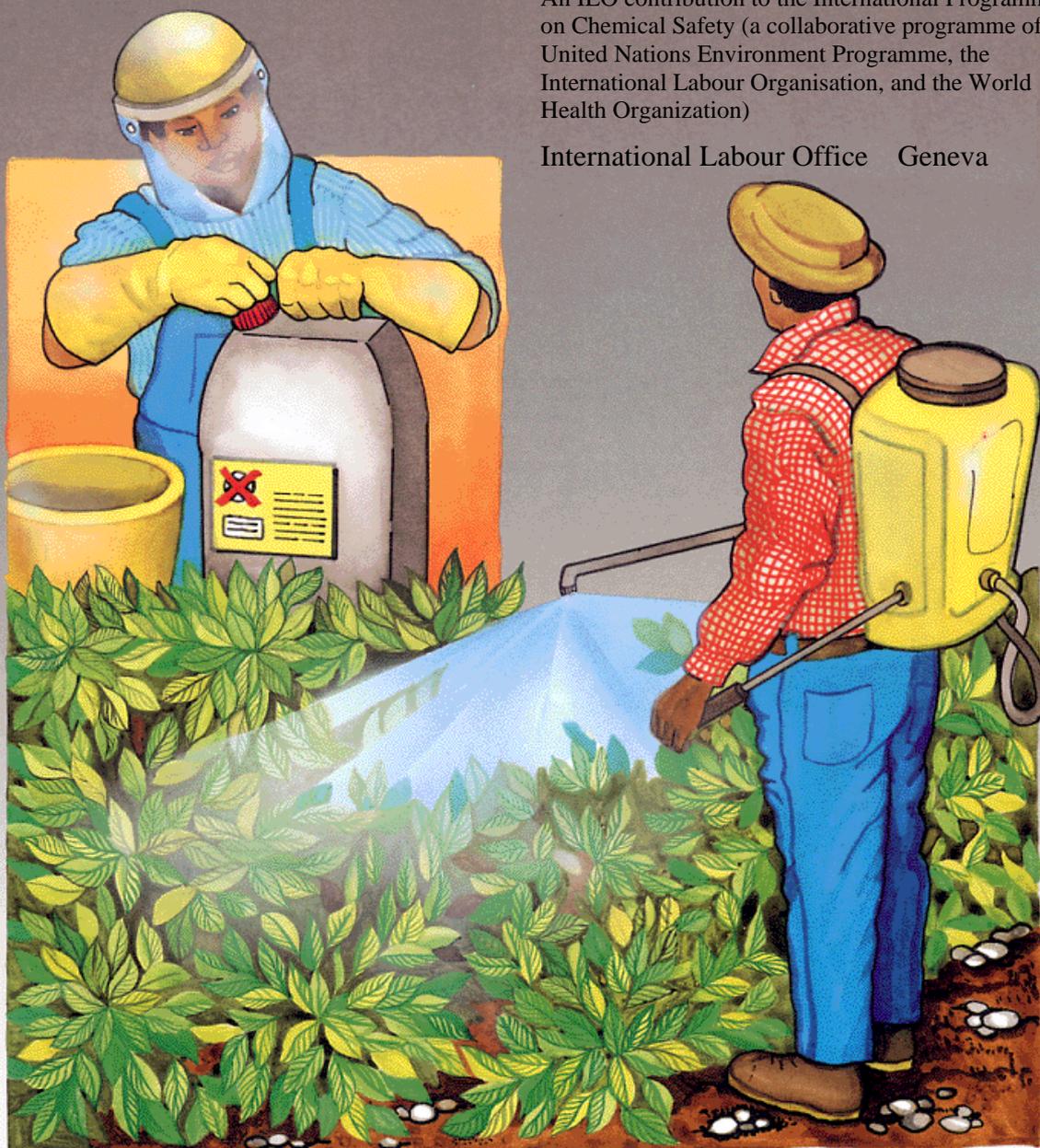


Safety and health in the use of agrochemicals: A guide

An ILO contribution to the International Programme
on Chemical Safety (a collaborative programme of the
United Nations Environment Programme, the
International Labour Organisation, and the World
Health Organization)

International Labour Office Geneva



The International Programme for the Improvement of Working Conditions and Environment (PIACT) was launched by the International Labour Organisation in 1976 at the request of the International Labour Conference and after extensive consultations with member States.

PIACT is designed to promote or support action by member States to set and attain definite objectives aiming at “making work more human”.

The Programme is thus concerned with improving the quality of working life in all its aspects for example, the prevention of occupational accidents and diseases, a wider application of the principles of ergonomics, the arrangement of working time, the improvement of the content and organisation of work and of conditions of work in general, a greater concern for the human element in the transfer of technology. To achieve these aims, PIACT makes use of and co-ordinates the traditional means of ILO action, including:

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- tripartite meetings between representatives of governments, employers and workers, including industrial committees to study the problems facing major industries, regional meetings and meetings of experts;
- action-oriented studies and research; and
- clearing-house activities, especially through the International Occupational Safety and Health Information Centre (CIS) and the Clearing-house for the Dissemination of Information on Conditions of Work.

This publication is the outcome of a PIACT project.

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Preface

In 1990, with a view to reducing the incidence of chemically induced illnesses and injuries at work, the International Labour Conference adopted the Safety in the Use of Chemicals at Work Convention (No. 170), and Recommendation (No. 177). As one of its actions to promote the implementation of ILO standards on safety in the use of chemicals – including agrochemicals – at national level, the International Labour Office is preparing a training manual on the safe use of chemicals at the workplace. It has also embarked upon the task of providing basic guidelines on safety and health in the use of agrochemicals – in the recognition that agrochemicals will continue to be used in large quantities world-wide in the years to come and that an estimated 2 million people annually are poisoned by pesticides, of whom some 40,000 die. This book is the outcome of that project.

During the past two and a half decades, the ILO has undertaken a series of actions at international level to improve the safety and health of many millions of workers engaged in agriculture; in 1965 it published a code of practice on *Safety and health in agricultural work*,¹ followed by a *Guide to safety in agriculture* in 1969. While the code provided a set of rules for the guidance of those with responsibilities for safety and health in agriculture, the guide gave further details on prevention but dealt only in summary fashion with matters of health and hygiene. *Safe use of pesticides*, published in 1977, laid down general principles and safety requirements for various application techniques as well as medical measures of prevention. The subject of safe transport of pesticides was also treated adequately in this publication. *A Guide to health and hygiene in agricultural work*, published in 1979, was intended to protect agricultural workers from accidents and diseases at work. It dealt extensively with the physiology and toxicology of pesticides and with medical surveillance.

It is hoped that the information in the present guide will be of value to those directly engaged in the handling and use of agrochemicals. Emphasis has been laid extensively on safe handling and use, and on practical measures to be taken to avoid undue consequences. The guide is intended for use as a training aid in ILO technical co-operation projects to encourage action at national level. Training activities within technical co-operation programmes are carried out through existing national infrastructures – government authorities, employers and workers and their organisations – to ensure tripartite involvement in promoting safety and health in agriculture. Thus the guide will be complementary to the activities of other international

agencies that contribute to safe working conditions in agriculture such as the World Health Organization (WHO), the Food and Agriculture Organisation of the United Nations (FAO) and the United Nations Environment Programme (UNEP).

The ILO appreciates the technical assistance given by Mr. John Summerscales, Deputy Chief Agricultural Inspector of the Health and Safety Executive, United Kingdom, in the preparation of the guide. Thanks are also due to Noha Karanuh, who drew the illustrations.

¹ Out of print, but may be consulted in libraries.

Scope

There is a wealth of literature about agrochemicals and the information base is spreading as a result of their wide use. This pertains to agricultural economics; the technology of manufacture; standards on transport, distribution, sale and application; and a variety of other aspects including harmful effects on workers who use agrochemicals, as well as their impact on the general environment. Despite this, both confirmed and unconfirmed reports have revealed that many workers, particularly in developing countries, continue to be poisoned or killed mainly on account of unsafe practices in the use of agrochemicals. In spite of the existing information, including that dealing with safety and health aspects, the evidence points to the difficulty of providing safe working conditions for persons handling agrochemicals. Safety and health concerns deserve closer attention because agricultural production is increasing in most parts of the world. Food supplies will have to be more than doubled in the next 30 years to meet even the minimum requirements of the world population. The use of agrochemicals will also necessarily increase.

One main obstacle in achieving safe working conditions is the wide geographical distribution of agricultural workers, who are often self-employed. Simple “ready-to-use” information on safety in the use of agrochemicals must in some way reach the target group. Realistically, one cannot expect many farmers to have the potential or the motivation for self-education in safety and health. Hence the present guide is primarily aimed at community leaders such as agricultural extension workers, farm managers who play an active role in supervising agricultural workers, schoolteachers, primary health-care workers, retail salespeople, and workers' education leaders at community centres. It is also hoped that employers' and workers' organisations in the organised plantation sector will find the guide a useful training aid.

Because of the target group, detailed accounts of human physiology and toxicology, and treatment of poisoning, have been purposely omitted from the text. Practical guidance on safety precautions to be observed in the use of agrochemicals has been given in simple and understandable language.¹ The reader will see that such guidance is repeated in various sections of the chapters. This is intentional. The reason is that these sections have been structured in a manner to enable trainers to treat individual units separately in their training activities. Discussions and activities are suggested at the end of

each chapter and of several sections of Chapter 2. It is hoped that trainers will find these useful, particularly in group training exercises. Individual users will find them equally valuable for self-evaluation.

¹ A glossary of the technical terms used in this book is given in Annex A.

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1. Introduction

1.1. Needs and precautions

Agrochemicals are used world-wide to improve or protect crops and livestock. Fertilisers are applied to obtain good yields from crops that are protected from insects and disease by the timely use of pesticides. Farm animals are similarly protected from parasites and disease by veterinary treatment such as vaccination, oral dosing or immersion dipping. The word “use” should be interpreted in its widest sense to include the use by any person, whether employer, worker or family, and should also include any associated activity such as handling, storage, transport, spillage and disposal.

All these uses may involve a wide range of equipment from aircraft to self-propelled sprayers; or from manually operated sprayers to application by hand. The substances in use also vary and may include powders, granules, liquids or gases. Many are poisonous or harmful to humans, livestock, wildlife and the environment through several causes: toxic and corrosive effects; risk of explosion or fire; indiscriminate use that might pollute the air, water and soil resulting in high residual levels in foodstuffs that are consumed; and contamination of drinking-water.

Practical measures to eliminate or minimise the harmful effects of agrochemicals are described in this guide, together with an outline of good practice in distribution, formulation, use, storage and disposal, as well as the proper recording of relevant events and incidents. The guide also attempts to recognise the special problems within some developing countries. The advice provided should play a significant role in ensuring that agrochemicals are used safely and without unnecessary risk to human beings, livestock, wildlife and the environment.

This guide interprets the word “agrochemicals” to mean all chemical products which are manufactured or processed for use at work in agriculture and allied industries. It includes pesticides, veterinary products and the more hazardous fertilisers and chemicals as described in the next section. Furthermore, the recommendations and advice given in this guide are compatible with and support the relevant provisions of the *FAO International code of conduct on the distribution and use of pesticides*, adopted in 1985.¹

¹ Rome, 1986.

1.2. Grouping of agrochemicals

1.2.1. Pesticides

The word “pesticides” describes a group of agrochemicals intended to destroy or control pests of all kinds. Pesticides are named according to their intended use. For example, insecticides are used against insects, herbicides against plants and fungicides against fungi. A list of examples is given in Annex B. Some insect predators, and certain micro-organisms such as bacteria (*Bacillus thuringiensis*), fungi (*Verticillium lecanii*) and viruses (pine sawfly NPV) are also used to kill or control pests. This guide will, however, be confined to agrochemical pesticides.

1.2.2. Commodity chemicals

Commodity chemicals are those substances which are manufactured for use in either agriculture or other industries. They may also include by-products of an industrial process or even industrial waste such as dilute caustic or acidic solutions. These substances are generally used in farming and have corrosive action on exposed parts of the human body. Some examples are listed in Annex B.

Figure 1. Applying pesticide dust to cattle to control lice



1.2.3. On-farm veterinary products

On-farm veterinary products are those substances used in the rearing of animals. This group of agrochemicals is applied to the skin of animals (figure 1) or administered orally or by injection by agricultural workers (figure 2). It excludes those substances manufactured only for use by veterinary surgeons. Annex B gives a list of examples.

Figure 2. Oral dosing of sheep to control internal parasites



1.2.4. Fertilisers

Fertilisers are plant nutrients and trace elements applied generally to the soil to promote the growth of crops (figure 3). A list of these chemicals, also known as “artificial manure”, is given in Annex B. Some of them, both naturally occurring and manufactured, can cause irritation or burrs to the skin.

