, arterial pH and blood gases, blood glucose, liver function tests and urine analysis. Investigations may also include an electrocardiogram and chest X-ray.
- Cholinesterase activity is helpful in diagnosing organophosphorus pesticide poisoning but not in managing the illness. Red cell (acetyl-) cholinesterase activity is a more accurate measure of poisoning. Blood should be drawn into a heparinized tube before treatment is begun. In cases of unknown organophosphorus poisoning, the first aspirate or the pesticide formulation, if available, can be used to identify the type of organophosphorus pesticide.

Module No. 7 A 3

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 3 Carbamate poisoning

Level: Advanced

Main points

- Generally, the clinical effects are not as severe as those seen with organophosphorus pesticides; as carbamates do not penetrate the central nervous system as effectively as organophosphorus pesticides, they have more limited toxicity. Ingestion of large amounts of carbamate can, however, result in severe, protracted symptoms, including unconsciousness lasting days.
- Controlled studies in humans indicate that symptoms can be seen a few minutes after exposure and can last for a few hours. Thereafter, recovery starts: the symptoms disappear within hours, and the cholinesterase activity in erythrocytes and plasma returns to normal, as the carbamate is rapidly metabolized and the metabolites excreted.
- The clinical picture of carbamate intoxication results from accumulation of acetylcholine at nerve endings. The signs and symptoms can be categorized into:
 - muscarinic manifestations: increased bronchial secretion, excessive sweating, salivation and lachrymation, pinpoint pupils, bronchoconstriction, abdominal cramps (vomiting and diarrhoea) and bradycardia
 - nicotinic manifestations: fasciculation of fine muscles (in severe cases, the diaphragm and respiratory muscles are also involved) and tachycardia.
 - central nervous system manifestations: headache, dizziness, anxiety, mental confusion, convulsions, depression of respiratory centre and coma.
- These signs and symptoms can occur in various combinations and can vary in onset and sequence, depending on the chemical, dose and route of exposure. The duration of symptoms is usually shorter than that observed in organophosphorus poisoning. Mild poisoning might include muscarinic and nicotinic signs only. Severe cases always show central nervous system involvement; the clinical picture is dominated by respiratory failure, sometimes leading to pulmonary oedema due to a combination of the above-mentioned symptoms.

Subsidiary points

- The diagnosis is based on the history of exposure and the characteristic presentation of muscarinic, nicotinic and central nervous system effects of an excess of acetylcholine.
- The diagnosis is confirmed by measuring acetylcholinesterase in red blood cells or plasma (pseudocholinesterase). In view of the rapid reversibility of the signs, particular care should be taken to use analytical procedures that include immediate analysis and careful control of sample dilutions. Chemical analysis of body fluids (gastric lavage, blood, urine) should be performed for identification.

Module No. 7 A 4

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 4 Organochlorine poisoning

Level: Advanced

Main points

- Poisoning by organochlorine pesticides is uncommon. It can be caused by massive contamination, occupational exposure or accidental or deliberate ingestion. The signs and symptoms are all related to excitation of the central nervous system by these compounds.
- The onset of signs and symptoms may occur within hours of exposure. Initially, the central nervous system effects include headache, apprehension, excitement and dizziness. In severe cases, these may be followed by disorientation, vomiting, muscle weakness, tremors and epileptiform convulsions leading to death.
- After treatment, recovery is usually complete within 1–3 days. No sequelae or persistent disability is expected.

Subsidiary points

- Laboratory tests can be carried out to confirm the diagnosis: These consist of detection of the compound at an adequate level in blood or urine. The tests take time and can be carried out only in well-equipped, experienced laboratories. There is no specific antidote. Treatment should never be delayed until the results of tests are available.
- The detection of small amounts of organochlorine compounds in biological material is very common and only indicates exposure at some time in life.

Module No. 7 A 5

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 5 Pyrethroid poisoning

Level: Advanced

Main points

- The onset of symptoms varies with factors such as the route of absorption and the quantity absorbed.
- In patients exposed occupationally, skin symptoms usually develop within 4–6h, and systemic symptoms occur as late as 48 h after exposure. Paraesthesia of the facial skin can develop about 30 min after exposure but does not usually last more than 24 h after termination of exposure.
- After ingestion, the initial symptoms involve the gastrointestinal tract and develop 10–60 min after exposure. Patients with acute oral poisoning usually have clear digestive symptoms, such as epigastric pain, nausea and vomiting. Severely poisoned patients may have frequent convulsive attacks, coma or pulmonary oedema.
- The prognosis is good if treatment is given, usually with full recovery even of severely poisoned patients. Death may occur from respiratory paralysis.

Subsidiary points

- The diagnosis should be made on the basis of verified exposure to a pyrethroid pesticide, the corresponding symptoms and signs and reasonable exclusion of other diseases.
- The facial skin sensations that may be experienced by people handling pyrethroids can be considered an early warning signal that exposure has occurred.
- The only laboratory test available is for blood or urine concentrations of the compound or its metabolite. This is a very sophisticated test and is not recommended, especially as few tests can be carried out in time to provide significant results.

Module No. 7 A 6

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 6 Anticoagulant rodenticide poisoning

Level: Advanced

Main points

- Accidental ingestion of small doses is usually asymptomatic and does not require specific treatment. The exception is ingestion of superwarfarins such as brodifacoum.
- The onset of clinical signs of poisoning may be delayed for several days after exposure to a single large dose or until after a few weeks of repeated ingestion of small doses. The signs of poisoning are epistaxis and bleeding gums; pallor and sometimes petechial rash; massive ecchymoses or haematomata (especially of articulating joints); blood in urine and faeces; occasional paralysis due to cerebral haemorrhage; and haemorrhagic shock and death.

Subsidiary point

- Laboratory investigation and follow-up of poisoning include international normalized ratio or prothrombin time.

Module No. 7 A 7

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 7 Calciferol derivative poisoning

Level: Advanced

Main points

- The symptoms include anorexia, nausea, vomiting, weight loss, fatigue, headache and weakness. Many of the other effects of chronic vitamin D toxicity are due to induced hypercalcaemia. Polyneuropathy may be seen. Cardiac arrhythmias and myocardial infarct can occur after long-term ingestion of high doses.
- Long-term exposure can cause metastatic calcification of the renal tubules, resulting in albuminuria, nocturia, polydipsia and polyuria
- Serum calcium and phosphate levels should be monitored closely. Vitamin D is usually estimated in a specialized laboratory.

Module No. 7 A 8

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 8 Fluoroacetate poisoning

Level: Advanced

Main points

- After a latent period of 6h or more after exposure, minor symptoms may be seen, including vomiting, tingling of the nose and numbness of the face. The serious symptoms can be broadly divided into neurological and cardiac effects. The central nervous system effects include tremulousness, hallucinations, convulsions and respiratory depression. The cardiovascular effects include hypertension, then hypotension, arrhythmias, cardiac failure, ventricular fibrillation and cardiac arrest. The clinical outcome appears to be either death or complete recovery, although there is some evidence of long-term cardiac damage.

Module No. 7 A 9

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 9 Zinc phosphide poisoning

Level: Advanced

Main points

- Common symptoms and signs are nausea, vomiting, abdominal pain, loose stools, restlessness, low volume pulse, tachycardia, tachypnoea, acidosis, marked hypotension, dizziness, headache, dyspnoea and pulmonary oedema. Acute respiratory distress syndrome, cardiac disturbance, neuronal damage, lung insufficiency and liver and kidney dysfunction may occur. There can be neurobehavioural changes like ataxia, stupor and tremors, which may be followed by convulsions and coma.

Module No. 7 A 10

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 10 Chloralose poisoning

Level: Advanced

Main points

- Vomiting, vertigo, trembling and a sensation of inebriation followed by coma may occur. In cases of massive intoxication, coma may occur within some minutes, but it usually develops after one to several hours. Increased pulmonary secretions have also been noted. Fever may be marked, up to 41°C (in contrast to the hypothermia often observed in smaller mammals or birds).
- There may be agitation and myoclonia. Myoclonic jerks, either spontaneous or after minimal stimuli, and salivary hypersecretion are considered typical. There is debate as to whether the occasional severe seizures are truly epileptic or whether they represent bilateral synchronous myoclonic disturbances. The latter view is supported by a poor correlation with electroencephalogram abnormalities.
- Comatose patients usually regain consciousness after some hours or after at least 12–24h in cases of severe poisoning. One reported fatality was due to circulatory collapse.

Module No. 7 A 11

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 11 Thallium poisoning

Level: Advanced

Main points

- In acute thallium poisoning, the onset of symptoms is often insidious, reaching a maximum in the second or third week after exposure. The signs and symptoms are:
 - initial clinical features including gradual development of gastrointestinal disturbance (severe constipation), hyperaesthesia, paraesthesia and hyperalgesia of the lower limbs (affecting the sole of the foot in particular), followed by motor weakness of the lower limbs and foot drop;
 - at the end of the second week, the characteristic symptom of hair loss; and
 - psychiatric disturbances, ranging from hysteria to complete psychosis.
- The signs and symptoms of severe poisoning are:
 - encephalopathy and retrobulbar neuritis and
 - early death due to myocardial failure.