Discussion and activities

1. List the different types and quantities of agrochemicals you use.
2. Give the name and address of your retailer.
3. List the names and addresses of the agricultural extension workers and primary health-care worker of the area. Give the names and addresses of any other persons or organisations who can help you in the correct use of agrochemicals.
4. Find out from other users what kinds of agrochemicals they use and stock.
5. Discuss with the extension workers and community leaders how other users stock and use agrochemicals.
 - 5.1. If they use fewer agrochemicals per acre, can you find out why?
 - 5.2. Do they use other methods to control pests?
 - 5.3. Can you find ways of using fewer agrochemicals? *If you can use less, you save money.*
 - 5.4. Could you also reduce your stock of agrochemicals? *Less stock means less investment at one time. There is also less chance of chemicals going to waste.*

Figure 3. A tractor mounted with a fertiliser spreader



2. Safety and health

Safety and health in the use of agrochemicals has been one of the primary concerns of international organisations and of many governments, employers and workers and their organisations for over two decades. Some agrochemicals such as pesticides are extremely hazardous to the health of workers and the general public, and also to the environment. However, they can be used safely if proper precautions are taken. Many industrially developed countries therefore enforce strict regulations with regard to the production, sale and use of pesticides, the most hazardous group among agrochemicals. These countries have banned or severely restricted the use of some very hazardous pesticides. It may happen that other countries may be compelled to import those banned or restricted agrochemicals because of specific needs, for example to eradicate a particular pest. For these countries the economic benefits of agricultural development outweigh the risks involved. Therefore, although the safety and health problems may vary in different countries, it is important to establish clear, common procedures for the use of agrochemicals.

All those who are responsible for the production, import, storage and sale of agrochemicals have a role to play in ensuring safety and health in their use. International organisations, governments, employers and workers and their organisations, and community leaders have a fundamental role: educating agrochemical users on the hazards of the substances they handle, how these enter the body, the nature of toxic effects and the proper methods of use, and informing them of the duties and responsibilities of government authorities, other organisations and the public.

2.1. How dangerous substances can enter the body

Most agrochemicals will have an adverse effect if they enter the body. Those that are more toxic are particularly dangerous even in small amounts. Many agricultural workers die and many more are poisoned or injured each year by such substances entering the body; the main routes of absorption are through the respiratory tract (inhalation), through the skin (dermal absorption) and through the digestive tract (ingestion) – see figures 4-6. Almost all such casualties can be avoided by preventing the entry of agrochemicals into the body.

2.1.1. Inhalation

Breathing agrochemicals into the lungs is more likely to happen if they are in the form of gases, fine spray droplets, dust, fumes and smoke. Gases mix with the air. Others tend to remain suspended in the air for some time after release, for example by spraying. Often these particles are so small or well dispersed that they

cannot be seen. Spraying agrochemicals without adequate precautions is noted to be a common cause of poisoning by inhalation. Users of fumigants and gases are particularly at risk of poisoning by inhalation.

Animal handlers are at risk from inhaling the spray created by animals which shake themselves after emerging from veterinary treatment dips.

Figure 4. Inhalation



Figure 5. Skin absorption



2.1.2. Skin absorption

This is one of the most common poisoning routes. Pesticides act on pests and destroy them by penetrating the insect's skin or surfaces of plants considered to be weeds. Therefore, these substances can easily penetrate the intact human skin, if allowed to do so. Some formulations are especially hazardous if they are both toxic and contain penetrative solvents such as kerosene, petroleum products or xylene. These may pass through work clothing unnoticed by the worker. Hot working

conditions which open the pores on the skin add a further risk they allow more rapid skin absorption, as does skin damaged by cuts, abrasions or skin disease. Further, many veterinary products are chemicals that can easily be absorbed through the skin.

Figure 6. Ingestion



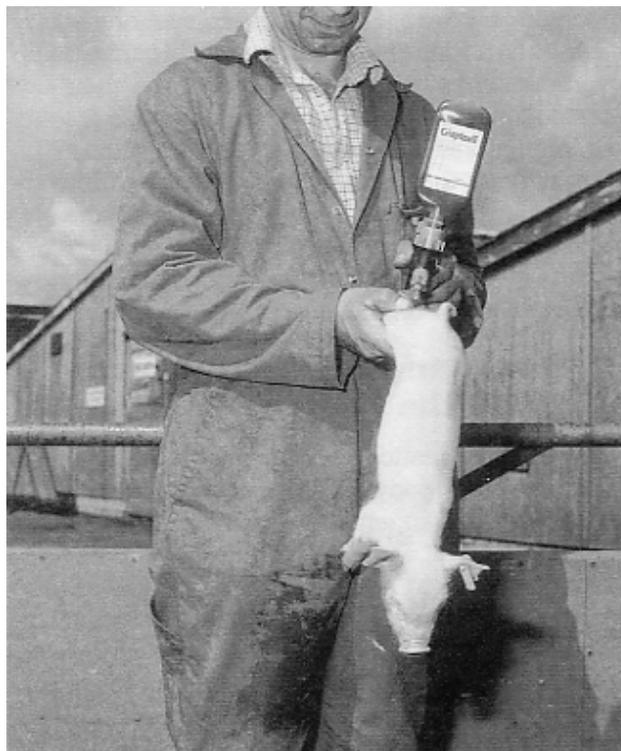
2.1.3. Ingestion

Contamination of the lips and mouth or accidental swallowing of agrochemicals is often caused by poor hygiene or bad practice. Failure to wash properly before eating is a common cause, as is smoking during work. Attempting to clean a blocked sprayer nozzle by putting it between the lips and blowing through it is another bad practice. In some countries pesticides and veterinary products are decanted from large and properly labelled containers into unlabelled bottles and sold. These could subsequently be mistaken for soft drinks and consumed. Such practices should be banned. Even very small quantities of a toxic substance could cause death if ingested in this way. Inhaled toxic substances could subsequently be ingested by swallowing contaminated sputum.

2.1.4. Other

Many agrochemicals cause localised ill-effects on contact with skin or eyes even if they are not absorbed. They include some pesticides, strong acids such as sulphuric acid and strong alkalis such as caustic soda. Veterinary products may also cause problems when their use is subject to the added task of controlling the animal being treated. Accidental self-injection or needle grazing of the skin could occur (figure 7). Such accidents may produce severe localised ill-effects, depending on the extent of skin penetration.

Figure 7. Injecting a piglet with iron to prevent anaemia (care should be taken when handling injection needles)



2.2. Classification and related measures

It has already been said that agricultural workers may be exposed to a variety of agrochemicals at work. Most of these are toxic. Therefore, all agrochemical users must know how to use the products safely by increasing their knowledge of the hazards involved, both to themselves and others. Knowledge is a powerful weapon which can be obtained by reading and understanding the label on the container. By strictly following the instructions on the label, agrochemical users will learn to protect themselves, other people, livestock, wildlife and the environment.

2.2.1. Classification

The hazards of the many thousands of agrochemicals on the market are described as toxic, harmful, corrosive, irritant, flammable, explosive or oxidising. This is called classification. Some agrochemicals may possess more than one of these hazards.

The word “toxic” has already been used in this guide to mean generally that a substance would cause ill-effects if it entered the body. It should be noted that words such as “toxic” or “harmful” have specific significance when they appear on a label. These words usually accompany a symbol.

Note: Agrochemical users must also remember that the products they obtain for use are not highly concentrated. Usually the active ingredient in the agrochemical product is mixed with other substances; in some instances it may be dissolved in a solvent that might penetrate the skin. The symbol to be used on the label is calculated, based on the percentage weight or volume of the active ingredient in the agrochemical product. Therefore, a product with 10 per cent of the active ingredient might belong to a lower toxicity class than another product with 25 per cent of the same active ingredient. It may be claimed by the manufacturers that the latter product is more potent, but users must remember that it is also more toxic.

2.2.1.1. Toxicity

The toxicity of a substance is mainly determined from the results of laboratory tests on small animals such as rats. These tests determine the amount of the substance that kills up to 50 per cent of a sample of laboratory test animals within a specified period. The results and hence the toxicity of the substance are expressed in two ways, depending on the test procedure: whether the animals were made to ingest or inhale the substance.

For example, a lethal dose 50 (LD 50) of 25 means that when a diet containing 25 milligrams (mg) of the substance was fed to each animal among a group of rats, half of them died after a given period assuming that each rat weighed 1 kilogram (kg). In practice the amount of toxic substance to be fed is calculated according to the body weight of the test animal. Thus the animal feed would have contained only 12.5 mg of the substance if the rats weighed half a kilogram each.

Similarly, lethal inhaled concentration 50 (LC 50) refers to the amount of the substance that will kill 50 per cent of the test population by inhalation.

In practice, the agrochemical container would carry the hazard classification symbol rather than LD 50 or LC 50 values. However, it is important to understand the relationship between the two. It should be remembered that the lower the LD 50 or LC 50 value, the higher the toxicity.

As there are many varieties of agrochemicals, the labels are also different. Different symbols in several colours, as well as the words on the label, are used to describe the harmful effects. Therefore one should understand what the symbols and words mean.

A label might have the following symbol with one of the following words:

VERY TOXIC
or
TOXIC



This symbol with the words “very toxic” is used to label a substance which, if it is inhaled or ingested or if it penetrates the skin, may involve extremely serious, acute (immediate) or chronic (longer-term) health risks and even death. The same symbol with the word “toxic” also denotes a highly hazardous substance. The decision to use the word “toxic” is based on LD 50 values. Therefore, extreme caution is necessary in the use of these agrochemicals and instructions on the label must be strictly followed.

Very toxic and toxic substances might also be denoted on the label by hazard class, such as class I^a and I^b respectively.

The following symbol with the word “harmful” should appear on the label of a substance which, if it is inhaled or ingested or if it penetrates the skin, may involve limited health risks.



It might also be listed as an agrochemical in class II. It should be noted that class II presently denotes a “moderately hazardous” substance according to *The WHO recommended classification of pesticides by hazard and guidelines to classification 1990-91*.¹

2.2.1.2. Irritancy

The same symbol as for “harmful” but with the word “irritant” may instead be found on some labels. It is meant for a non-corrosive substance which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation.

Other labels may specify that a substance belongs to toxicity class III, or class 4 or class 5, depending on the country classification concerned. There may be other labels with the words “does not belong to any toxicity class”. Such classification is again linked to LD 50 values. It is important to follow instructions on the label in all cases.

2.2.1.3. Corrosivity

The following symbol with the word “corrosive” will be found on the label of a substance which may destroy living tissues on contact with them. Severe burns on the skin and flesh might result from splashes of such substances on the body.



¹ A revised version has been published by the UNEP/ILO/WHO inter-agency International Programme on Chemical Safety (IPCS) for limited distribution (WHO/PCS/90.1).

Note: While toxicity, irritancy and corrosivity describe health hazards, there are other symbols to denote important physical properties. Agrochemical users must understand these symbols and the words on the labels. This knowledge is necessary to avoid injury and accidents that may result in destruction of machinery, equipment and property.

2.2.1.4. Flammability

The following symbol with the words “extremely flammable” denotes a liquid that would boil at body temperature and would catch fire if exposed to a flame. The same symbol with the words “highly flammable” denotes a substance which:



- may become hot and finally catch fire in contact with air at ambient temperature;
- is a solid and may readily catch fire after brief contact with the source of ignition and which continues to burn or to be consumed after removal of the source of ignition;
- is a gas and burns in air at normal pressure;
- in contact with water or damp air releases highly flammable gases in dangerous quantities;
- is a liquid that would catch fire with slight warning and exposure to a flame.

The same symbol with the word “flammable” denotes a substance which is a liquid that would catch fire if it were allowed to warm above room temperature. Smoking or lighting a flame should be prohibited near flammable substances. Such substances should also not be exposed to direct sunlight or allowed to warm up.

The following symbol with the word “oxidising” denotes a substance which releases a lot of heat while it reacts with other substances, particularly flammable substances.



2.2.1.5. Explosivity

The following symbol with the word “explosive” denotes a substance which may explode under the effect of a flame or if subjected to shocks or friction.



2.2.2. Labelling and relabelling

The purpose of a label is to convey a message about what the product is, who makes it and how it may be used safely and effectively. Considerable effort goes into ensuring that labels communicate to the user in a clear, concise and easily understandable manner.

It follows that if the product is to be used safely, then users must first read, understand and comply with the label. This is as important an activity as any other

involving the use of the agrochemical, and must not be neglected. If users experience any difficulty in progressing beyond this first crucial stage, they should seek advice before going any further.