Module No. 7 A 12

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 12 Paraquat and diquat poisoning

Level: Advanced

Main points

- Paraquat is not absorbed readily through intact skin, unless contact is prolonged. If it is swallowed accidentally or deliberately, the effects are catastrophic, with very high mortality. The clinical course of paraquat poisoning is as follows:
 - immediate onset, with corrosive effects on the mouth and pharynx, leading to ulceration;
 - in severe cases, rapid death from pulmonary oedema and acute oliguric renal failure;
 - in less severe cases, signs of renal impairment and liver damage; anxiety, ataxia and convulsions may occur;
 - pulmonary fibrosis at the end of the first week, even if the patient is showing signs of improvement, with gradually increasing dyspnoea and hypoxaemic pulmonary failure.
- Diquat poisoning is less common. The clinical course is as follows:
 - immediate onset, with corrosive effects on the mouth and pharynx;
 - in severe cases, vomiting and diarrhoea within hours, with disordered liver function and proteinuria;
 - metabolic acidosis with thrombocytopenia and anuria;
 - disorientation and convulsions;
 - in severe cases, death from renal or cardiac failure within the first week;

Recovery is usually complete, and the delayed pulmonary effects seen with paraquat do not occur.

Module No. 7 A 13

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 13 Glyphosate poisoning

Level: Advanced

Main points

- The clinical manifestations after ingestion of glyphosate vary according to the severity of poisoning.
- Mild: stomach cramps, nausea and vomiting, diarrhoea, mouth and throat pain, hypersalivation
- Moderate: gastrointestinal tract ulceration, hypotension, hypovolaemic shock, hepatic damage, renal damage
- Severe: respiratory failure, renal failure, respiratory pneumonitis, secondary organ dysfunction, seizures, coma, death
- The manifestations of glyphosate poisoning also vary according to route of exposure.
- Eye: conjunctival irritation, conjunctivitis, periorbital oedema, nystagmus
- Inhalation: voice alterations, raspy feeling in the throat, fatigue, headache, rash, unexplained fall in blood pressure
- Skin (with high concentration of surfactant): irritation, corrosion

Module No. 7 A 14

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 14 2,4-Dichlorophenoxyacetic acid poisoning

Level: Advanced

Main points

- The manifestations of acute toxicity due to 2,4-dichlorophenoxyacetic acid (2,4-D) include:
 - dermal burns with concentrated solutions (> 12%);
 - vomiting, nausea and diarrhea;
 - cardiac arrhythmia (bradycardia or sinus tachycardia);
 - elevated lactic dehydrogenase and alanine and aspartate aminotransferase activity;
 - tonsillitis, paranasal sinusitis and contact eczema;
 - thrombocytopenia;
 - myoglobinuria, rhabdomyolysis

Subsidiary points

- Fatalities have been reported after ingestion of amounts ranging from 80 mg/kg body weight to 3g/kg body weight.
- Chronic tonsillitis and paranasal sinusitis were reported among workers packaging 2,4-D sodium salt.

Discussion point

- Have you seen cases of severe 2,4-D poisoning after prolonged dermal exposure from a leaking knapsack sprayer?

Training note

- The peak plasma concentration after an oral dose of 5mg/kg body weight was 35mg/l at 24h. A plasma concentration > 100mg/l was associated with coma.

Module No. 7 A 15

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 15 Pentachlorophenol poisoning

Level: Advanced

Main points

- The clinical manifestations of acute systemic poisoning with pentachlorophenol are: headache, nausea, thirst, abdominal colic, tachypnoea, depression, weakness, chest pain, sometimes fever, profuse sweating and tachycardia. Mental distress can occur, progressing to coma and occasionally convulsions.
- When pentachlorophenol is inhaled, there can be irritation of the skin, mucous membranes and respiratory tract, including painful irritation of the nose and intense sneezing.
- After dermal exposure, contact dermatitis and chloracne may develop.
- Long-term exposure can cause porphyria cutanea tarda, weight loss, increased basal metabolic rate, functional changes to the liver and kidneys, insomnia and vertigo.

Module No. 7 A 16

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 16 Arsenic poisoning

Level: Advanced

Main points

- Diagnosis is based on history, symptoms, signs and laboratory investigations, but treatment should start at the first suspicion of poisoning. The diagnosis can be confirmed by quantifying arsenic in urine in acute cases and in hair after long-term exposure.
- Acute arsenic ingestion generally produces signs and symptoms within 30 min, but onset may be delayed for several hours. The initial signs and symptoms of arsenic ingestion include burning lips, throat constriction and dysphagia, followed by intense abdominal pain, haemorrhagic gastritis, gastroenteritis, severe nausea, vomiting, profuse 'rice water-like' diarrhoea, with hypovolaemia that may result in hypotension and an irregular pulse. Muscle cramps, dyspnoea, chest pain, dehydration, intense thirst and fluid–electrolyte disturbances are also common after significant exposure. A garlic-like odour may be found in the breath and faeces.
- Encephalopathy, with headache, lethargy, mental confusion, hallucinations, emotional lability, memory loss and delirium may occur; seizures, stupor, convulsions, coma and death may follow within 24h of severe acute exposure. Dysrhythmia (particularly QTc prolongation and torsade de pointes), cardiomyopathy, acute respiratory distress syndrome, hepatitis, rhabdomyolysis, haemolysis and renal failure may develop over several days. Peripheral polyneuropathy, skin eruptions, alopecia and Mees lines may develop days to weeks after acute exposure. Anaemia, leukopenia and thrombocytopenia may occur.
- After acute arsenic poisoning, barium-like opacities may be seen on abdominal X-rays. Owing to the toxic action of inorganic arsenic on the gastrointestinal tract in acute poisoning and the subsequent liquid losses, special attention should be paid to the fluid–electrolyte balance to prevent cardiovascular toxicity.
- The main causes of early death are hypovolaemia, cardiac arrhythmia and cardiovascular failure.

Module No. 7 A 17

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 17 Organic mercury poisoning

Level: Advanced

Main points

- The initial phase of acute poisoning after ingestion, lasting up to 36 h, includes immediate and painful erosion of the oral and pharyngeal mucosa.
- Rapid progression of transient neurotoxic effects follows, which many include fine tremors of the hands and face, ataxia, paresis, tunnel vision and delirium similar to those seen with alkyl mercury poisoning. Abdominal upset occurs within minutes, involving epigastric pain followed by diffuse abdominal pain, vomiting of mucus containing blood and mucosal shreds, tenesmus, diarrhoea and haemorrhage.
- General malaise and a metallic taste sensation with profuse salivation and excessive thirst follow.
- Within hours, cardiovascular and respiratory signs appear, which can include tachycardia leading to fibrillation, falling blood pressure, shallow breathing, pallor, prostration and finally collapse. Death, if it occurs, is usually due to cardiac failure.
- If the first phase is survived, the second phase may follow 1–3 days after exposure, unless the dose was small or persistent purging and vomiting have effectively eliminated the compound from the gut. This phase is similar to the second phase of inorganic mercury poisoning and may include:
 - membranous colitis with dysentery, tenesmus, ulceration and haemorrhage;
 - stomatitis characterized by glossitis, ulcerative gingivitis with profuse salivation and major oral complications;
 - renal tubular necrosis, progressing through transient polyuria, albuminuria, cylinduria and anuria;
 - recovery or azotaemia and renal acidosis leading to death from complete renal failure.
- Liver necrosis as evidenced by increased serum alanine and aspartate aminotransferase activity is infrequent.
- Without treatment, death follows 10–14 days after exposure.

Module No. 7 A 18

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 18 Organotin poisoning

Level: Advanced

Main points

- Organotin pesticides cause excessive salivation, sore throat and coughing and drowsiness. If exposure is heavy, central nervous system depression and unconsciousness occur.
- They are severe eye irritants, and lachrymation may be the earliest sign.
- Contact with the skin will result in moderate irritation. Discolouration of the skin may result. Repeated or prolonged skin contact may lead to irritant contact dermatitis. The compounds can be absorbed through the skin, with resulting toxic effects, particularly on the nervous system. Tributyltin oxide is a potent skin irritant but has a delayed effect, burns from splashes not showing for at least 1 h. In some cases, dermatitis and rashes appear 8–10h after exposure.
- Evidence from tests in animals and studies on exposed workers indicates that repeated or prolonged exposure to this chemical could result in cumulative effects, producing loss of body weight as well as adverse liver, kidney and central nervous system effects, possible respiratory depression and occasional fatalities.

Module No. 7 A 19

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 19 Copper salt poisoning

Level: Advanced

Main points

- The symptoms of mild intoxication generally include nausea, vomiting, diarrhoea and excess salivation (sialorrhoea).
- In severe cases, haematemesis, melaena, intravascular haemolysis, jaundice, haemoglobinaemia, oliguria, acute hepatic necrosis, hypotension, coma and death have been reported. Acute pancreatitis, myoglobinuria and methaemoglobinaemia have also been observed.
- Gastrointestinal symptoms and intravascular haemolysis are particularly common in patients with or developing renal failure. It is thought that haemolysis may play a role in the latter condition. While it is known that copper is toxic to renal tubular cells, the kidney may not receive an acutely toxic load unless copper is released from the liver or from erythrocytes, which can occur in a haemolytic crisis. The resulting tubular damage is considered to be one factor, although haemolysis products, dehydration and hypotension are also important.
- Prolonged or repeated exposure to copper dusts can cause irritation of the mucous membranes, runny nose and atrophic changes. Nasal ulceration and perforation have also been reported.
- Long-term ingestion of copper can lead to diarrhoea, progressive wasting, prostration, red extremities, hypotonia, photophobia, peripheral oedema and liver abnormalities.
- Repeated inhalation of copper sulfate mists (e.g. Bordeaux mixture) can induce a condition known as 'vineyard sprayer's lung', which is asymptomatic until later stages, when granulomas are found in the liver and lungs. The symptoms include weakness, malaise, loss of appetite and weight, cough and greenish-brown sputum.