Some agrochemical containers are too small for a label to be glued or stuck on. In such instances there should be a leaflet securely attached to, or tagged on to, the container. Users should always ensure that a leaflet is presented with small containers. Information might also include any literature provided separately in a package, e.g. product information documents or chemical safety data sheets. This material should not be overlooked by the user.

Labelled information seeks to identify a product and describes how, when and where it should be used. It is then completed with details of potential hazards, good practices, safety precautions, first aid instructions and advice to health personnel.

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

- hazard symbol;
- trade name of the product;
- name and quantity of active ingredient;
- purpose for which it is to be used;
- registration number when required by legislation;
- name and address of the manufacturer, distributor or agent;
- directions for use;
- safety precautions;
- warnings and statements of good practice;
- first-aid instructions and advice to health personnel;
- name and quantity of any solvent or similar material classified as hazardous;
- amount by weight or volume in the container;
- identification number of the batch or consignment;
- interval between agrochemical application and harvesting;
- any matter required by national legislation such as a reference to the requirements of specific regulations.

Users should always read the label before use or, if they do not understand the instructions, ask someone who knows. If the label is too small and cannot be read, they should use a magnifying glass or ask someone with better eyesight to read it to them. If it is torn or defaced, it may be necessary to ask the supplier for another container on which the label is legible.

Agrochemicals may be transferred from labelled containers to other containers or equipment. This may be done by suppliers who import in bulk quantities or by the user at the farm. In all instances the person responsible for

the transfer must ensure that other such containers are *relabelled*. Relabelling must ensure that the contents are identified in a manner which will make known to the users:

- the hazards associated with their use;
- the methods of using them safely; and
- emergency procedures.

For further information reference could be made to FAO: *Guidelines on good labelling practice for pesticides* (Rome, 1985), and GIFAP (International Group of National Associations of Manufacturers of Agrochemical Products): *Pictograms for agrochemical labels*, devised in cooperation with the FAO (Brussels, 1988).

2.2.3. Chemical safety data sheets

For each labelled agrochemical, suppliers should have a *chemical safety data sheet*. These should be supplied upon request to employers, agricultural officers and extension workers, and community leaders. Such data sheets contain essential detailed information regarding the identity and classification of the product, the hazards it presents and the appropriate safety precautions and emergency procedures. Some examples of chemical safety data sheets are given in Annex C.

2.2.4. Identification

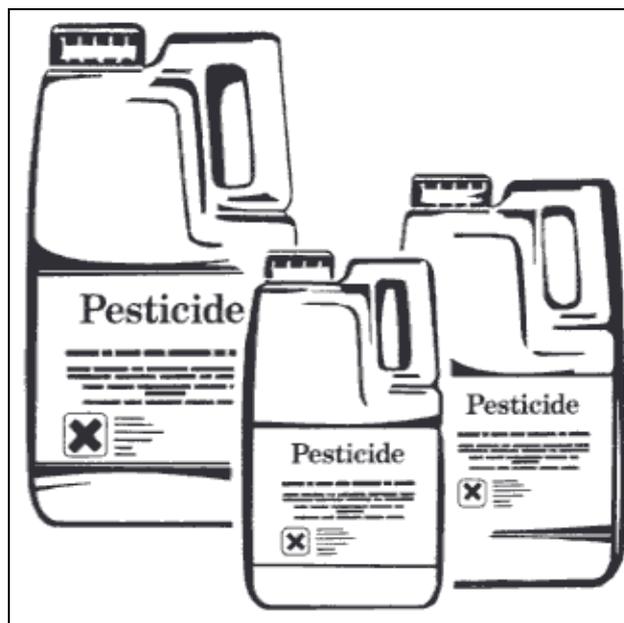
As already mentioned, all agrochemicals should be labelled or marked (figure 8). The label should provide essential information regarding the identity, the classification, the hazards presented and the safety precautions to be observed. In addition it should cover the information on use described in section 2.2.2. Less hazardous agrochemicals, such as some fertilisers, should also be marked. Each marking should provide information on the identity and important properties relevant to the safety and health of users, as well as the name and address of the supplier.

In addition to the essential information on the label, less hazardous agrochemicals might be accompanied by product information documents. Such documents would be indispensable in instances where chemical safety data sheets are not provided. This information is given to the user, at no extra cost, because it is important. Every user should read, understand and follow the instructions to ensure safety and health in the use of agrochemicals. Such information should include:

- instructions on how, when and where to use the product safely and effectively;
- explanatory notes on specific matters such as dose/application rates, timing and method of treatment or application;
- warnings in some detail to prevent incorrect or inappropriate use;

- notes for observing any safety interval between the application of an agrochemical and harvesting or between the treatment of an animal and the consumption of it or its product, such as milk;
- expiry date of any product or its container if it is likely to deteriorate under normal storage conditions;
- general instructions essential to proper use such as mixing, application, compatibility with other products, preferred storage conditions, and disposal of surplus and used containers;
- description of necessary safety precautions such as the wearing of protective clothing and what to do in the event of contamination or other emergency;
- warnings about avoiding harmful effects on livestock, wildlife and the environment;
- instructions about first aid and advice to doctors indicating what to do in the event of poisoning and, where necessary, special antidotal measures with particular products;
- prohibition on the reuse of any container used for classified products, except those specifically designed and intended for such reuse.

Figure 8. All agrochemicals should be labelled or marked



For agrochemicals that have been marked only to indicate their identity and are without a label, the supplier should provide on request, to employers and other users, information in order to determine any precautionary measures that need to be taken during transport, handling, use and disposal.

Agrochemical users should not attempt to use the product until they have read and understood the label or the marking. They should seek the advice of the employer,

agricultural extension worker or community leader in case of doubt.

When an agrochemical product is unknown and the information for its safe use is not available, then it should not be used. If inquiries fail to discover its identity, it should be disposed of safely as described later in the guide (see section 2.3.9).

Discussion and activities (sections 2.1 and 2.2)

1. Read the labels of the agrochemicals in your store.
2. Describe how they could enter your body: by inhalation, ingestion or skin absorption.
 - 2.1. Which would be the most common way for the chemicals to enter the body?
 - 2.2. Could they enter by all routes at the same rate?

Point to remember:
If the label does not give information on hazards and precautionary measures, obtain the relevant information from the retailer, another user or a community leader before you use the agrochemicals.

3. Describe any cases of poisoning in your locality from (a) inhalation, (b) ingestion, (c) skin absorption, (d) all routes.
 - 3.1. What lessons did you learn?
 - 3.2. How can this information be shared with others in your locality?
4. Read the label of the agrochemicals in your store. Using a chart as shown below, list by category those which are: very toxic, toxic, harmful, corrosive, irritant, flammable, oxidising and explosive.
 - 4.1. How many have more than one property that would affect health?
 - 4.2. How many have three or more properties?
 - 4.3. How many have only one?

Point to remember:
Ask the retailer for a chemical safety data sheet. Bring it to someone who will explain the classification to you. This is particularly important if the label does not give the classification.

Some agrochemicals such as fertilisers may not be classified. In these cases ask the retailer for any *information or documentation* on effective use that would give essential safety information.

5. Have you ever bought an agrochemical without a label? If yes, why?
 - 5.1. Did the retailer sell it to you? *If yes, return it to him.* If the retailer confirms that the product was not labelled because it did not belong to any toxic class, check with other users before use.
 - 5.2. Have you ever noticed a retailer or another user dispensing agrochemicals from a labelled container to an unlabelled one (a) for sale, (b) for storage? If yes, (c) how did you react then?
 - 5.3. Describe how you would react now that you have understood about labelling and relabelling.

2.3. Safe handling and use

This major section deals with packaging, transport, transfer, storage, dispensing, pesticide application, other agrochemical applications, spillage and disposal of containers and waste.

As pesticide application is a major activity in the use of agrochemicals and also the most hazardous, precautions to be taken before, during and after application are treated separately.

Storage, management of spills and disposal are also hazardous operations. Precautions to be taken, both for the safety of users as well as the general public and the environment, are described.

Reference is also made to a series of FAO guidelines that are relevant to this section. These include:

- *Guidelines for the packaging and storage of pesticides* (Rome, 1985);
- *Guidelines for the disposal of waste pesticide and pesticide containers on the farm* (Rome, 1985);
- *Guidelines on good practice for ground and aerial application of pesticides* (Rome, 1988).

List of agrochemicals in store – by classification (question 4)

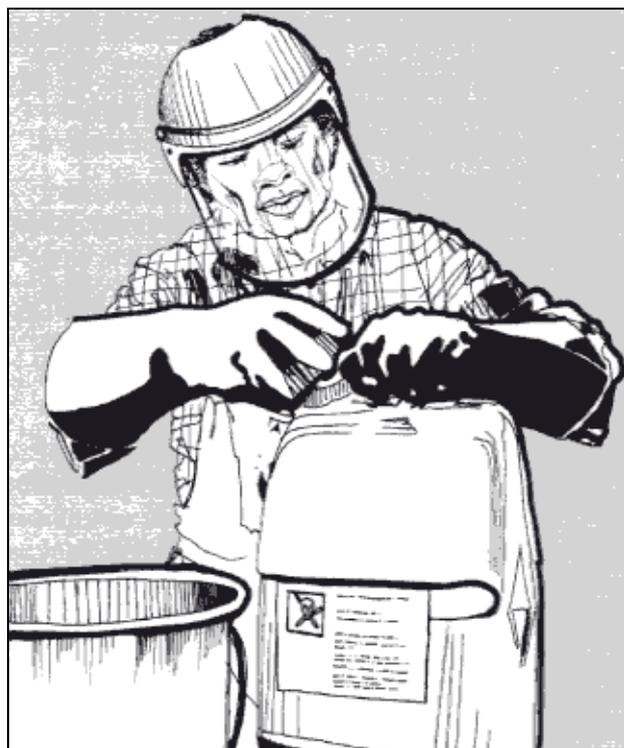
Agrochemical product	Classification							Total number of properties	
	Very toxic	Toxic	Harmful	Corrosive	Irritant	Flammable	Oxidising		Explosive

2.3.1. Packaging

Agrochemicals are usually supplied in packages.¹ These may vary greatly in size, from a small bottle or box to a large metal or plastic drum. Packages are made of glass, metal, plastic or paper. In some cases they are subject to high internal pressures. Liquefied gases such as methyl bromide or anhydrous ammonia could evaporate inside the container to exert pressures on its walls. Packages need to be resistant to these pressures or the corrosive action of chemicals.

Agrochemical users should know that each package must comply with the national standards and regulations that apply to the packaging of agrochemicals. Such regulations may not exist in some countries. Therefore, users should be aware of general requirements for packaging. This information will be useful to identify properly packaged agrochemicals during purchase. Improperly packaged products could cause health risks.

Figure 9. Opening a correctly designed container



An agrochemical package should be so designed and constructed that:

- the contents cannot escape during handling, storage, stacking, loading and unloading;
- the contents will not deteriorate or be spoilt;
- the materials from which it is made, including fastenings such as lids, do not react with the contents to form other compounds;

¹ There are exceptions. Some fertilisers such as lime, ground rock phosphate or basic slag may be delivered in bulk by lorry.

- all parts of it are well made and will not be adversely affected by changes in atmospheric conditions such as pressure, temperature and humidity;
- it is provided with a seal which is destroyed on opening for the first time, and has a fastening device so designed that it can be repeatedly refastened by the user (figure 9);
- it is labelled or marked.

Users should clearly understand that packaging and repackaging of agrochemicals is beyond their competence unless they have been trained to do so. Further, they should never attempt to repack any agrochemical in a container not meant for it. Even if it had contained the same pesticide, there is a risk, for example, that the package may be damaged or the lid may not fasten properly. Users run a risk of contamination with toxic substances by even trying to examine whether a container is fit for reuse.

2.3.2. Transport

Manufacturers, exporters and importers of agrochemicals should comply with international transportation and safety regulations. They might also have to comply with national regulations. Agrochemical users should be aware that such regulations exist. They are also concerned with transport, which may be from suppliers to farm or from store to field. Safe transport should ensure that:

- only products in good-quality containers are accepted from the supplier; those which are damaged or leaking should be refused;
- any vehicle transporting a product will not damage the container. Sharp edges on vehicle sides or nails which have worked upwards from floorboards should be hammered down or otherwise removed;
- a package or container is handled in a manner to avoid unnecessary collisions or violent falls. These may burst or weaken the container to cause spillage of its contents;
- any information provided with the agrochemicals such as labelling, accompanying information or data sheets is transported with it;
- random stacking is avoided during transport; for example, containers of liquid products should be transported top-side up and not be subjected to pressure by excessive loads which may cause them to burst;
- agrochemicals are isolated from other materials transported on the same vehicle;
- paper, cardboard or water-soluble packages are protected from rain or bad weather by a vehicle roof or waterproof covering;
- agrochemicals are not carried alongside the driver in either a vehicle or a tractor cab
- drivers take extra care. They should be competent to take suitable precautions in the event of a collision or

other emergency. This may involve containing spillage wherever possible and avoiding contamination of anyone providing assistance.