Module No. 7 A 20

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 20 Thiocarbamate poisoning

Level: Advanced

Main points

- In view of the low toxicity of this compound, serious symptoms are unlikely. A disulfiram-like reaction (flushing, sweating, headache, weakness, tachycardia and hypotension) may be seen when ethanol is ingested after exposure to large amounts of thiocarbamates.
- Some of these agents may be formulated with hydrocarbon-based solvents, which may have toxic effects.
- Dermal exposure can cause irritation and dermatitis in sensitive individuals. Inhalation of high concentrations of dust or spray can lead to pharyngitis, rhinitis, bronchitis and conjunctivitis. Inhalation of dusts that contain manganese and zinc can cause progressive poisoning.

Module No. 7 A 21

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 21 Methyl bromide poisoning

Level: Advanced

Main points

- Methyl bromide is an odourless, colourless liquid or gas. At high airborne concentrations, it irritates the eyes, skin and mucous membranes. Absorption occurs readily through the lungs and to a lesser extent through the skin. Onset of toxicity may be delayed by 4–12h and may be limited to headache, nausea, vomiting and visual changes.
- Massive exposure may result in pneumonitis, pulmonary oedema, intracranial haemorrhage, paralysis, seizures, coma, chronic neurologic dysfunction or death.
- The signs and symptoms may include blurred or double vision, nystagmus, hypotension, cough, tachypnoea, cyanosis, lethargy, profound weakness, dizziness, slurring of speech, hyperreflexia, albuminuria, haematuria, oliguria, anuria and impaired liver function. Memory loss, confusion, delirium, euphoria, disorientation, agitation and hallucinations may occur.
- Dermal contact with the liquid can cause a tingling or burning sensation, itching, redness, and swelling; contact with large amounts may cause numbness or aching pain, blisters, papules, vesicles or chemical burns.
- Death may occur within a few days due to circulatory failure or pulmonary oedema and multiple organ failure.

Module No. 7 A 22

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 22 Chloropicrin poisoning

Level: Advanced

Main points

- Chloropicrin is both a lachrymal and a lung irritant, the most severe toxicity resulting from inhalation. It causes severe irritation of the eyes, skin and mucous membranes of the respiratory and gastrointestinal tracts, which results in nausea, vomiting, difficulty in breathing, headache, dizziness, cyanosis, pulmonary oedema, and death in severe cases.
- Chloropicrin has been used as a choking agent in warfare. More severe injury is produced to the medium and small bronchi than to the trachea and large bronchi. Pulmonary oedema occurs and is the most frequent cause of early death. The toxicity of this substance is thought to be intermediate between that of chlorine and phosgene.
- Acute ingestion can cause oral burns, sore throat, vomiting, oesophageal and stomach burns, difficulty in breathing, headache, dizziness and cyanosis.
- Skin and eye contact may result in severe irritation and damage.

Module No. 7 A 23

Module: 7 Medical treatment of pesticide poisoning

Subject: A Signs and symptoms

Number: 23 Sulfuryl fluoride poisoning

Level: Advanced

Main points

- Dyspnoea, irritation and pulmonary oedema can occur. Cardiac dysrhythmia and hypotension may develop in patients with severe poisoning.
- Weakness, restlessness, seizures and central nervous system depression may occur. Nausea, vomiting, drooling and faecal incontinence may be seen after acute exposure by ingestion.
- Long-term exposure can be associated with olfactory deficits and subclinical central nervous system effects.

Module No. 7 B 1

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 1 General principles

Level: Advanced

Main points

- Treatment of any case of pesticide poisoning depends on the history of exposure and the chemical concerned. Treatment must never be delayed pending the result of a laboratory test. The supportive therapy is the same as for any chemical poisoning. Specific antidotes should be used as soon as possible.
- The following is a suggested sequence of treatment:
 1. Check vital signs and apply resuscitative measures if required.
 2. Give antidote(s) if required.
 3. Check need to stop further absorption by removing wet clothing, decontaminating the skin or emptying the stomach (except in paraquat poisoning). If the patient is obtunded within 1 h of ingestion, gastric lavage with endotracheal intubation might be considered.
 4. Monitor the progress of the patient frequently over the first few hours and regularly for days, as required.
 5. Keep full notes on case progress.

Subsidiary points

- In areas of heavy pesticide usage, stocks of antidotes should be readily available.
- The possibility of pesticide poisoning should be borne in mind in treating attempted suicides. In some countries, pesticides are frequently used for this purpose because of the ready availability of highly toxic formulations.
- A poison centre or trained medical personnel should be consulted for appropriate guidance in management of the patient.

Module No. 7 B 2

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 2 Organophosphorus poisoning

Level: Advanced

Main points

- In cases of massive overdose, acute respiratory failure may occur. It is important to keep the airways open and to prevent aspiration if nausea and vomiting occur. The patient should be atropinized early. Oxygen should be administered early if necessary. The patient must be watched constantly, and respiratory support should be instituted if necessary. In the case of ingestion, gastric aspiration followed by lavage should be performed within 1 h. Activated charcoal may be effective.
- The patient should be observed carefully during the early stages of treatment, because the principal concern is severe respiratory depression. Certain drugs, such as phenothiazines, methylxanthines, central nervous system depressants and parasympathomimetic agents, are to be avoided. Drugs metabolized by plasma cholinesterase are contraindicated.
- When muscarinic signs are present, organophosphate pesticide poisoning must be treated with atropine. The oximes, such as pralidoxime or obidoxime, may also be indicated. Diazepam is used to treat seizures.
- Atropine: An initial intravenous dose of 1–2mg (0.05mg/kg body weight) should be administered and then the patient reassessed for signs of atropinization (loss of salivation and bronchial hypersecretion, reversal of bradycardia). If the patient is not atropinized, significant toxicity will ensue and will require further doses of atropine given at 5-min intervals until signs of atropinization occur. In severe cases, the atropine requirements are high, and subsequent doses can be doubled until the patient is atropinized (e.g. 1mg, 2mg, 4mg, 8mg). If intravenous therapy is not possible, atropine may be given intramuscularly. In severe cases, both tachycardia and mydriasis may be unreliable features, as they may result from nicotinic stimulation.
- Pralidoxime: The effective dose regime for pralidoxime has not been established. A commonly used intravenous dose is 1 g in 20ml of water given slowly (less than 500 mg/min). For a child, 20–50mg/kg body weight should be given, depending on the severity of poisoning. Pralidoxime may be repeated within 1–2h and then every 4–6h. In cases of severe poisoning, these doses may be doubled and preferably administered as an intravenous infusion (in 250ml of 5% dextrose over 30 min); however, this regime has been criticized as being likely to produce sub-therapeutic oxime levels. An alternative regime, supported by WHO, is 2g loading dose and 500mg/h by continuous infusion. This regime is more likely to give a constant therapeutic concentration that may be of benefit in severe poisoning.

- Obidoxime: The adult dose is usually 3mg/kg body weight given by slow intravenous infusion; the dose can be given intramuscularly when the intravenous route is inaccessible. The maintenance dose is 0.4 mg/kg body weight per h.
- Diazepam: The adult dose is 5–10mg (0.2–0.3mg/kg body weight) by slow intravenous administration over 3 min. The dose may be repeated to control convulsions up to a maximum of 30mg, beyond which the patient may require intubation.
- Some organophosphorus pesticides cause delayed peripheral neuropathy. There is no specific therapy for this condition except symptomatic measures; e.g. physiotherapy.

Subsidiary point

- Atropine is life saving, and hundreds of milligrams have been given to severe cases within the first 24h.

Module No. 7 B 3

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 3 Carbamate poisoning

Level: Advanced

Main points

- The patient should be evaluated and the airways, breathing and circulation supported. Oxygen should be given to symptomatic patients. In the case of ingestion, activated charcoal should be given, or, if the patient is obtunded within 1 h of ingestion, gastric lavage with endotracheal intubation may be undertaken. Emesis should not be induced because of the risk of sudden seizures, coma or respiratory depression.
- Specific treatment is atropine intramuscularly or intravenously. An initial intravenous dose of 1–2mg (0.05mg/kg body weight) should be administered and then the patient reassessed for signs of atropinization (loss of salivation and bronchial hypersecretion, reversal of bradycardia). If the patient is not atropinized, significant toxicity will ensue and will require further doses of atropine given at 5-min intervals until signs of atropinization occur. In severe cases, the atropine requirements are high, and subsequent doses can be doubled until the patient is atropinized (e.g. 1mg, 2mg, 4mg, 8mg). If intravenous therapy is not possible, atropine may be given intramuscularly. In severe cases, both tachycardia and mydriasis may be unreliable features, as they may result from nicotinic stimulation.
- When dermal exposure occurs, the decontamination procedures include removal of contaminated clothes and copious irrigation.
- After ocular exposure, extensive irrigation with water or saline should be performed.

Subsidiary point

- Reactivation of cholinesterase is spontaneous and rapid. Pralidoxime should not be used unless there is evidence of severe nicotinic symptoms.

Module No. 7 B 4

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 4 Organochlorine poisoning

Level: Advanced

Main points

- There is no specific antidote for organochlorine poisoning. The aim of treatment is symptomatic and supportive, to maintain ventilation and control hyperactivity and convulsions.
- If the compound has been ingested recently, use of gastric lavage and activated charcoal should be considered.
- If the compound has been absorbed through the skin, soap and water decontamination should be thorough.
- To control or prevent convulsions, diazepam should be used, at doses of 5–10mg intravenously for adults and 0.3mg/kg body weight for children.

Subsidiary point

- Monitoring must be continued for several days.

Module No. 7 B 5

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 5 Pyrethroid poisoning

Level: Advanced

Main points

- There is no specific antidote. Treatment is essentially symptomatic and supportive after decontamination to prevent further absorption.
- The skin irritation and paraesthesia that follow dermal exposure are self-limiting and can be alleviated with topical vitamin E cream, after washing of the skin and area affected to remove any contamination.

Module No. 7 B 6

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 6 Anticoagulant rodenticide poisoning

Level: Advanced

Main points

- Decontamination is indicated after deliberate ingestion of anticoagulants by adults. Immediate testing of coagulation status with an international normalized ratio (INR) is only required when:
 - There are obvious signs of haemorrhage.
 - The patient is receiving anticoagulant therapy.
 - There is possible long-term or repeated ingestion of the anticoagulant.
 - The time of ingestion is unknown or unreliable.
- The INR measurement should be repeated 24 and 48h after ingestion.
- Rapid treatment of severe haemorrhage is essential and requires clotting factor concentrate or fresh frozen plasma and replacement of lost blood. Only vitamin K1 should be used as an antidote; the vitamin K analogue menadione (vitamin K3) or any other vitamin K analogue should not be used for treatment of anticoagulant overdose.
- Persons receiving anticoagulation for other clinical reasons should be managed cautiously, including heparinization, and re-institution of oral anticoagulant therapy should be monitored carefully.
- If the INR is < 5 , treatment may not be needed; however, use of oral vitamin K1 to correct coagulopathy is a reasonable precaution based on clinical judgement. For administration of fresh frozen plasma, patients should be classified according to the severity of poisoning. For those taking anticoagulation drugs, use of heparin of low relative molecular mass should be checked. The oral doses of vitamin K1 are 0.25mg/kg of body weight for children and 10 mg for adults.
- If the INR is 5 or greater, it is appropriate to use high oral doses of vitamin K1 to reverse the warfarin effect rapidly and completely. The doses in this case are at least 0.25mg/kg body weight for children and at least 20mg for adults.
- In cases of severe haemorrhage, after emergency stabilization, oral vitamin K1 is recommended (provided gut absorption is not compromised), as appropriate stabilization of haemorrhage will rapidly reverse coagulopathy. Dosing is required throughout the day to maintain the effect.

Module No. 7 B 7

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 7 Calciferol derivative poisoning

Level: Advanced

Main points

- Gastrointestinal decontamination is not recommended after ingestion of this substance, as its acute toxic effects after inadvertent ingestion or overdose are unknown. There are no antidotes.
- Fluids and electrolytes, particularly calcium, should be monitored. In patients who are hypercalcaemic, the electrocardiogram should be monitored and the need for glucocorticoid therapy evaluated. For example, prednisone at a dose of 1mg/kg body weight per day to a maximum of 20mg/day should be administered for 1–2 weeks, thereby decreasing plasma calcium. Rebound increases in plasma calcium may occur upon discontinuation of prednisone.
- Severe hypercalcaemia that does not respond to other treatment has been treated with sodium EDTA or mithramycin. These agents should be used with extreme caution. Haemodialysis or peritoneal dialysis against a calcium-free dialysate may be useful.
- Cardiac arrhythmia due to hypercalcaemia may be treated with potassium in cautious doses, under continuous electrocardiogram monitoring.
- Fluids and electrolytes (potassium and sodium) should be replaced with intravenous fluids, as necessary.
- Calcitonin has been used with good results. Steroids have also been found to be effective but slower acting. Chelating agents are ineffective.

Subsidiary points

- Intravenous porcine calcitonin was used to treat three adult patients with vitamin D intoxication at 40 IU intravenously twice daily and a continuous infusion of 120 IU every 12h.
- In animals, calcitonin and prednisolone in combination were successful in reversing hypercalcaemia. In the presence of extensive tissue mineralization, however, this may not be life saving.

Module No. 7 B 8

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 8 Fluoroacetate poisoning

Level: Advanced

Main points

- Induction of emesis is contraindicated (because of potential arrhythmia and convulsions).
- Gastric decontamination should be considered in patients who have ingested the compound recently.
- Cardiac arrhythmia, electrolyte abnormalities and metabolic acidosis should be monitored. Treatment is symptomatic and supportive.

Module No. 7 B 9

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 9 Zinc phosphide poisoning

Level: Advanced

Main points

- Emesis is contraindicated as it may off-gas phosphine and could pose a risk of secondary contamination of medical staff, particularly in enclosed areas. If spontaneous vomiting occur, the vomitus should be isolated quickly.
- Gastric lavage should be considered in cases of ingestion of potentially life-threatening amounts, if it can be performed soon after exposure. Activated charcoal may also be useful.
- Treatment is symptomatic and supportive.

Module No. 7 B 10

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 10 Chloralose poisoning

Level: Advanced

Main points

- Emesis is contraindicated, as the patient may have impaired central nervous system function.
- Gastric lavage is recommended for ingestion of more than 15mg/kg body weight by adults and more than 20mg/kg body weight by young children.
- Single-dose activated charcoal may be useful up to 30–60 min after a potentially toxic dose of a liquid substance and 4 h after a solid dose.

Module No. 7 B 11

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 11 Thallium poisoning

Level: Advanced

Main points

- A diagnosis of poisoning is based on a characteristic clinical presentation and on laboratory confirmation of thallium in biological fluids. Use of gastric lavage should be considered after ingestion of a potentially life-threatening amount of substance, if it can be performed soon after exposure. Use of activated charcoal should also be considered.
- Diuretics should be used until urinary thallium excretion is less than 1 mg/24 h. The possibility of heart failure due to impairment of the pacemaker function of the heart and myocardial contractility should be monitored.
- Charcoal haemoperfusion has been shown to be successful if performed within 48 h of ingestion of thallium, and therefore during the distribution phase.

Module No. 7 B 12

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 12 Paraquat and diquat poisoning

Level: Advanced

Main points

- Similar treatment is given for poisoning with the two compounds. There are no specific antidotes. Treatment is aimed at reducing absorption in the gut and at removal of adsorbed compound. Gastric lavage is contraindicated. As soon as possible, 300g of Fuller earth or 70g of bentonite in 1 l of water should be given. Activated charcoal should also be given, if available.
- Treatment of absorbed compound is symptomatic. Dialysis has been tried but has usually been ineffective. In symptomatic patients, immunosuppression with high-dose steroids and cyclophosphamide has been suggested as treatment.
- After acute ingestion of paraquat, oxygen is contraindicated unless the patient is hypoxic as paraquat is more toxic in the oxygenated lung.

Subsidiary point

- The mortality rate in large clinical series is 40%. Recovery is usually complete, but the prognosis is very poor once delayed pulmonary effects have been established.

Module No. 7 B 13

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 13 Glyphosate poisoning

Level: Advanced

Main points

- In patients poisoned with glyphosate, the important steps in treatment are decontamination and supportive care.
- For decontamination, induction of vomiting is not recommended. Use of activated charcoal should be considered after ingestion of large amounts. If the eyes have been exposed, they should be irrigated with copious amounts of clean water for at least 15 min. All clothing should be removed, and the skin and hair should be washed.
- There is no specific antidote for glyphosate poisoning. Supportive care includes providing adequate respiratory support and supporting the cardiovascular system to avoid shock.

Subsidiary point

- Haemodialysis may effectively remove glyphosate but not the surfactant, as this is a large molecule. There is no clear evidence that accelerating glyphosate removal in patients with normal kidney function has additional benefit.

Discussion point

- What laboratory examinations should be ordered in a patient with glyphosate poisoning?

Module No. 7 B 14

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 14 2,4-Dichlorophenoxyacetic acid poisoning

Level: Advanced

Main points

- Emergency stabilization should be performed and urgent metabolic problems treated. After an overdose, the other general principles involved in the treatment of 2,4-D poisoning are decontamination, enhancement of elimination and supportive therapy.
- For decontamination, induction of vomiting is not recommended. Gastric lavage with saline solution is effective after recent ingestion. Use of activated charcoal should be considered. If the eyes have been exposed, they should be irrigated with copious amounts of clean water for at least 15 min. All clothing should be removed and the skin and hair washed.
- Forced alkaline diuresis may enhance the elimination and excretion of 2,4-D.
- There is no specific antidote. Supportive care includes providing adequate respiratory and circulatory support, monitoring kidney function and supporting the cardiovascular system to avoid shock.

Subsidiary points

- A patient who has inhaled 2,4-D should be moved to fresh air and monitored for respiratory distress. Preparations should be made to support ventilation.

Discussion point

- What laboratory examinations should be ordered in a patient with 2,4-D poisoning?

Training notes

- 2, 4-D poisoning may present with significant dysrhythmia, requiring cardiac monitoring. Drugs for the treatment of arrhythmia should be available.

Module No. 7 B 15

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 15 Pentachlorophenol poisoning

Level: Advanced

Main points

- Absolute rest is essential. Gastric lavage may be considered in cases of recent ingestion, followed by administration of activated charcoal. No specific antidote or treatment is known.
- Symptomatic and supportive measures are the basis for treatment, irrespective of the route of exposure or absorption. Hospitalization is essential. Hyperthermia should be controlled by sponging or baths of lukewarm water. Antipyretics are not recommended, because they are likely to enhance the toxicity of phenolic compounds. Circulation and ventilation: should be supported by clearing the airways and oxygenating tissues by aspirating secretions and by assisted pulmonary ventilation. Lung oedema may occur after a few hours and may be aggravated by physical effort. Fluids should be replaced, and electrolytes and the acid–base balance checked. Signs of cerebral oedema should be monitored. Urine alkalinization, forced diuresis and exchange transfusion may be considered. Cholestyramine can bind pentachlorophenol in the gastrointestinal tract and prevent absorption; it may be administered as a suspension in water at a dose of 80 mg/kg body weight three times per day.