Figure 10 shows pesticides being loaded on to a lorry.

Figure 10. Loading pesticides on to a lorry



2.3.3. Transfer

Only in very exceptional cases should agrochemical products be transferred from one container to another. The practice has many disadvantages including the possibility that an agrochemical may mistakenly be consumed as a soft drink; this has caused fatalities in several countries. That is why the practice is banned in many countries.

Where in exceptional circumstances it is necessary to transfer agrochemicals from one container to another, the receiving container should be:

- wherever possible, the agrochemical manufacturer's container which has previously held the same product and been tested by a competent person as fit for reuse;
- of the same quality as the original container;
- properly labelled or marked;
- completely clean and empty;
- not overfilled with a liquid so as to cause spillage when pouring or due to expansion in volume by rise in temperature.

Precautionary measures should be observed when agrochemicals are transferred. Particular attention should be paid to protective clothing, removal of spillage, personal hygiene and the avoidance of contamination of any foodstuffs.

2.3.4. Storage

Agrochemicals are usually delivered to a store by the supplier or transported by the user. They are also returned to the store after partial use at the farm. During storage they are most vulnerable to theft, vandalism, accidental or deliberate misuse or the effects of extreme weather conditions. Users who have to store agrochemicals should know how to construct and maintain a place for storage, thereby ensuring their own safety and that of others. They should also take necessary action to prevent the pollution of the environment.

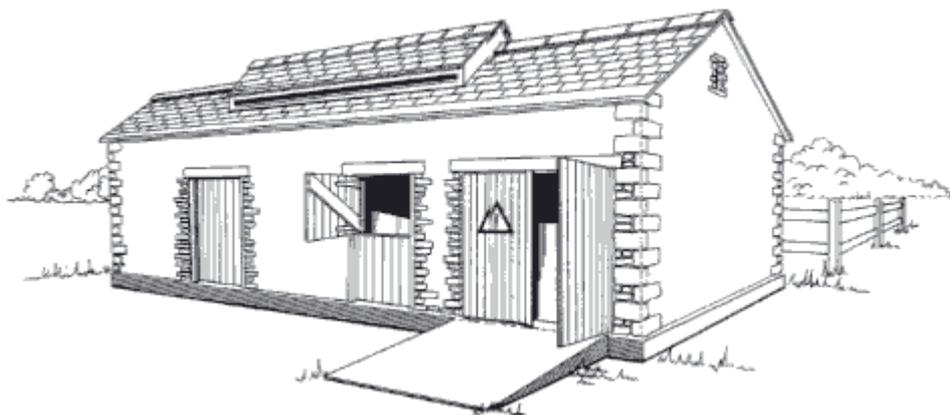
In general, safe and secure storage should ensure *correct siting* to allow easy access for the delivery of agrochemicals and transfer to farm vehicles. If the store is within a general-purpose building it should be separated from other stocks such as flammable materials. The location of the store should also take account of possible pollution risks from leaks and spillages. It should be situated away from living accommodation and surface waters such as rivers, streams and reservoirs used for the supply of drinking or irrigation water. Figure 11 shows an agrochemical store.

Stores should not be located:

- in areas liable to flooding or with a potential for the pollution of underground water supply sources such as wells and boreholes; or
- in upstream catchment areas for water supply or
- in environmentally sensitive areas;

There should be *adequate capacity* for storing the maximum amount of agrochemicals and provision for secure stacking and easy access.

Figure 11. A correctly designed agrochemical store

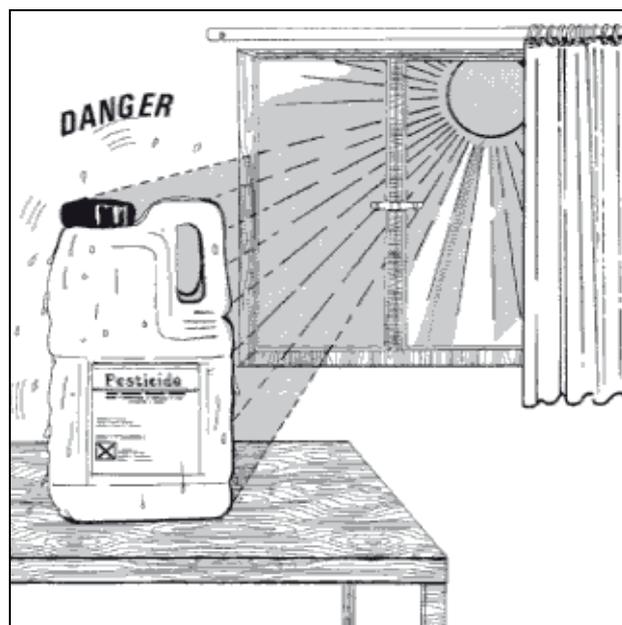


Users should also ensure that any building used to store agrochemicals:

- is of sound construction, resistant to fire, extremes of temperature and chemical action, and impervious to liquids. Floors should be so designed as to contain spillage or leakage and have a non-slip surface which can be easily cleaned. External walls should give at least 30 minutes' fire resistance and all walls should be impervious to water, their inside surfaces smooth, easily washable and free from dust traps. If a store is of single-storey construction, the roof should be of non-combustible material which will fall in quickly and act as a vent in the case of fire;
- has suitable entrances and exits with fire-resistant doors opening outwards wherever possible. Doorways should be of adequate size to allow the safe movement of materials, and interior doors should be of the swing-door type. Where stores are constructed within a general purpose building, it is preferable that access doors open directly on to the outside of that building. Where this is not possible, access should not be shared with areas used for domestic purposes, storage of foodstuffs or keeping animals;
- could contain spillage and leakage in order to protect the external environment. In circumstances where environmental conditions are particularly sensitive, it may be necessary to construct an internal drainage system connected to a containment tank or to an encircling wall (bunding) with the capacity to hold all the agrochemicals in store;
- is kept dry and is resistant to extremes of temperature. In very hot or freezing conditions most agrochemicals would deteriorate and could even damage the containers. Similarly, dampness will weaken paper sacks, possibly resulting in spillage of the contents. The growing practice of supplying pesticides in water-soluble sachets makes it particularly important that they are stored in absolutely dry conditions;

- has adequate natural or artificial light by the provision of sufficient window area or artificial (e.g. electric) lighting. Windows should not allow direct sunlight to fall on to agrochemicals because ultra-violet light may cause deterioration of containers and contents (figure 12).

Figure 12. Avoid exposing agrochemical containers to direct sunlight



This could be avoided by shading windows or, if building a new store, by positioning windows. Electric lights and switches should be positioned so as to avoid mechanical damage and there should be an adequate separation distance between lamps and stored agrochemicals to avoid the transmission of heat;

- is properly ventilated to remove stale or contaminated air. This may be achieved by the provision of “air bricks”. Where adequate natural ventilation cannot be provided, an extractor fan should be installed. In all

circumstances the removal of air should be to a point on an external wall of the building of which the agrochemical store is a part;

- is suitably marked with a warning sign (figure 13) and secured against theft. Any warning sign should conform to national requirements in respect of colour, pictorial symbol and geometrical shape. If national regulations have not been specified, the skull and crossbones is generally acceptable. The security of the store is important in preventing theft or misuse of contents by unauthorised people (figure 14). The extent of security should be adequate in all foreseeable circumstances;
- is well organised so that on delivery agrochemicals can be promptly stored and properly shelved and stacked in a secure and orderly way with clearly visible labels. Flammable products should be segregated by placing them in an isolated and particularly fire-resistant part of the store. Oxidising products and fumigants should, additionally, be stored in absolutely dry conditions. In any storage arrangement, care should be taken to avoid overloading shelving or compressing containers at the bottom of a stack.

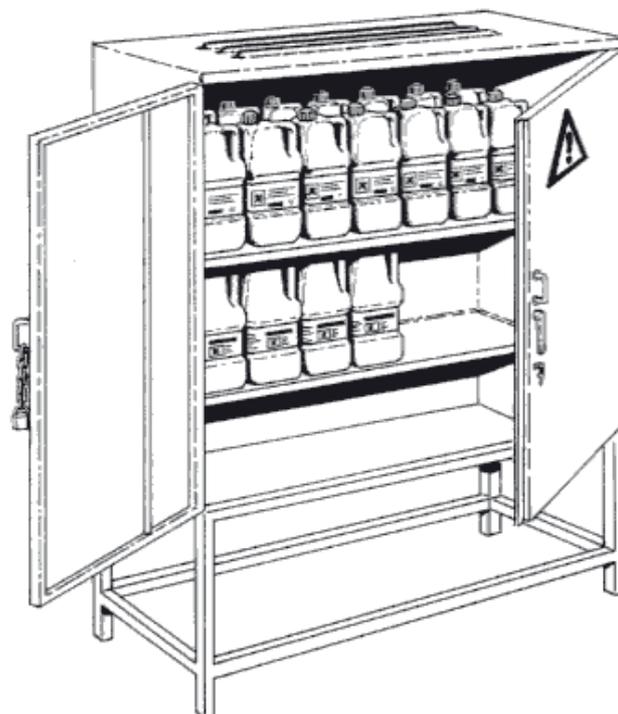
Figure 13. Warning! Pesticide storage! No access to unauthorised persons!



Other considerations:

- *water supply.* A water supply should be provided nearby but not in the store. Any water supply used to fill sprayer tanks or animal treatment baths should be so designed as to avoid back siphonage;
- *records.* A record should be made of agrochemicals in store but kept separately in a safe place, so that there could be easy access to it in the event of an emergency such as fire or unauthorised use;

Figure 14. Agrochemicals should be stored under lock and key



- *first aid.* Adequate first-aid facilities should be available to treat minor injuries and contamination of eyes and skin;
- *fire precautions.* Smoking and the use of a naked flame should be prohibited within the store. A suitable fire extinguisher in good working order should be at hand, in case of emergencies;
- *washing facilities.* Washing facilities should be provided close to the store for anyone who handles agrochemicals. They should be equipped with a wash-basin and clean running water, soap and towel (disposable towels are best if these are available);
- *protective-clothing accommodation.* Separate ventilated accommodation must be provided for protective clothing and for personal clothing. This accommodation, which is generally in the form of a cupboard or locker, must not be within the agrochemical storage area;
- *storage for empty containers and solid agrochemical waste.* Empty containers, other than those used for agrochemicals which react to produce gas with water, e.g. phosphide, should be washed at least three times and stored in a secure dry area with agrochemical waste; they should never be used to store food, water or other substances that may be consumed by people or animals. It should be remembered that a tiny amount of agrochemical residue from within the container could lead to serious illness or death;
- *preparation areas.* Where agrochemicals are dispensed into application equipment close to the store, a solid level surface should be available. They

should drain only into an agrochemical containment area, to avoid polluting the surrounding environment.

2.3.5. Dispensing

Agrochemicals such as fertilisers, dusts and granules may be supplied ready for use. Others such as pesticides would need to be measured from concentrated formulations and mixed, for example with water. Dispensing agrochemicals in this way requires particular care to ensure that it is carried out safely and efficiently. This will include:

- reading the label in order to work out what equipment, such as measuring jugs, funnels, stirrers and protective clothing, is required (figure 15);

Figure 15. Always read the label before using agrochemicals



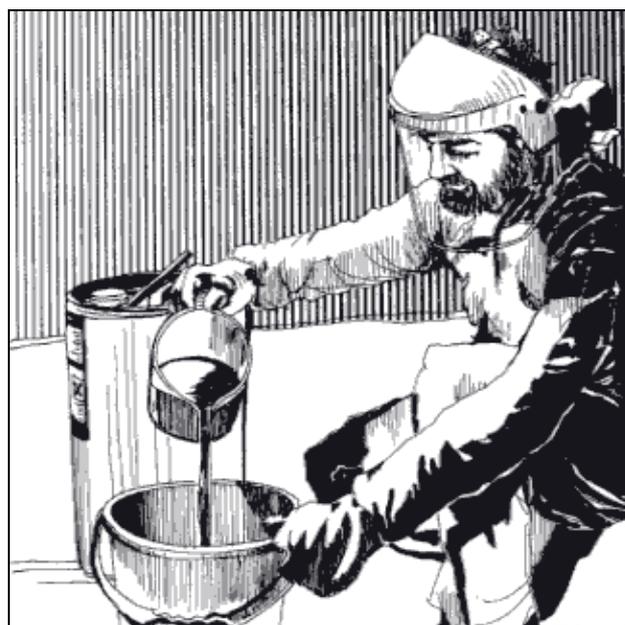
- setting out the agrochemical and dispensing equipment at an uncluttered place away from homes or livestock, and which could be cleaned of any spillage should it occur (figure 16);
- reading the label again to work out the correct dose rates and dilutions and how this can be achieved with the dispensing equipment available;
- wearing appropriate protective clothing, particularly gloves, as specified on the label or recommended in information sheets (figure 17);
- adding the dispensed agrochemical to the applicator in such a way that it is part full of water or any other diluting fluid recommended. This would prevent any accidental splash-back of the concentrated substance;
- carefully emptying packs of agrochemical dusts and powders into applicators to avoid their becoming airborne and being inhaled;

- decontaminating the utensils used for dispensing by washing or cleaning and returning to safe storage. Care should be taken to avoid inhalation, ingestion or skin absorption.

Figure 16. Set out the dispensing equipment in an uncluttered place



Figure 17. Wear the appropriate protective clothing when dispensing agrochemicals



2.3.6. Pesticide application

The safe use of pesticides is determined by the care and attention given to precautionary measures before, during and after application. It is very important to select the safest agrochemical that will act effectively with the least risk to people, livestock, wildlife and the environment.

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

- the scale of operation; and
- the form in which the agrochemical is applied.

It is not possible to give safety instructions about the full range of agrochemical application machinery in this guide. Some general principles, particularly with regard to the use of portable sprayers, are listed under three separate steps: prespraying, during application and post-spraying precautions. These must be observed in order to ensure effective and safe use.

Before discussing these steps, all agrochemical users must ensure that they are properly trained as sprayer operators. If a helper is at hand he or she should also be trained. Users should ensure that the training has adequately covered the following aspects of application:

- choice of equipment;
- checking of equipment to ensure proper functioning;
- filling the applicator with the agrochemical;
- calibrating;
- operating;
- safety precautions and emergency measures in the event of malfunction or accident;
- cleaning, maintenance and replacement of spare parts;
- fault-finding;
- attending to simple repairs.

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

- operating procedures;
- replacement of spare parts; and
- repairs;

is always available for reference.

2.3.6.1. Pre-spraying precautions

- Read and understand labelled instructions and any other information provided with either the agrochemical, the application equipment or the protective clothing (figure 15).
- Assess the risks of application to people, animals and the environment and decide what action is necessary to reduce or eliminate them. Apart from the points covered in this guide there may be others

because of the many, varied and sometimes unique circumstances of pesticide application. Seek the necessary advice before you commence application.

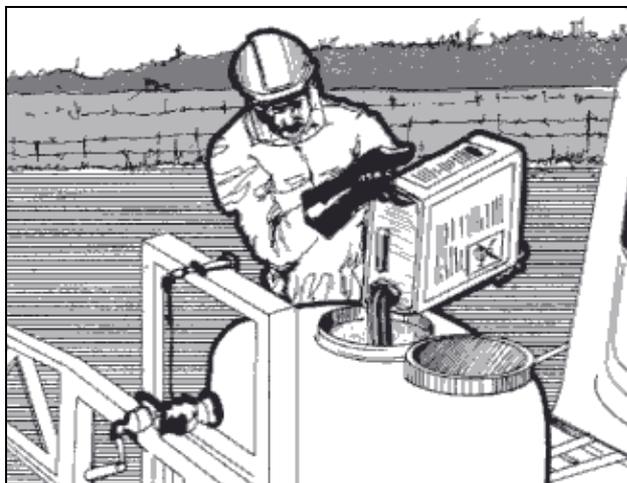
- Ensure that the user is competent and that he or she has received effective training in application techniques and the precautions to be observed. The user should also be familiar with the requirements under the law and guidance given in codes of practice.
- Arrange such health monitoring as may be necessary for certain hazardous agrochemicals based on their frequency of use. Do not use organo-phosphorus or carbamate pesticides if under medical advice not to do so.
- Check application equipment to ensure that it operates satisfactorily without leaking or spilling and is calibrated for the necessary application rates.
- Check that protective clothing and other safety equipment including breathing apparatus, if required, is complete, is of the correct quality and is in good condition. Replace any items that are worn or missing.
- Decide how the work is going to be done and set up an action plan to cover its implementation, together with any emergencies that may arise.
- Check that weather conditions are satisfactory, particularly to avoid excessive wind speeds and consequent spray drift.
- Warn people nearby if they might be affected in any way or have a need to know. They may include beekeepers, school authorities, or someone in charge of water supplies or sensitive plants or animals.
- Ensure the safe disposal of empty containers, tank washings and surplus pesticides.

2.3.6.2. Precautions during application

- Do not apply agrochemicals without adequate training.
- Wear appropriate protective clothing as prescribed on the label or information sheet for handling concentrated products.
- Avoid blow-back from granule or powdered materials when transferring container contents into the application unit. A slow, steady release causes least disturbance of air and reduces the risk of particles becoming airborne and being inhaled.
- Mix only the correct amount of agrochemical required for a particular task so as to avoid the need to dispose of any surplus.
- Handle containers carefully to prevent gurgling or spillage during pouring into an applicator. Pour correctly from large containers with the spout uppermost so as to allow air to flow into the container at the same rate as the contents flow out (figure 18).
- If two or more agrochemicals have to be mixed, ensure that they are compatible and without risk of a

chemical reaction that would cause a “tank mix” operator hazard.

Figure 18. Pour correctly from large containers with the spout uppermost



- Where protection is supplemented by an engineering control measure such as an autofill device, a closed system or a cab filtration unit, ensure that these controls are functioning correctly.
- Use an agrochemical only for the purpose for which

it was intended and at the correct application/dilution rate. Ensure that an edible crop has a sufficient time interval between application and harvest so as to protect the consumer from ingesting unacceptable levels of pesticide residues.

- Do not eat, drink or smoke while applying agrochemicals.
- Ensure that dangerous practices such as putting a blocked nozzle to the mouth to blow it clear are prohibited. Clean the nozzle with water or a soft probe, such as a grass stem.
- Do not allow other workers in the field, particularly when pesticides are being applied. Take particular care to observe that children are neither allowed to spray nor are exposed to pesticides.
- Take notice of changing weather conditions, such as an increase in wind speed. This would cause drift and could blow the spray towards sensitive areas such as a drinking-water supply, resulting in health hazards. It may also blow the spray towards the operator, causing an inhalation hazard.
- Look out for overhead electricity cables and make sure that the spray boom will not come close to “live” wires (figure 19). The spray boom would act as a conductor of electricity and the operator could be electrocuted. Fatal accidents have been caused by such negligence.



Figure 19. Look out for overhead electricity cables

- Never leave containers open and containers or application equipment unattended.
- If spillage occurs, keep everyone away until it is cleaned up and disposed of safely. This may be done by washing or using absorbent material such as soil or sawdust to soak up the agrochemical.

- Fumigants supplied as liquefied gas in pressurised cylinders are subject to special rules. Observe the rules applying to each liquefied gas under pressure.

Figures 20 and 21 show correct methods of manual spraying.

Figure 20. Correct method of using a knapsack sprayer



Figure 21. When spraying trees, take notice of wind speed and direction



2.3.6.3. Post-spraying precautions

- Thoroughly wash hands, face and neck as well as other parts of the body which may have become contaminated. If gloves have been worn, wash them before removal.

- Return unused agrochemicals to safe storage and safely dispose of empty containers and any surplus in the application equipment.
- Decontaminate application equipment by washing it thoroughly (figure 22). The washings should be drained into a soak-away or similar chamber to be safely confined and without risk to the environment.
- Decontaminate protective clothing by thoroughly washing items such as apron, boots and face shield. Launder the work clothing each day after spraying. Gloves should be washed inside and out and allowed to dry. Respiratory protection equipment should be wiped clean.
- Bathe or wash thoroughly again after completing the above four actions.
- Complete a record of use so as to provide information about the agrochemicals used, the date and place of use and the name of the user. This is both good management practice and also a source of reference in the event of agrochemical-related illness.
- Remove warning signs when no longer necessary so that they remain meaningful and carry a message that is always relevant. The warning signs are then more likely to be taken seriously.

Figure 22. Clean thoroughly all equipment used for application of agrochemicals. Take care not to contaminate the environment with waste water



2.3.6.4. Re-entry

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

The minimum re-entry period should be increased substantially if entry into treated areas would result in exposure to more than an occasional skin contact or if individuals who might be susceptible had to enter. These may include children and others likely to develop skin allergies or similar adverse reactions on exposure to traces of chemicals.

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

The re-entry period should not be confused with the harvesting interval, which is the time between

agrochemical application and the harvesting of a crop for eating.

There may be circumstances when a re-entry period for animals is also prescribed. Animals may be particularly vulnerable to the agrochemical sprayed or to the effect of the agrochemical on the vegetation that might make it taste or smell different. This may confuse the animals into eating poisonous plants which they would otherwise avoid (for example, herbicide spraying on ragwort).

Minimum re-entry periods

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

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

During the time that entry to any treated area is prohibited, action should be taken to ensure that those concerned are aware of the restriction. In most cases a hazard warning sign prominently displayed at entry points such as field gateways and footpaths would be sufficient. There will, however, be circumstances where signs are inadequate. If children or adults with reading or seeing difficulties are likely to enter a sprayed area, an alternative but equally effective means of warning, such as fencing or a loudspeaker announcement, should be made.

2.3.7. Other agrochemical applications

Agrochemicals are also applied as veterinary products, fertilisers and commodity chemicals. The precautionary measures described earlier also apply to these types of product. Different methods of agrochemical application will, however, require further consideration of risks to the user. Precautions as illustrated by the following examples should be taken:

- Animal injection treatments occasionally result in skin grazing or self-injection of the handier.

Prevention requires patience and care with excitable animals. A needle set in a retractable spring-loaded sleeve which protects against accidental contact should be used.

- Animal dips for sheep or cattle are a site of intense activity and contamination. There is often much physical handling of livestock together with the splash of immersion and the cloud of spray from the animal shaking itself on exit (figure 23). The agrochemical in use generally requires a basic level of personal protection (figure 24). In addition, any person working at the site of exit might require some respiratory protection. Alternatively, a rota system of working on short shifts should be arranged.
- Hydrofluoric acid is used to clean debris and moss growth from the roof surfaces of glasshouses. Application may be by means of a brush or by spraying from a knapsack sprayer. In such instances, personal protection appropriate to work with strong acids is necessary (figure 25).

Figure 23. Avoid contamination from animals shaking themselves after a pesticide dip



Figure 24. Use personal protective clothing when dipping animals



- Formalin liquid is made to react with potassium permanganate to produce formaldehyde gas as a fumigant. This is a common treatment against disease-causing organisms present in some livestock buildings. The main precaution is in the mixing, which requires the measured amount of potassium permanganate to be added (last) to the required

quantity of formalin; never the other way around, because the reaction and heat generated would be particularly violent.

- Strychnine and cyanide may, in certain exceptional circumstances, be approved for the control of pests such as moles or rabbits. The agrochemical is usually released underground. These extremely toxic substances should be used only by those thoroughly trained in all aspects of the work and the precautions to be observed.
- Fertilisers supplied as granules or naturally occurring rock powders may be applied by hand or by tractor-drawn machine. Applying fertilisers by hand should be avoided by using a shovel or spade. If handling is unavoidable, suitable protective gauntlet gloves may be needed.
- Liquid fertilisers are used in modern horticultural units where plants are reared hydroponically under glass roofs and individually fed through an arrangement of flexible pipes from a liquid mix and metering control unit. The concentrate may include products such as nitric and phosphoric acid which will require the handler to be protected against acids which can burn the skin. When opening acid containers, precautions should also be taken to disperse any gaseous fumes safely.
- Silage additives often include acids such as formic, phosphoric or sulphuric acid. Application is generally from a sprayer unit attached to the forage harvester. Appropriate personal protection is necessary when handling strong acids.

Figure 25. Personal protective clothing appropriate for working with hydrofluoric acid



2.3.8. Spillage

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

- containers bursting as a result of bad handling;
- container leaks due to defective packaging that does not withstand heat or humidity;
- containers being punctured during transport by sharp edges or metal studs protruding upwards through vehicle floorboards;
- careless pouring while transferring from container to applicator;
- equipment failure prior to or during application because of worn pipe couplings or hose lines.