Module No. 7 B 16

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 16 Arsenic poisoning

Level: Advanced

Main points

- Diagnosis is based on history, symptoms, signs and laboratory investigations, but treatment should start at the first suspicion of poisoning. The diagnosis may be confirmed by quantification of arsenic in urine in acute cases and in hair after long-term exposure.
- After acute, massive arsenic ingestion, barium-like opacities can be seen on abdominal X-rays. Owing to the toxic action of inorganic arsenic on the gastrointestinal tract in cases of acute poisoning and the subsequent liquid losses, special attention must be paid to the fluid–electrolyte balance to prevent cardiovascular toxicity. Hypovolaemia, cardiac arrhythmias and cardiovascular failure are the main causes of early death. Transport of the patient to a hospital and monitoring of vital functions in an intensive care department are therefore mandatory.
- Early gastric decontamination by gastric lavage and activated charcoal is highly recommended. Whole-bowel irrigation should be considered if the presence of arsenic in the lower gastrointestinal tract is observed by X-ray. High urine output with an alkaline pH should be maintained. Chelation therapy with dimercaprol (BAL) and its oral congeners dimercaptosuccinic acid (DMSA) or dimercaptopropane sulfonate (DMPS) should be rapidly envisaged.

Module No. 7 B 17

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 17 Organic mercury poisoning

Level: Advanced

Main points

- Treatment of mercury poisoning generally requires the use of sulfhydryl-containing chelation agents, including the parenterally administered dimercaprol (BAL) and its oral congeners dimercaptosuccinic acid (DMSA) and dimercaptopropane sulfonate (DMPS). While chelation therapy has been used successfully in hastening the elimination of mercury in patients who have ingested mercury salts or inhaled elemental mercury, recent evidence suggests that none are effective in poisoning due to organic mercury. In one patient who ingested a toxic dose of thiomersal (organomercurial bactericide), however, treatment with both dimercaptosuccinic acid and dimercaptopropane sulfonate may have prevented uptake and transport into the central nervous system or may have promoted gastrointestinal excretion. If this observation is correct, dimercaptosuccinic acid and dimercaptopropane sulfonate might be effective early in the clinical course.
- Dimercaprol (BAL) is considered to be contraindicated in exposure to organic mercury because of its tendency (in experimental animals) to redistribute mercury into the brain.

Module No. 7 B 18

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 18 Organic tin poisoning

Level: Advanced

Main points

- Organic tin poisoning is treated symptomatically and supportively.

Module No. 7 B 19

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 19 Copper salt poisoning

Level: Advanced

Main points

- Whole-bowel irrigation is recommended after ingestion of potentially severely toxic doses, as activated charcoal is not an effective decontaminant. The only irrigant recommended is polyethylene glycol electrolyte solution. Chelating agents have been recommended in severe copper poisoning, although there are few pharmacokinetic data on which to evaluate their effectiveness. While some kinetic data suggest a role for chelating agents like dimercaprol, the available data do not suggest a significant clinical benefit of large doses of copper. Their use can be complicated by the development of renal failure (to which they could potentially contribute).
- Haemodialysis may be considered; however, penicillamine might be useful in the event of hepatic complications, especially in relatively late interventions.

Module No. 7 B 20

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 20 Thiocarbamate poisoning

Level: Advanced

Main points

- In view of the low toxicity of this compound, serious symptoms seem unlikely, and management would be symptomatic and supportive. Most studies suggest that no specific treatment should be necessary. Patients should not be exposed further for several weeks, and they should not drink alcohol for several days after poisoning.
- Complete recovery is the usual outcome after acute toxicity. If a person becomes sensitized after exposure, subsequent contact even at low levels may produce a strong dermal reaction.

Module No. 7 B 21

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 21 Methyl bromide poisoning

Level: Advanced

Main points

- The patient should be removed from exposure by taking off the clothing clothes and washing the body. Oxygen and β_2 agonists (salbutamol) should be given if there is evidence of bronchospasm. Treatment is supportive.

Module No. 7 B 22

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 22 Chloropicrin poisoning

Level: Advanced

Main points

- The patient should be removed from exposure by taking off the clothing and washing the body. Oxygen and β_2 agonists (salbutamol) should be given if there is evidence of bronchospasm. Treatment is supportive.
- Gastrointestinal decontamination is unlikely to be useful after acute ingestion.

Subsidiary point

- Patients with significant exposure should be admitted to hospital and observed for at least 24 h.

Module No. 7 B 23

Module: 7 Medical treatment of pesticide poisoning

Subject: B Treatment

Number: 23 Sulfuryl fluoride poisoning

Level: Advanced

Main points

- The patient should be removed from exposure by taking off the clothing clothes and washing the body. Oxygen and β_2 agonists (salbutamol) should be given if there is evidence of bronchospasm. Treatment is supportive.
- Measurement of serum fluoride and calcium concentrations may be useful after ingestion or significant inhalation. Hypocalcaemia may need specific correction.



Other Related Subjects

Module 8: Other, related subjects

Subject A: Administrative subjects

No. 1 Selection of staff	A
No. 2 Records of exposure to pesticide	I
No. 3 Reporting cases of poisoning and environmental incidents	I
Annex I Form for reporting exposure to pesticides (PER)	
Annex II Form for reporting incidents involving severely hazardous pesticide formulations- Health Incidents (SHPF)	
Annex III Form for reporting incidents involving severely hazardous pesticide formulations - Environmental incidents	

Subject B: Scientific subjects

No. 1 Field testing of cholinesterase activity	I
No. 2 Interpretation of results of cholinesterase testing	A

Educational objectives

Decision-makers, supervisors and medical personnel should be able to:

- explain the need for and focus of a medical examination before a person starts working as a pesticide applicator, in particular regarding a test for pre-exposure cholinesterase activity for persons working with organophosphates; and
- record exposure to pesticides and report cases of poisoning on the forms provided or alternatives developed or improved during the course,

Medical personnel should be able to perform a pre-employment medical examination on pesticide applicators, describe how to test for cholinesterase activity and interpret the results.

Other modules can be inserted under these headings to meet local needs and can include other aspects of reporting or record keeping.

Module No. 8 A 1

Module: 8 Other, related subjects

Subject: A Administrative subjects

Number: 1 Selection of staff

Level: Advanced

Main points

- For jobs involving probable regular or prolonged exposure to pesticides, a medical examination before employment is highly desirable. This protects the employer and reminds the worker that he or she will be handling chemicals of a hazardous nature. It is also an opportunity to stress the importance of following the correct safety precautions to minimise risks of being affected by the pesticides.
- The medical examiner must consider whether any existing disease might be exacerbated by exposure to pesticides or whether absorption of pesticides might be increased. Relevant conditions are asthma, a skin disorder on exposed skin, physical or mental nervous disease or a major liver disorder.
- If the worker is to handle organophosphorus formulations of moderate or greater hazard a pre-employment cholinesterase test is essential for estimating his or her exposure in the future. It may obviate an unnecessary suspension from contact with these pesticides.

Subsidiary point

- As for any probable exposure to a toxic chemical, the possibility of pregnancy and lactation in female workers of child-bearing age must be considered.

Training note

- For interpretation of tests for cholinesterase activity, see **Module 8B2**.

Module No. 8 A 2

Module: 8 Other, related subjects

Subject: A Administrative subjects

Number: 2 Records of exposure to pesticides

Level: Intermediate

Main points

- When workers are handling pesticide formulations of moderate or greater hazard, brief records of exposure should be kept. The records are useful if the worker shows any sign of intoxication by a pesticide.

Subsidiary points

- These records are additional to or can form a part of a register of operational details. This is always desirable and may be required in some operations.
- The following table is an example of a form in which records might be kept.

Name		Week beninning													
Product Applied	Day														
	1		2		3		4		5		6		7		
	H	P	H	P	H	P	H	P	H	P	H	P	H	P	

H, total hours worked at spraying (or bagging or mixing or loading) during the day; P, number of sprayer tankfuls (pump charges) sprayed or any other appropriate measure.

Only one column, H or P, need be completed, but it should be consistent for all workers.

Module No. 8 A 3

Module: 8 Other, related subjects

Subject: A Administrative subjects

Number: 3 Reporting cases of poisoning

Level: Intermediate

Main points

- Whenever a case of poisoning by pesticides occurs, it is important that full details be recorded. This is not just an administrative exercise; its objective is to define the hazard, to prevent the worker from being poisoned again and to prevent others from being poisoned.

Subsidiary points

- The following basic information should be obtained. Other points can be added according to local circumstances. The information may have to be collected from several sources before it is complete.
 - name, age and sex of the person;
 - occupation, spare-time occupation;
 - date and time of onset of symptoms;
 - nature and progress of symptoms and signs;
 - first aid given and referral of case;
 - dose and time of any medication given before referral;
 - pesticides to which the person might have been exposed;
 - common or approved names of the pesticides and percentages of pesticides in formulations used;
 - method of application.
 - exposure, with quantitative data, if possible, e.g. sprayer tankfuls (pump charges) sprayed, hours of work, wind direction;
 - protective measures taken by worker, type of clothing worn, use of washing facilities, condition of application equipment;
 - any other workers affected;
 - details of medical examination;
 - results of biological tests;
 - treatment given, dosage and times;
 - course of case;
 - any residual disability on discharge from treatment; and
 - follow-up.

Discussion point

- What are the local procedures for investigating and reporting cases of poisoning?

Training notes

- Course participants should be made aware of the ‘Pesticide exposure recording’ format used for recording pesticide poisonings developed by IPCS¹. They should be encouraged to complete a record when they encounter a poisoning.

¹ World Health Organization. Epidemiology of pesticide poisoning—harmonized collection of data on human exposures (IPCS/EPP/00.1), Geneva, 2000.