Action in the event of spillage should include:

- taking immediate steps to avoid the spillage spreading and contaminating a wider area;
- keeping other people, animals and vehicles away from the site;
- wearing protective clothing appropriate to the use of the concentrated formulation involved;
- soaking up the agrochemical with absorbent material such as dry sand, soil or wood shavings in the case of a liquid, and removing the contaminated matter with a brush and shovel and storing securely in a bag to be disposed of safely (figure 26);

Figure 26. Using sand to contain and remove an agrochemical spill



- removing a dry powder or granule gently with a brush and shovel and storing securely in a bag to be disposed of safely. If there is a risk of the spillage becoming airborne, some damp sand should be scattered before attempting to decontaminate;
- decontaminating any remaining traces of spillage including that on vehicles or equipment by washing down and draining the contaminated water to a safe place, or soak-up;

- bathing or thoroughly washing immediately afterwards.

2.3.9. Disposal of containers and waste

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

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

- Agrochemical waste should never be dumped indiscriminately.
- Agrochemicals should never be disposed of so as to cause any risk to people, animals, crops, water supplies or the environment.
- First of all, the supplier should be asked if he would accept the waste for disposal.
- Whenever possible, waste should be disposed of through a company or persons licensed to handle waste disposal. Advice should be sought from the supplier, local authority or community leader.
- Accumulation of waste should be avoided. Waste should be disposed of as soon as possible.
- The user should read the label on the package or container for any specific advice on waste disposal.
- Empty agrochemical containers should never be reused except possibly, if in good condition, to contain an identical product transferred from a deteriorated or leaking container. All other containers should always be cleaned thoroughly before disposal. They may be cleaned in accordance with the labelled instructions. In the absence of instructions, rinse the containers in water successively at least three times. Care should be taken to ensure that the water used for rinsing does not contaminate the environment; particularly drinking-water, for example.
- Liquid containers should be drained out before cleaning. Ideally cleaning should take place when a spray mixture is being prepared so that the drained material and the rinsing liquid can be added to form a part of that mixture. In other instances the rinsings should be collected for subsequent disposal elsewhere. After cleaning, the containers should be punctured in several places or crushed to make them unusable, and stored in a secure compound until their disposal is arranged. Packages of dry powders and granules must be shaken out thoroughly into a mixing vessel or the applicator tank.
- Containers may be buried on premises owned or occupied by the agrochemical user. The burial site must be chosen carefully so that there can be no risk of pollution to surface water or groundwater. The

approval or the advice of the local authority should be sought beforehand. The containers should be buried to a depth of at least 1 metre below the surface and below the level of any land drains (figure 27). The area used should be fenced or marked with warning signs. A record should be kept of the dates and the material buried.

- It should be possible to obtain the permission of the local authority to have a common disposal site, such as a landfill, for several users. It should allow secure burial of waste to a depth of at least 1 metre below the surface and away from any land drains or water courses so that there is no risk of seepage from the site which might cause pollution (figure 28).

Figure 27. Containers and waste should be buried at a depth of 1 metre

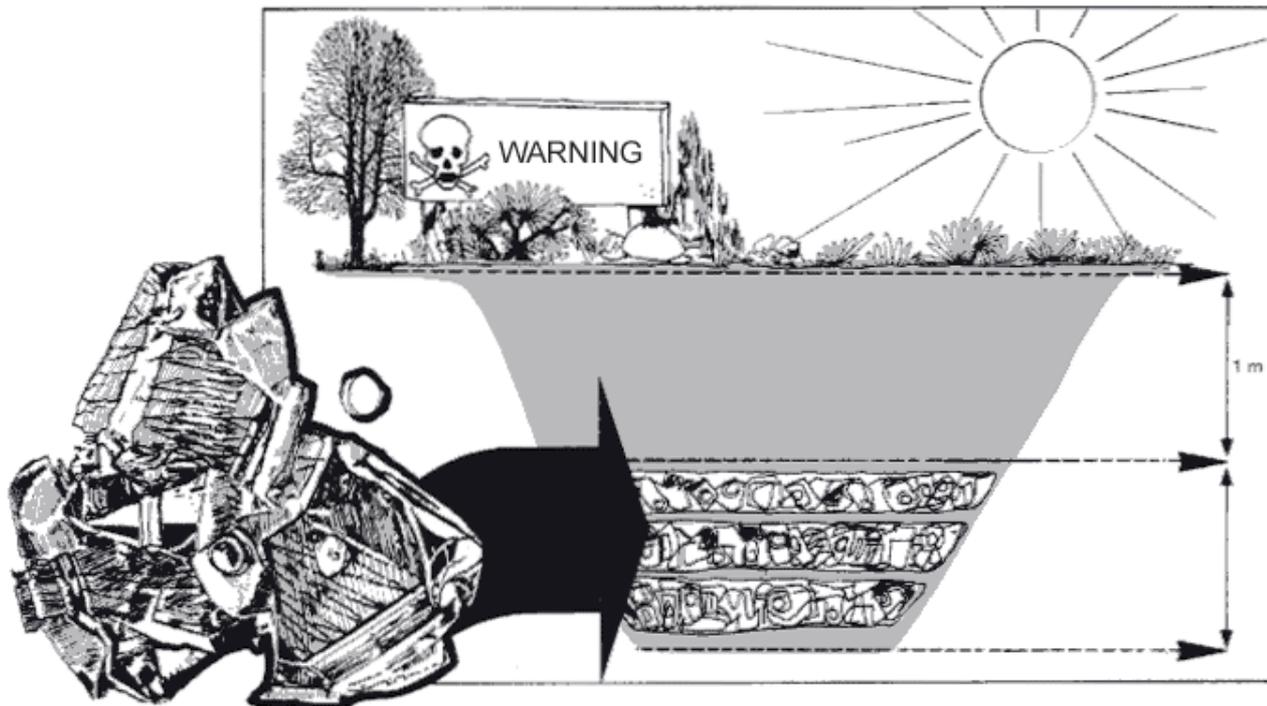
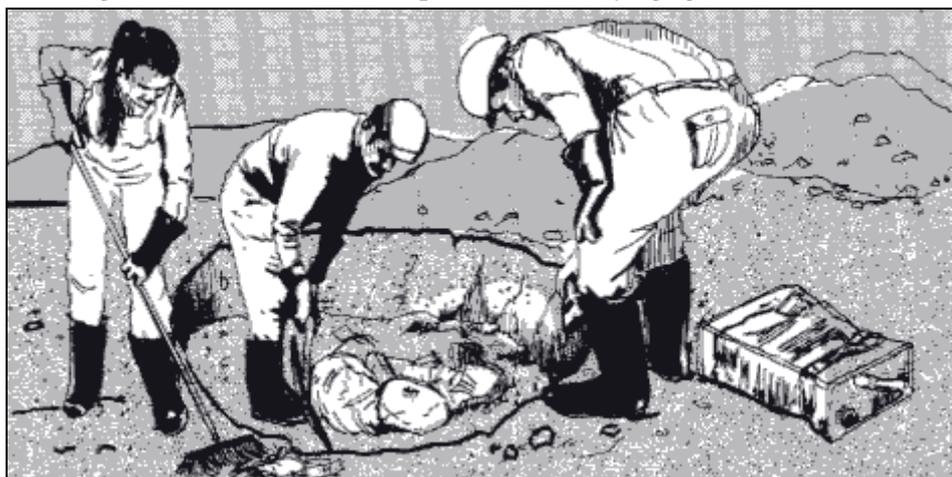


Figure 28. Choose a safe disposal site for burying agrochemical waste



- During burial of waste, protective clothing appropriate for the most hazardous product handled should be worn.
- Containers in which hydrogen cyanide gassing powders or aluminium, magnesium or zinc phosphides were supplied, or which have contained these materials, should not be rinsed or cleaned with water when empty. These substances react with

water to produce hazardous gases. Instead they should be filled with dry earth and punctured in several places immediately before disposal. The treated containers should then be buried. On no account should the empty containers be taken into or kept within a building.

- In certain instances it may be permissible to burn lightly contaminated packaging as a means of

disposal. Fumes and any smoke produced may, however, present a serious health risk and advice from the supplier of the agrochemical should be sought for any activity other than a very minor operation. The local authority should be consulted beforehand.

- When waste packaging is to be burnt (figure 29), the user should ensure that:
 - (a) burning takes place in an open space at least 15 metres from a public highway and not in a location where any smoke produced is likely to drift over persons or livestock or move towards housing or business premises;
 - (b) a perforated metal drum or a fabricated incinerator is used for the bonfire;
 - (c) all containers are opened and placed on a very hot fire a few at a time;
 - (d) the fire is supervised constantly and care is taken to avoid breathing any smoke produced;
 - (e) the fire is extinguished after use;
 - (f) any residues resulting from the operation are buried as described earlier.
- On no account should packaging or containers which have held any of the following pesticide

formulations be burnt: benazolin, clopyralid, 2,4-D, 2,4-DB, dicamba, dichlorprop, fenoprop, MCPA, MCPB, mecoprop, oxadiazon, picloram, sodium chlorate, 2,4,5-T, 2,3,6-TBA, triclopyr; other pesticides or formulations classed as “highly flammable pyrotechnic devices”, e.g. smokes and atomisable fluid containers under pressure. These should be buried.

- Some agrochemical operations may produce liquid waste. It will then be necessary for the user to provide arrangements for safe disposal such as the construction of a soak-away which should be environmentally acceptable for the types and quantities involved. The user should consult the local authority and seek the advice of the supplier.
- On completion of spraying all the equipment involved in the operation needs to be cleaned, washed and rinsed. This will produce a relatively large volume of dilute pesticide for reuse or disposal. Possible disposal routes include authorised discharge into a sewer connected to a sewage works with or without some prior treatment, or the use of a suitable soak-away. The local authority should be consulted.

Figure 29. Burning agrochemical containers



Discussion and activities (section 2.3)

1. Packaging

- 1.1 List the different types of package used to hold agrochemicals in your store. What are their sizes and volumes?
- 1.2 Have you bought any damaged packages in the past at a reduced price? If yes, would you react differently now? How?

- 1.3 Give two good reasons why you would not buy damaged packages of agrochemicals.
- 1.4 List five items you consider important to ensure that a package is up to the mark.

2. Transport

- 2.1. Who transports your agrochemicals?
- 2.2. When you transport your stock, by what means: cart, open truck, lorry?

- 2.3. Do you regularly or occasionally transport agrochemicals with other goods such as food items ?
- 2.4. What precautions do you take to ensure that other such items are not contaminated?
- 2.5. Have you experienced any contamination by spillage or container damage during transport? If yes, how did it happen? How did you manage the situation?
- 2.6. How can you prevent such spillage or container damage from happening in the future? List five steps you would take to ensure safety and health in the transport of agrochemicals.
3. Transfer
 - 3.1. Have you ever had a need to transfer agrochemicals from one container to another? If yes, what precautions did you take? Whom did you consult?
 - 3.2. List four steps you would take to ensure safety and health in the transfer of agrochemicals to another container.
4. Storage
 - 4.1 How big is your store?
 - 4.2 How far is it from your dwelling?
 - 4.3 Where do you keep the register of your stock? How often do you take inventories?
 - 4.4 How many persons, other than you, are authorised to enter your store? Did you ever experience unauthorised entry? If yes, what steps will you take to prevent a recurrence?
 - 4.5 What special precautions do you take to ensure that children do not have access to the store ?
 - 4.6 How do you ensure the security of your store so that no unauthorised persons have access to it?
 - 4.7 Have you ever experienced any theft or pilferage? If yes, what additional security measures did you take?
 - 4.8 What special arrangements have you made to facilitate storage after transport?
 - 4.9 Have you informed the local authorities, fire authorities and agricultural inspector about the siting, quantities and products stored?
 - 4.10 Did you ever experience a spillage or a fire involving agrochemicals in storage? If yes, how did you manage? Did you make any mistakes that resulted in (a) self-contamination, (b) contamination of others, (c) contamination of waterways or any other aspect of the environment?
 - 4.11 List seven items that you consider important to ensure safety and health in the storage of agrochemicals.
5. Dispensing
 - 5.1 Do you normally get a helper to assist you during dispensing chemicals? If yes, is he or she trained by you? How do you ensure that he or she takes the same precautions as you do?
 - 5.2 List five steps that you would take to ensure safety during dispensing agrochemicals.
6. Pesticide application
 - 6.1 Who trained you in pesticide spraying? Do you have a licence? Is there a licensing procedure or certification of competence? Did you receive a certificate after your training? If not, why was it not possible?
 - 6.2 List the types of equipment you use.
 - 6.3 How often do you check that the equipment is in order?
 - 6.4 For each of the following list steps that are required to ensure safety and health: (a) before application; (b) during application; (c) after application.
 - 6.5 What is a re-entry period? Prepare a chart showing the re-entry periods you follow after application of pesticides you are using.
7. Other agrochemical applications
 - 7.1 Do you rear animals? If yes, list the veterinary products you use.
 - 7.2 List the fertilisers you use.
 - 7.3 List four precautionary measures you would take to ensure safety and health in the use of veterinary products.
8. Spillage
 - 8.1 Describe the most recent case of an agrochemical spillage that you managed.
 - 8.2 List five steps you consider important to ensure safety and health in managing an agrochemical spillage.
9. Disposal
 - 9.1 Where is your disposal site? Could you draw an outline of it ?
 - 9.2 Are you aware of anyone in your locality using agrochemical containers for other purposes, e.g. for storing rain-water to be used during droughts? What would you advise?
 - 9.3 How often do you dispose of your empty containers or waste?
 - 9.4 List five steps you would take to ensure safety and health in the disposal of agrochemical containers.
 - 9.5 Do you burn empty packages? If yes, list five items you consider important to ensure safety and health during burning.

2.4. Operational control

Agrochemical users must make every effort to use those products that minimise the risk to themselves and others. In the choice of agrochemicals they may often be guided by advertisements in the mass media. It is therefore important that users seek advice from agricultural extension workers and several independent suppliers.

Similarly, choice of safe technology is important. For example, there may be several types of spray equipment on the market, but the cheapest ones are often not the best for safety. They may be of poor quality and might start to leak. The same may be true of the choice of personal protective equipment. Again, users should remember to seek advice.

The adoption of safe working systems and practices will minimise risk. Some of these have already been discussed in sections 2.3.6 and 2.3.7. The arrangement of working time, particularly in hot climates, would be relevant here. For example, agrochemical spraying could be undertaken in the early hours of the morning.

Engineering control measures, personal hygiene and other measures, the use of personal protective equipment as a last line of defence and the alternatives to agrochemicals will be discussed in the following subsections.

2.4.1. Engineering control measures

A basic principle of user protection is that all possible measures should first be taken to reduce exposure at the source. Routine maintenance should ensure that agrochemical application equipment is in good condition and without any potential to leak or spill. Particular attention should be given to knapsack sprayers where leakage could seriously contaminate the user. Figure 30 shows how they have been made safer to use by improved design that incorporates engineering control measures.

New developments in engineering controls go much further by introducing improved design features which automate agrochemical handling or make some tasks easier or safer. Figure 31 shows the design of a trailed crop sprayer (also known as a tractor-drawn sprayer). Examples of engineering control measures include:

Figure 30. Safe use of knapsack sprayers by improved design and engineering control measures

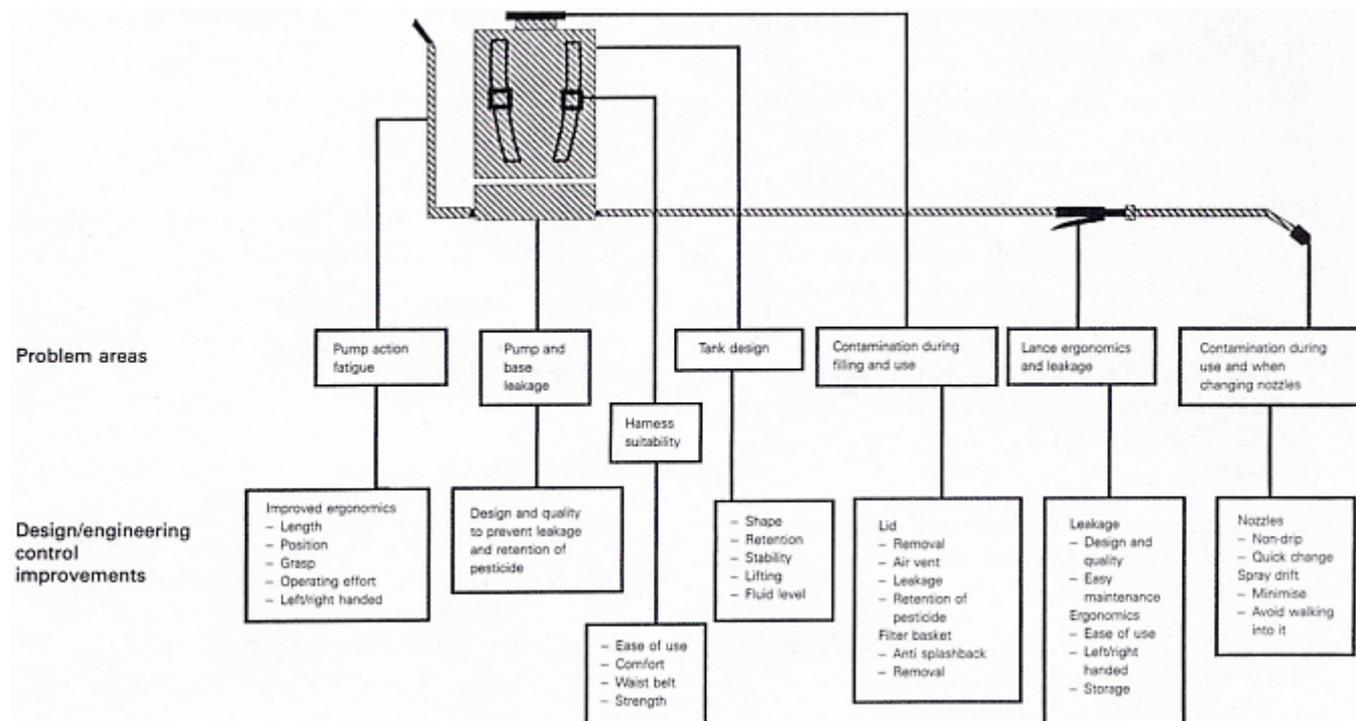
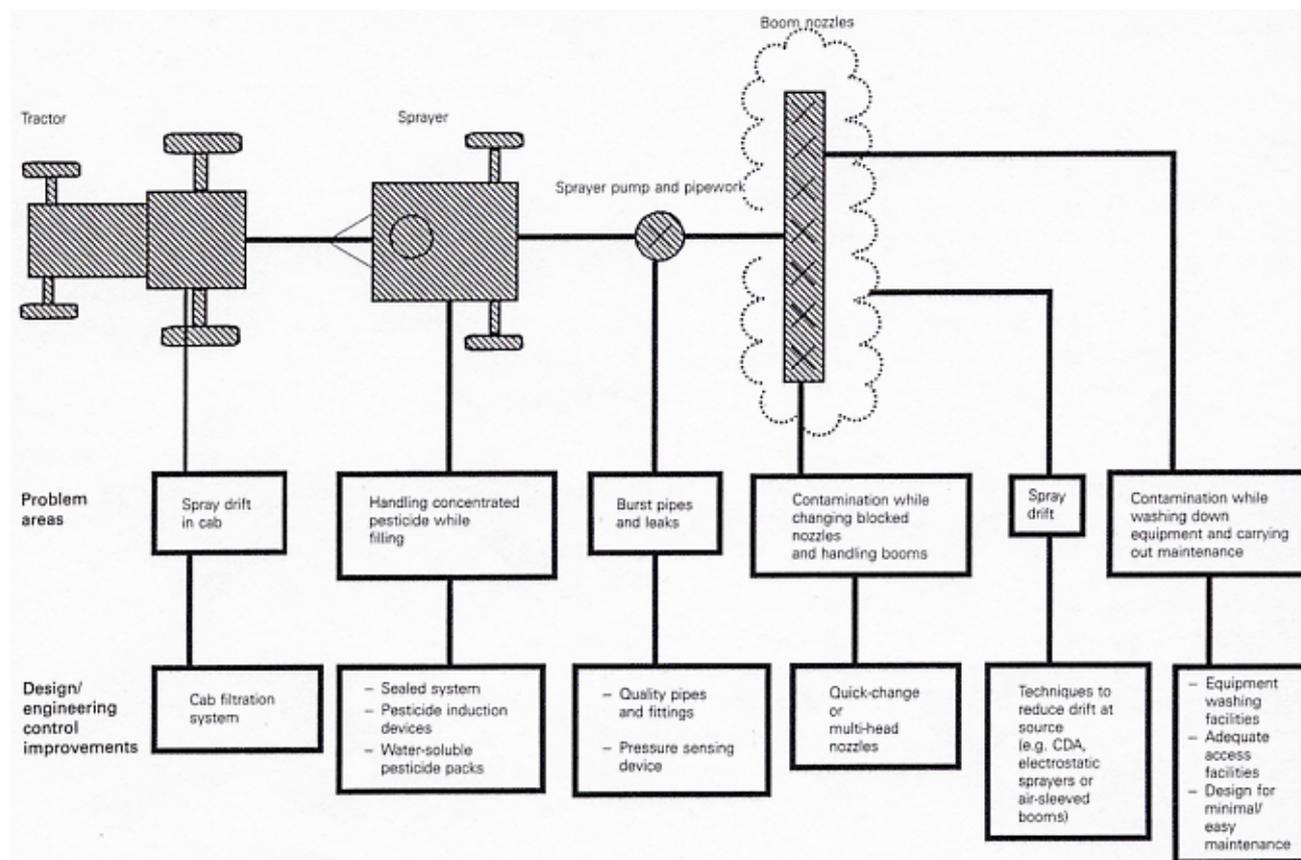


Figure 31. Safe use of trailed crop sprayers by improved design and engineering control measures


- *Closed systems.* The container is opened and the contents are automatically released through a measuring or weighing device into the spray tank.
- *Filling probe.* This transfers agrochemicals by suction from an opened container on the ground into the spray tank.
- *Pre-mix bowl.* This is a low-level bowl into which the agrochemical is poured (figures 32 and 33). It is then automatically transferred to the spray tank.
- *Anti-siphoning device.* This prevents back-siphoning of spray tank contents into the water supply used for dilution or mixing.
- *Easy access sprayer.* Here the user can reach all parts of the sprayer for manual filling or maintenance.
- *Automatic boom.* In this operation the spray boom opens and folds automatically.
- *Sprayer controls.* These controls fitted on to the tractor are readily accessible from the driver's seat.
- *Quick-change nozzles.* Devices used for rapid nozzle changing and cleaning.
- *Storage.* Areas in the tractor designed for clean water, protective clothing, pesticide containers and spare nozzles.

2.4.2. Personal hygiene

Personal hygiene aims to keep the body clean and not allow anything harmful to remain on it for long periods as it can be absorbed through the skin. It is equally important to avoid inhaling or ingesting small, even minute, quantities of agrochemicals because of their harmful effects on health.

The basic rules of personal hygiene in using agrochemicals are as follows:

- avoid exposure to agrochemicals by following safe practices and using protective clothing and equipment when necessary;
- thoroughly wash exposed parts of the body after work, before eating, drinking or smoking, and after using the lavatory (figure 34);
- examine the body regularly to ensure that the skin is clean and healthy;
- provide a protective dressing to any part of the body where there are cuts or sores;
- avoid self-contamination at all times, particularly when decontaminating or removing protective clothing;

- never attempt unsafe practices, such as blowing through sprayer nozzles to unblock them (always use a soft probe);
- do not carry contaminated items such as dirty rags, tools or spare nozzles in the pockets of personal clothing;
- remove and wash separately any contaminated item of personal protective clothing daily (figure 35);
- keep finger-nails clean and short;
- avoid working with any product which causes an allergic response such as a skin rash.

There are other hygienic measures to be observed:

- even if the product label does not recommend wearing protective clothing, remember to cover as much of the body as possible with lightweight clothing, e.g. long-sleeved shirt; hat or towel on head; long trousers made of cloth (rather than of plastic or similar material that might cause discomfort);
- as protective clothing is uncomfortable to wear and work in, seek advice about agrochemicals that do not require the use of protective clothing. Read the label before purchasing and ask the supplier.