Annex I. Form for reporting exposure to pesticides

PESTICIDE EXPOSURE RECORD (Confidential)

1. EXPOSURE TIME AND PLACE		Record number: / / /	
Date of consultation: / /	Time elapsed since exp: hs dy ms	City 	
Date of exposure: / /	Duration of exposure : hs dy ms	Province 	
2. COMMUNICATION (Source of information)			
Name:	Institution: ()	Phone:	Data collection date: / /
Category of person supplying information: ☐ Medical ☐ Paramedical		Officer's initials:	
3. PATIENT DETAILS			
Name (Initials):		Identity N°	
Sex: ☐ M ☐ F	Age: 	☐ Unknown If unknown: ☐ Child ☐ Adolescent ☐ Adult	
4. CIRCUMSTANCES OF EXPOSURE (check one, plus "uncertain", if relevant)			
☐ Intentional ☐ Accidental ☐ Occupational ☐ Uncertain ☐ Unknown ()			
5. MAIN ACTIVITY AT TIME OF EXPOSURE (check one, or more than one if "Multiple")			
☐ Manufacturing/Formulation	☐ By-standing	☐ Veterinary Therapy	
☐ Application in field	☐ Transportation	☐ Multiple (specify) 	
☐ Public health campaign	☐ Mixing/Loading	☐ Not relevant	
☐ Household application	☐ Equipment care	☐ Other (specify) 	
☐ Field re-entry	☐ Human Therapy	☐ Unknown	
6. LOCATION OF EXPOSURE (check one)			
☐ Home (urban/periurban)	☐ Home (rural)	☐ Farm/field	☐ Greenhouse ☐ Unknown
☐ Garden (urban/periurban)	☐ Garden (rural)	☐ Public area	☐ Storage site ☐ Other (specify)
7. ROUTE OF EXPOSURE (check main route or more than one, if applicable)			
☐ Oral ☐ Dermal ☐ Respiratory ☐ Ocular ☐ Unknown ☐ Other (specify) 			
8. PRODUCT IDENTITY (add other page(s), if necessary, for each product)			
Product name(s):		☐ Unknown ☐ Concentration (if available) %	(Co-ordinator to fill-in) Use intended: ☐ Registered ☐ Not approved
Active Ingredient:			
Physical form: ☐ Gas ☐ Liquid ☐ Solid ☐ Unknown			
Actual use: ☐ Insecticide ☐ Herbicide ☐ Tick control ☐ Unknown ☐ Rodenticide ☐ Fungicide ☐ Other (specify) 			
9. CHEMICAL TYPE (check one or more if relevant)			
☐ Organophosphorus	☐ Thiocarbamate	☐ Dinitrophenol deriv.	☐ Fluoroacetate ☐ Unknown
☐ Carbamate	☐ Coumarin	☐ Organomercurial	☐ Other (specify)
☐ Organochlorine	☐ Dipyridyl	☐ Phosphide	☐ Specific chemical:
☐ Pyrethroid	☐ Phenoxyacid	☐ Arsenical	
10. MANAGEMENT			
Treatment given: ☐ Yes ☐ No ☐ Unknown ☐ Referred to other hospital			
Hospitalisation: ☐ Yes ☐ No ☐ Unknown If yes, days in hospital Days in ICU 			
11. SEVERITY GRADING			
Effects: ☐ Local ☐ Systemic ☐ Both PSS: ☐ None ☐ Minor ☐ Moderate ☐ Severe			
12. OUTCOME			
☐ Recovery ☐ Recovery with sequelae ☐ Death related ☐ Death unrelated ☐ Unknown			
13. COMMENTS (stating section; continue overleaf if necessary)			
.....			

Annex II. Form for reporting incidents involving severely hazardous pesticide formulations

Human Health Incidents

The forms included here in annex II and annex III have been developed under the Rotterdam Convention.

The report form consists of three sections:

Introduction: The text is intended to provide relevant background information on the Rotterdam Convention and how the information collected on the form and submitted by the designated national authority will be used.

Part A is to be completed by the designated national authority once **Part B** is received from the field. It reflects the information requirements of **Part 1** of **Annex IV** of the Convention. There is some redundancy between **Parts A** and **B** of the form, particularly with respect to information on product identity. It was considered that this redundancy might help countries to consolidate responses by using Part A of the form to report on more than one incident with the same formulation.

Part B is designed to provide “a clear description of the incidents related to the problem, including the adverse effects and the way in which the formulation was used” (**Part 1** paragraph g of **Annex IV** of the Convention). The form has been constructed around these points. It consists of a series of closed questions or checklists that capture the basic information needed, with options for including additional information when it is available.

Part A. Transmittal Form – Designated National Authority

Information required from a designated national authority

1	Name of the formulation:
2	Type of formulation: (for example EC, WP, DP, GR, TB).
3	Trade name and name of producer, if available:
4	Name of the active ingredient or ingredients in the formulation:
5	Relative amount of each active ingredient in the formulation: (% concentration)
6	Attach copy of the label(s), if available (or describe the key aspects of the label: language, etc.).
7	Common and recognized patterns of use of the formulation within the country – ⇒ Is the formulation registered / permitted for use in the country? ⇒ What uses are permitted? ⇒ Are there any handling or applicator restrictions specified as a condition of registration? ⇒ Information on the extent of use of the formulation, such as the number of registrations or production or sales quantity (indicate the source of information) ⇒ Other information on how the formulation is commonly/typically used in the country (this information should be submitted on a separate sheet attached to the completed form)
8	A clear description of incidents(s) related to the problem, including adverse effects and the way in which the formulation was used (for example <i>Part B pesticide incident report form</i> identifies key elements and appropriate level of detail). Other report formats that may exist at the national level may also be used, provided they contain comparable information.
9	Any regulatory, administrative or other measure taken, or intended to be taken, by the proposing Party in response to such incidents.

Date, signature of DESIGNATED
NATIONAL AUTHORITY and
official seal:

PLEASE RETURN THE COMPLETED FORM TO:

Secretariat for the Rotterdam Convention
Plant Protection Service
Plant Production and Protection Division, FAO
Viale delle Terme di Caracalla
00100 Rome, Italy

Tel: (+39 06) 5705 3441
Fax: (+39 06) 5705 3224
E-mail: pic@fao.org

OR

Secretariat for the Rotterdam Convention
UNEP Chemicals

11-13, Chemin des Anémones
CH – 1219 Châtelaine, Geneva, Switzerland

Tel: (+41 22) 917 8183
Fax: (+41 22) 797 3460
E-mail: pic@unep.ch

Part B. Pesticide incident report form

This form should be completed for each individual exposed in a given incident. For an incident that involved more than one formulation, please complete Section I and question 13 for each.

I. Product identity: <i>What formulation was being used when the incident took place?</i>	
1. Name of formulation: _____	
2. Type of formulation (check one of the following)	
☐ Emulsifiable conc. (EC)	☐ Wettable powder (WP)
☐ Ultra-low-volume (ULV)	☐ Tablet (TB)
☐ Dustable powder (DP)	
☐ Water-soluble powder (SP)	
☐ Granular (GR)	
☐ Other, please specify: _____	
3. Trade name and name of producer, if available: _____	
4. Name of the active ingredient(s) in the formulation: _____	
5. Relative amount of each active ingredient in the formulation: (% concentration, g/l, etc.) _____	
6. Attach copy of the label(s), if available.	

II. Description of the incident: How was the formulation used?	
7. Date of incident: (M/DD/YY) _____	
8. Location of incident:	
Village/city: _____	
Province/state/region: _____	
Country: _____	
9. Person exposed (identity should be checked and recorded before submission of the form)	
Sex:	☐ male ☐ female Age: _____
If age unknown:	☐ child (< 14 years) ☐ adolescent (14–19 years) ☐ adult (> 19 years)

10. Main activity at time of exposure (check one or more of the following):	
☐ application in field	☐ mixing/loading
☐ household application	☐ vector control application
☐ re-entry to treated field	☐ veterinary therapy
☐ human therapy	
☐ other, please specify: _____	

11. Was protective clothing used during application? ☐ No ☐ Yes	
If NO please explain why: _____	
If yes, briefly describe (check one or more of the following):	
☐ gloves	☐ overalls
☐ eye glasses	☐ respirator
☐ face mask	☐ boots/shoes
☐ long-sleeved shirt	☐ long pants
12. Information on how product was being used:	
(a) Location of exposure/incident (field, garden, greenhouse, house, etc.)	
(b) List the animals/crop(s)/stored products treated if relevant:	
(c) Application method: (How product was used e.g. hand, bucket and brush, soil injection, spray [backpack, tractor mounted, etc.], drip irrigation, aerial [helicopter, plane etc.]):	
(d) Dose applied/concentration (or amount of pesticide applied)	
(e) Duration of exposure: ☐ hours ☐ half day ☐ day ☐ other (specify): _____	

13. If more than one pesticide formulation was used at the same time, please respond to points (i) to (iv) below for each formulation. (see also Part I Product Identity)
- (i) Was the pesticide in its original container? ☐ No ☐ Yes
- (ii) Was the label available? ☐ No ☐ Yes
If yes, was the exposed individual able to read and understand label? ☐ No ☐ Yes
- (iii) Does the label include the reported use? ☐ No ☐ Yes
If no, describe how the use reported above differs from that recommended on the label (use a separate page if necessary):
- (iv) Is the reported incident typical of how the formulation is generally used? ☐ No ☐ Yes
14. Climatic conditions under which the incident occurred (eg. temperature, relative humidity):
15. Were other individuals affected in the same incident? ☐ No ☐ Yes
16. Include any other details that might be useful in describing the incident and the way in which the formulation was used, in particular how the use reported here reflects common or recognized use patterns for this formulation (additional pages may be attached).

III. Description of adverse effects

17. Individual's reaction (check one or more of the following):
- ☐ dizziness ☐ headache ☐ blurred vision ☐ excessive sweating
☐ hand tremor ☐ convulsion ☐ staggering ☐ narrow pupils/miosis
☐ excessive salivation ☐ nausea/vomiting ☐ death
☐ other, please specify: _____
18. Route of exposure (check main route or more than one if applicable)
- ☐ mouth ☐ skin ☐ eyes ☐ inhalation
☐ other, please specify: _____
19. How soon after last use of the formulation were the adverse effects observed?

IV. Management

20. Treatment given: ☐ No ☐ Yes
Hospitalization: ☐ No ☐ Yes
21. Include any other details/information regarding treatment including medical intervention/first aid/hospitalization/local practices etc. (additional pages may be attached):

V. Reporting/communication

22. Date of data collection/consultation:
23. Name and address of investigator/data collector:
24. Category of investigator/data collector: ☐ Medical ☐ Paramedical ☐ Non-medical
If non-medical, then specify type of person (applicator, formulator, vendor, extension worker, manager, etc.):
25. Contact if further information if needed: Tel: _____ Fax: _____
E-mail: _____
26. Has this incident been reported elsewhere? ☐ No ☐ Yes
If yes, where: _____

Send the completed incident report form to the designated national authority.
(Name and address of the designated national authority)

Annex III. Form for reporting incidents involving severely hazardous pesticide formulations

Environmental Incidents

The severely hazardous pesticide formulation report form consists of three sections:

The introduction is intended to provide relevant background information on the Rotterdam Convention and how the information collected on the form and submitted by the designated national authority will be used.

Part A is to be completed by the designated national authority once he or she receives **Part B** from the field. It reflects the information requirements of **Part 1** of **Annex IV** of the Convention. There is some redundancy between **Parts A** and **B** of the form, particularly with respect to information on product identity. It was thought that this redundancy might help countries to consolidate responses by using **Part A** of the form to report on more than one incident with the same formulation.

Part B can be completed by any competent person. It is designed to provide “a clear description of the incidents related to the problem, including the adverse effects and the way in which the formulation was used” (**Part 1** paragraph g of **Annex IV** of the Convention). The form has been constructed around these points. It consists of a series of closed questions or checklist that captures the basic information needed, with options for including additional information when available.

Part A. Transmittal Form – Designated National Authority

Information required from a Designated National Authority

1	Name of the formulation:
2	Type of formulation: (for example EC, WP, DP, GR, TB).
3	Trade name and name of producer, if available:
4	Name of the active ingredient or ingredients in the formulation:
5	Relative amount of each active ingredient in the formulation: (% concentration)
6	Attach copy of the label(s), if available (or describe the key aspects of the label: language, etc.).
7	Common and recognized patterns of use of the formulation within the country – ⇒ Is the formulation registered/permited for use in the country? ⇒ What uses are permitted? ⇒ Are there any handling or applicator restrictions specified as a condition of registration? ⇒ Information on the extent of use of the formulation, such as the number of registrations or production or sales quantity (indicate the source of information) ⇒ Other information on how the formulation is commonly/typically used in the country (this information should be submitted on a separate sheet attached to the completed form)
8	A clear description of incidents(s) related to the problem, including adverse effects and the way in which the formulation was used (for example <i>Part B pesticide incident report form</i> identifies key elements and appropriate level of detail). Other report formats that may exist at the national level may also be used, provided they contain comparable information.
9	Any regulatory, administrative or other measure taken, or intended to be taken, by the proposing Party in response to such incidents.

Date, signature of DESIGNATED
NATIONAL AUTHORITY and
official seal:

PLEASE RETURN THE COMPLETED FORM TO:

Secretariat for the Rotterdam Convention Plant Protection Service Plant Production and Protection Division, FAO Viale delle Terme di Caracalla 00100 Rome, Italy Tel: (+39 06) 5705 3441 Fax: (+39 06) 5705 3224 E-mail: pic@fao.org	OR	Secretariat for the Rotterdam Convention UNEP Chemicals 11-13, Chemin des Anémones CH – 1219 Châtelaine, Geneva, Switzerland Tel: (+41 22) 917 8183 Fax: (+41 22) 797 3460 E-mail: pic@unep.ch
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Severely Hazardous Pesticide Formulation Report Form

PART B – ENVIRONMENTAL INCIDENT REPORT FORM

Note: If the reported incident is associated with the use of a mixture of more than one formulation, **Section 2** (Product Identity) should be completed separately for each of the formulations. The remaining Sections of the form that describe how the formulation was used, the incident, adverse effects etc., need only be completed once for each incident.

In order to help keep the form as simple as possible, the term formulation is used throughout and refers to the chemical product (herbicide, insecticide, etc). For those incidents involving more than one formulation, it is understood that the use of this term in Sections 4–7 will refer to the mixture that was applied.

Section 1. Number of formulations used									
1. How many formulations were used when the incident took place? (Please circle or fill in number and proceed as indicated) a. One formulation was used. ☐ Yes ☐ No If YES, complete Section 2 (Product Identity) once. If NO, b. _____ (number) different formulations were used at the same time (e.g. tank mix of a herbicide and a fungicide) c. Please list the individual formulations here: e.g. Monitor (methamidophos 60 EC) Formulation 1: _____ Formulation 2: _____ Formulation 3: _____ Please complete Section 2 (Product Identity) for each of the listed formulations.									
SECTION 2. Product Identity: Formulation used and its preparation Please complete this section for each formulation used									
2. Name of the formulation? _____ 3. Type of formulation (please tick): <table border="0"><tr><td>☐ Emulsifiable concentrate (EC)</td><td>☐ Wettable powder (WP)</td><td>☐ Dustable powder (DP)</td></tr><tr><td>☐ Water soluble powder (SP)</td><td>☐ Ultra low volume (ULV)</td><td>☐ Tablet (TB)</td></tr><tr><td>☐ Granular (GR)</td><td colspan="2">☐ Other (please specify): _____</td></tr></table> 4. Trade names and names of the producer/manufacturer, if available: _____ 5. Name of the active ingredient(s) in the formulation: _____ 6. What is the name and relative amount of each active ingredient (a.i.) in the formulation? % concentration: _____ grams a.i./litre or: _____ ounce a.i./gallon or: _____ grams a.i./kg or: _____ ounce a.i./pound: _____ 7. Attach a copy of the label(s) and instructions for use, if available to this form (or describe the key aspects of the label: language, use instructions, etc). Label attached ☐ Yes ☐ No _____	☐ Emulsifiable concentrate (EC)	☐ Wettable powder (WP)	☐ Dustable powder (DP)	☐ Water soluble powder (SP)	☐ Ultra low volume (ULV)	☐ Tablet (TB)	☐ Granular (GR)	☐ Other (please specify): _____	
☐ Emulsifiable concentrate (EC)	☐ Wettable powder (WP)	☐ Dustable powder (DP)							
☐ Water soluble powder (SP)	☐ Ultra low volume (ULV)	☐ Tablet (TB)							
☐ Granular (GR)	☐ Other (please specify): _____								

8. What was the intended use (please tick)

☐ Insecticide ☐ Herbicide ☐ Tick control ☐ Rodenticide ☐ Fungicide

☐ Unknown ☐ Other (specify) _____

9. Are there any use restrictions or prohibitions regarding the use of this formulation or the active ingredient (e.g. use of safety equipment, application restrictions)?

☐ No ☐ Yes (please specify) _____

10. Was the formulation used as purchased or was it changed in any way?

☐ Used as purchased ☐ Changed (please specify how): _____

11. Was the formulation in its original container?

a. ☐ No (go to b) ☐ Yes (go to Question 13)

b. Did the repackaged formulation have a copy of the label attached?

☐ No ☐ Yes

12. Preparation of formulation:

a. Was the formulation (as outlined in Questions 2–8) mixed with a carrier or diluent before use (e.g. mixed with liquid, powder, bran)?

☐ No (go to Question 13) ☐ Yes

If YES,

b. How was the mixture prepared (e.g. mixed with water, diesel)?

c. What was the mixing ratio? (circle appropriate unit)

_____ litre or kg/lbs of formulation per _____ litre or kg/lbs of carrier/diluent

d. Was the mixture used immediately or was it stored?

☐ Used immediately ☐ Stored (please specify) _____

For how long? _____ hours/days/weeks (circle appropriate unit)

13. Application rate:

a. What was the application rate used?

_____ e.g.: g a.i./ha; litre/ha; lb/acre (circle appropriate unit) or specify _____

b. How much of the chemical product/or active ingredient (a.i.) was used?

For multiple applications, please estimate the total amount released. (circle appropriate unit)

Total amount: _____ (L; gallons; kg; or lb)

Concentration: _____ (g a.i./L; oz a.i./gallon; g a.i./kg; or oz a.i./lbs)

SECTION 3. Description of application

14. Location where the formulation was used?

Nearest village/city: _____

Province/state/region/district: _____ Country: _____

15. Date of application(s)

a. What were the date(s) (if known) the formulation was used? Beginning: _____ End: _____

16. Was it a single or multiple application? ☐ Single application ☐ Multiple application (please specify)

Number of applications: _____ Approximate date of each application: _____

17. Were any other pesticides used in the same area at the time of the incident?

18. Treated area and target pest:

- a. What was the type of crop or situation treated (e.g. maize, grassland, forest, pond)?
- b. What was the target pest (e.g. weeds in maize, locusts in grasslands, moths in forests, mosquitoes in ponds)?

19. Conduct of application

- a. How was the formulation applied (method of application)?

☐ By hand ☐ Backpack sprayer ☐ Tractor-mounted sprayer ☐ Aircraft

☐ In-furrow applicator ☐ Hand-held sprayer ☐ Other method (please specify) _____

- b. What were the weather conditions at the time of application?

Temperature: ☐ Hot ☐ Warm ☐ Cool

Sunny or cloud: _____

Rain: ☐ Light ☐ Medium ☐ HeavyWind speed: ☐ Light ☐ Strong

Direction: _____

General description of conditions: _____

- c. What were the weather conditions for the few days after application?

Temperature: ☐ Hot ☐ Warm ☐ Cool

Sunny or cloud: _____

Rain: ☐ Light ☐ Medium ☐ HeavyWind speed: ☐ Light ☐ Strong

Direction: _____

General description of conditions: _____

20. Please provide any relevant information regarding the person applying the formulation (e.g. level of training, literacy)

Section 4. Description of the Incident

21. What was the date when the incident was first noticed?

22. Location of the incident.

Was the location of the incident, the same location of the area treated? Please indicate where the incident occurred (be as specific as possible).

- ☐ Yes (as specified in Section 3 Question 14)
- ☐ No (please specify) Geographical coordinates, if available

Village/city: _____

Province/state/region/district: _____

Country: _____

23. Please indicate where the incident occurred and the size of the area affected, by completing all areas of the following table that apply. Please be as specific as possible; mark all boxes as appropriate:

Environment Affected	Size of area or volume affected (write a number)	Units (circle appropriate units)
Land		m ²
☐ Home garden		hectare (ha)
☐ Farm field		km ²
☐ Grassland		acre
☐ Other _____		Other (specify) _____

24. Please draw a rough map of the area around the incident. (Indicate scale if possible)
Use the box below or attach to the back of this form.

- a. the area affected;
- b. any nearby waterways that were, or could be, affected and the direction of water flow;
- c. location of any affected non-target organisms that were found;
- d. location where the formulation was applied;
- e. any other details which may further clarify the incident (*e.g. topography, soil properties, water table*).

[illegible][illegible]

Section 5. Description of adverse effects

26. Identify the non-target organism(s) adversely affected in the incident, including the number affected. Please be as specific as possible (common names and if possible scientific names) and complete as much as possible. Examples are provided in the table below.

Species of Animal or Plant	Number or Proportion Affected	Age or Development Stage (e.g. Juvenile, Larval, Seedling)	Observations (e.g. Abnormal Morphology or Behaviour, Toxicological Symptoms)	Duration of Effect (Including Date of Death or Recovery)
Examples				
<i>Terrestrial vertebrate</i>				
Domestic cattle	10	Adults	Excessive salivating, loss of balance, lethargy.	Recovered 26 May 2002
Birds – Mallard ducks	40	Adults and juveniles	Disoriented, ruffled appearance, head lesions	Recovered 30 May 2002
	6	Juveniles	Disoriented, lethargy	Recovered 21 May 2002
	5	Juveniles	Disoriented, lethargy	Died 22 May 2002
Fish e.g. various species	numerous	All size classes	Dead fish on riverbank up to 3km downstream of treatment area	No information
Invertebrates e.g. honey bee	100 colonies	Foraging during peak of flowering period	Colonies dead	All cases reported within 20 days post-application
Vegetation e.g. grassland	4 acres	Flowering	Wilted, yellowing	Dead patches

27. Was there any indirect evidence of severe hazards to non-target organisms (e.g. unexpected population declines, disappearance of certain species in the incident area)?

☐ No ☐ Yes (Please describe these effects) _____

28. Please provide any other relevant information such as:

a. links between the use of the formulation (Section 4) and observed effects in non target organisms (question 26):

b. any analytical measurements, if available, which confirm residues of active ingredient(s) in soil, water, air or biological tissues

☐ No ☐ Yes (attach data and source)

Section 6. Management

29. What practical steps (if any) were taken at the time the incident occurred to limit or stop its further impact on the environment (excluding administrative and regulatory actions)?

30. What steps (if any) were taken to clean up the area after the incident or to rehabilitate any species affected in the incident?

Section 7. Reporting/communication

31. Date of data collection/consultation: _____

32. Name and address of investigator/data collector:

33. Category of investigator/data collector (e.g. *environmental scientist, agricultural officer, government representative*):

34. Contact if further information needed:

Telephone: _____ Fax: _____

E-mail: _____

35. Has this incident been reported elsewhere?

☐ No ☐ Yes (*who was it reported to*)

36. Have similar incidents happened in that area before? ☐ No ☐ Yes

If YES, were they reported?

☐ No ☐ Yes

*Please send the completed incident report form to the Designated National Authority.
 (Name and address of the DNA)*

DNA- please attach all forms to Part A – Transmittal F

Module No. 8 B 1

Module: 8 Other, related subjects

Subject: B Scientific subjects

Number: 1 Field testing of cholinesterase activity

Level: Intermediate

Main points

- Field testing of cholinesterase activity is needed whenever organophosphorus formulations of moderate or higher hazard are applied for several days or more or when any worker has shown early symptoms or signs of poisoning.
- There are two main methods, with blood from the finger or earlobe.
- The first is a colorimetric method. A trained technician can carry out 10 tests in 1 h. All the equipment and reagents can be obtained commercially in a kit. This method cannot be used after exposure to carbamates.
- The second method is spectrophotometric, with a battery-operated instrument. It is also available in a kit. This method is more accurate but requires more experience. Individual tests take about 3 min each.

Subsidiary points

- The ambient temperature in which the tests are carried out must be recorded and adjustments made according to the correction charts available with the kits.
- Whenever the kits are used, care and replacement of reagents is essential and must be budgeted for.

Discussion point

- Are cholinesterase kits or testing services readily available in your country?

Module No. 8 B 2

Module: 8 Other related subjects

Subject: B Scientific subjects

Number: 2 Interpretation of results of cholinesterase testing

Level: Advanced

Main points

- Organophosphorus pesticides inhibit cholinesterase activity, and the results of tests are expressed as a percentage of the 'normal' pre-exposure activity of the worker, as this varies widely among individuals. Ideally, the 'normal' value of a person should be the value obtained before he or she was exposed to any organophosphorus or carbamate pesticide. Otherwise, a community norm is used or, in field testing, the value obtained in the same series of tests with blood from the technician.
- Two types of cholinesterase activity can be measured: acetylcholinesterase in erythrocytes and pseudocholinesterase in plasma. Whole blood contains mostly red cell cholinesterase and is adequate for field testing.
- A fall to 70% of normal cholinesterase activity indicates that working methods should be investigated and more frequent cholinesterase tests be conducted on the individual concerned.
- If the blood or red cell cholinesterase activity is less than 50% of normal, the worker must be suspended from all contact with organophosphorus or carbamate pesticides until the level rises above 70% of normal.
- Symptoms of poisoning may appear when the blood or red cell cholinesterase activity is less than 35% of normal.
- Pseudocholinesterase activity in plasma can fall to very low levels without evidence of symptoms. This only indicates undesirable exposure.

Subsidiary point

- For field testing, venous blood is more accurate than finger-tip or earlobe blood, but the latter can be obtained more conveniently. The skin must be carefully cleaned with alcohol to remove any pesticide residue. The puncture must not be squeezed, as this dilutes the sample with plasma.



Evaluation

Module 9: Evaluation

Subject: Method

Course evaluation, for trainer

Educational objectives

The trainer must be able to assess whether the selected educational objectives have been reached and evaluate the course.

Module No. 9 A 1

Module: 9 Evaluation of content of course

Subject: A Method

Number: 1 Course evaluation

Level: Trainer

Main points

- Each course should end with an evaluation of whether the main points of the course can be recalled by the participants and whether the selected educational objectives have been reached. The trainer should select educational objectives or modify them if need be according to the target group of trainees, their previous knowledge and their own learning goals. In addition, the course itself as given by the trainer can be evaluated, for example by asking the participants to evaluate whether the modules selected were useful to them and whether the presentation and teaching methods were effective. This will help the trainer to plan future courses, to incorporate any changes in emphasis and to reinforce important points to the participants.
- Participants should be told at the beginning of a course that they will be asked questions on it in the end. The educational objectives are a guide on what is expected of them.
- The time allowed for evaluation should be at least 5% of the total time for the course.
- Trainers may wish to keep their own records of responses, giving the group a mark out of 10 for the response to each question. The average marks indicates the receptivity of the group.
- From each section used during the course, the trainer should select the point considered most important. If time permits, other points should be selected in descending order of priority. For each point selected, a visual aid should be prepared for discussion. For example:
 - photographs shown during the course;
 - photographs taken for possible use during the course but not selected, perhaps because an error in composition meant the point was not well illustrated (such as inclusion of a bystander surrounded by application equipment and smoking!);
 - labels to interpret;
 - texts of procedures to put in correct order;
 - texts of names of local products for identification as to approved and common name or chemical group; and
 - texts of questions 'for discussion' in the modules.

MODULE 10

Documentations

Module 10: Documentation

Subject A: IPCS Pesticides CD-ROM

Content

I/A

Subject B: Other sources of information on chemicals

Links

Module No. 10 A 1

Module: 10 Pesticide documents

Subject: A Pesticides CD-ROM

Number: 1 Content

Level: Intermediate / Advanced

Main points

- The Pesticides CD-ROM allows rapid access to internationally peer reviewed information on pesticides commonly used throughout the world, which may also occur as contaminants in the environment and food. It consolidates information from a number of intergovernmental organizations whose goal it is to assist in the sound management of pesticides.
- It contains the following documents:
 - WHO Classification of pesticides by hazard
 - Joint Meeting on Pesticide Residues (JMPR)
 - Environmental Health Criteria monographs
 - International Chemical Safety Cards
 - Health and Safety Guides
 - Poison Information monographs
 - International Agency for Research on Cancer (IARC) summaries and evaluations
 - WHO Data on Human Pesticide Exposures
 - IPCS Antidote monographs

Subsidiary points

- The Pesticides Data Management System and Databank is a means for collecting and analysing information on pesticide exposure and poisonings, which will also aid countries in capacity building for diagnosis and treatment of pesticide poisonings, taking preventive measures and making decisions on the management of pesticides.

Training notes

- For further information, go to pest.ccohs.ca.