Figure 32. Flow diagram of a field sprayer fitted with a pesticide induction bowl

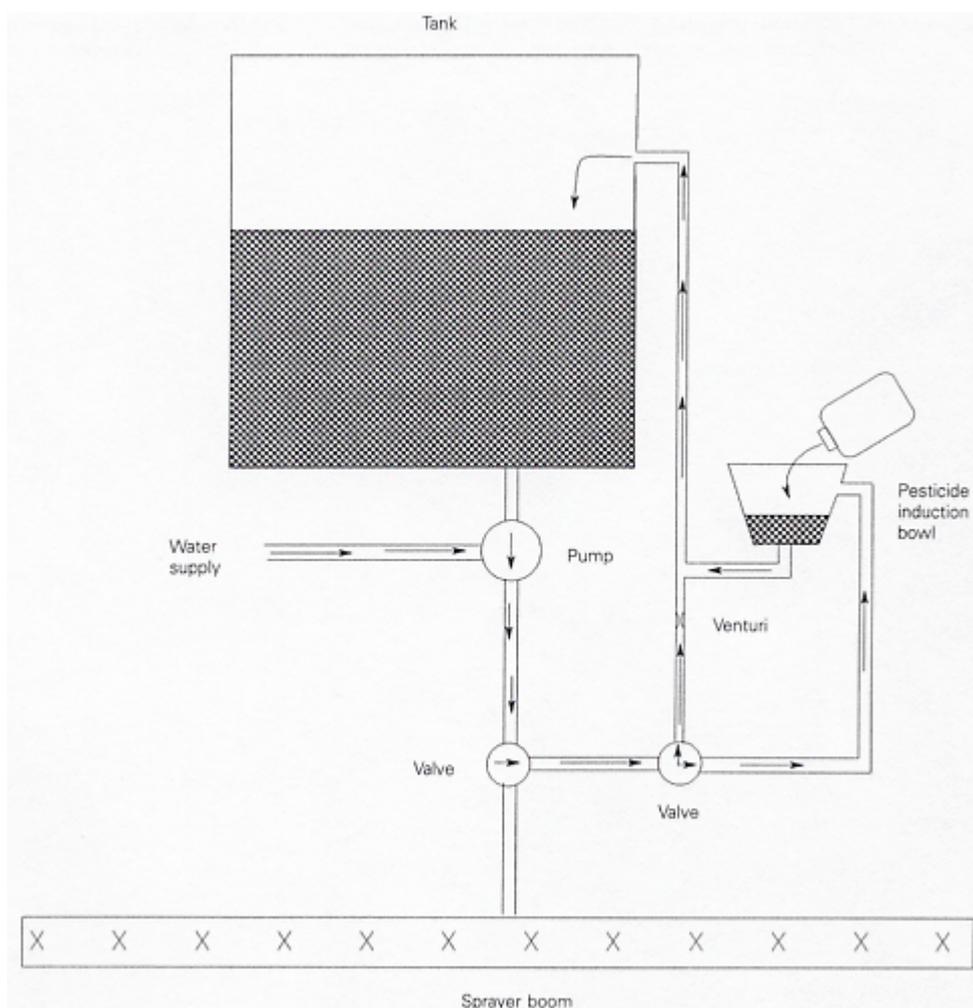


Figure 33. A user wearing protective clothing and filling a pre-mix bowl on a crop sprayer



Figure 35. Personal protective clothing should be washed after use

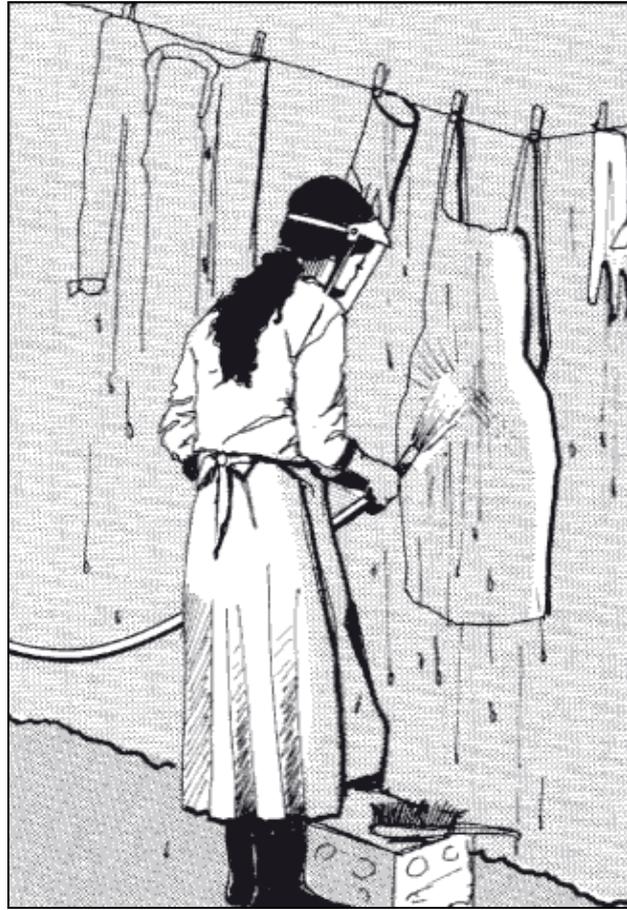
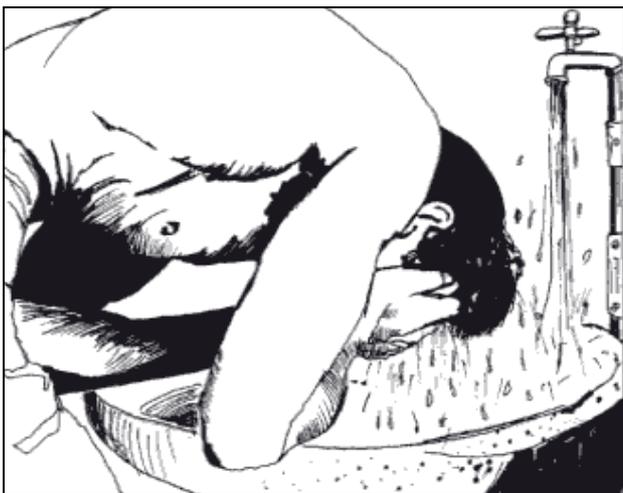


Figure 34. Thoroughly wash exposed parts of the body



2.4.3. Use of personal protective equipment

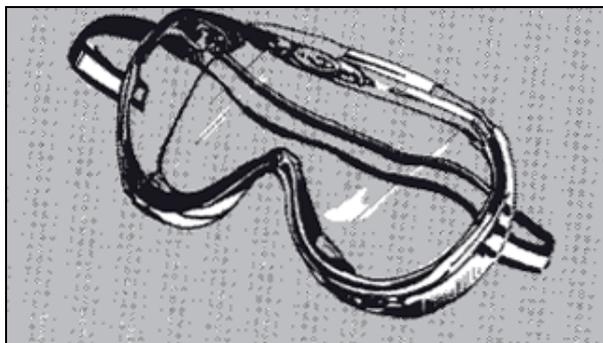
Most agrochemicals present a risk to the user which may be controlled by engineering control measures. Where recourse to the above measures does not suffice, personal protective equipment should be used.

Protective clothing

Because of the nature of farm work, engineering control measures may not always be feasible. Protective clothing therefore remains a necessary part of working with agrochemicals. The items required will depend on the harmful effects of the agrochemical and the way in which it is used. In practice, labelled information supplied with the agrochemical will generally specify the level of protection required. Detailed information on the quality of various items such as the minimum thickness of gloves or the material from which they are made, e.g. neoprene, nitrile or butyl, may also be supplied. Similarly, prescribed items of respiratory protective equipment and the care necessary in their maintenance might be listed. Examples of personal protective clothing are given in figure 36, and clothing and equipment necessary when working with highly toxic agrochemicals are shown in figure 37.

Figure 36. Examples of personal protective equipment

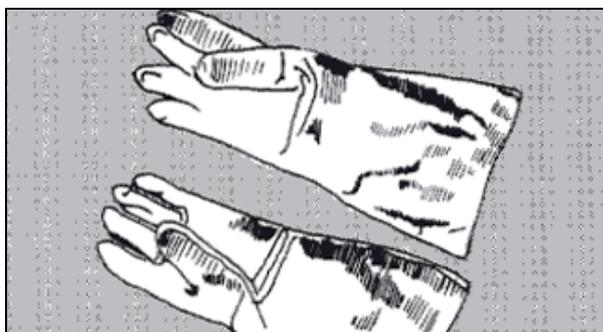
Goggles (for eye protection)



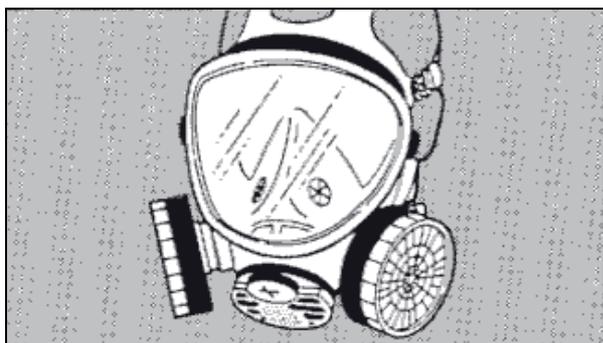
Headgear



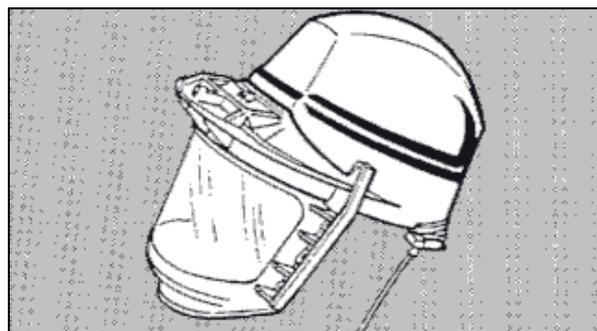
Gauntlet gloves



Respiratory protection



Head, eye and face protection



2.4.3.1. Head protection

Head protection may be provided as a single garment or as part of a coverall or of a face shield with hood. The advantage of such a combined garment is to ensure protection around the neck or to prevent agrochemicals spilled on the hood from soiling the work clothing worn underneath. Head protection should cover all parts of the head above the shoulders, with the exception of the face. The material used should be resistant to penetration by agrochemicals.

2.4.3.2. Eye and face protection

A face shield covering the whole of the forehead and face to a point below the jaw should be worn to protect against accidental splashes of dangerous liquids during opening or pouring from containers. Non-fogging goggles resistant to chemicals should be worn when handling dusts or granules.

2.4.3.3. Respiratory protection

Respirators may be half-faced, covering nose and mouth, or full-faced, covering nose, mouth and eyes. Their function is to prevent the wearer from inhaling hazardous agrochemicals. A filtering medium on the respirator removes the hazardous substances by absorption, adsorption or simple filtration. Filtration is by a simple gauze pad. In the case of highly hazardous agrochemicals, the air is filtered through a cartridge or canister containing other chemical substances that would absorb or adsorb the highly hazardous agrochemicals. Good respirators are manufactured to comply with national standards in several countries. The user should, however, ensure that the respirator provides a good fit around the nose and mouth and that he or she has received sufficient information and training on correct use and maintenance. The cartridges must be renewed periodically and the masks must be replaced regularly to ensure protection.

2.4.3.4. Protective gloves

Gloves are required when handling concentrated agrochemicals, particularly pesticides. These are very commonly absorbed through the skin or cause damage to the skin by burning. They should be at least 0.4 mm thick while retaining flexibility for simple manual tasks such as

opening containers or changing nozzles. The type of glove for a particular operation will depend on the agrochemical and the length of time in contact. For example, gloves of wrist length may be required for conventional spraying of toxic pesticides, elbow length for handling granules, and shoulder length for dipping plants in pesticides. A pesticide formulation with organic solvents such as xylene will require a glove of much higher-quality material because of its capacity to penetrate protective garments.

An indication of protective glove performance when tested against three groups of agrochemicals is given in Annex D.

Figure 37. Examples of protective clothing and equipment for work with highly toxic chemicals

Full-faced respiratory protection
Coverall
Boots (worn outside coverall)



2.4.3.5. Working clothes

Working clothes are items of personal clothing worn at work, while using agrochemicals, in this instance. They include such items as shirts, trousers, skirts, socks and shoes or boots. There will be many occasions when working clothes will be the main skin covering, e.g. when using lowrisk products or treating an animal.

Working clothes used at work with agrochemicals should be kept clean by washing immediately after use. Wearing clothes contaminated with agrochemicals may result in poisoning or skin irritation. There have also been cases where flammable substances, such as sodium

chlorate, deposited on clothes have ignited during cigarette smoking to engulf both clothing and the wearer in flames.

In general, working clothes should:

- fit comfortably so that free movement of the body and limbs is possible without undue restraint;
- be worn by the same person each day and not exchanged between individuals;
- be in good condition, sewn or mended when necessary;
- be clean and free of agrochemical deposits. Soiled work clothing should be cleaned separately from the family wash;
- be worn under protective clothing so that it is completely covered and not exposed to accidental contamination;
- be stored separately from protective clothing so that cross-contamination is avoided.

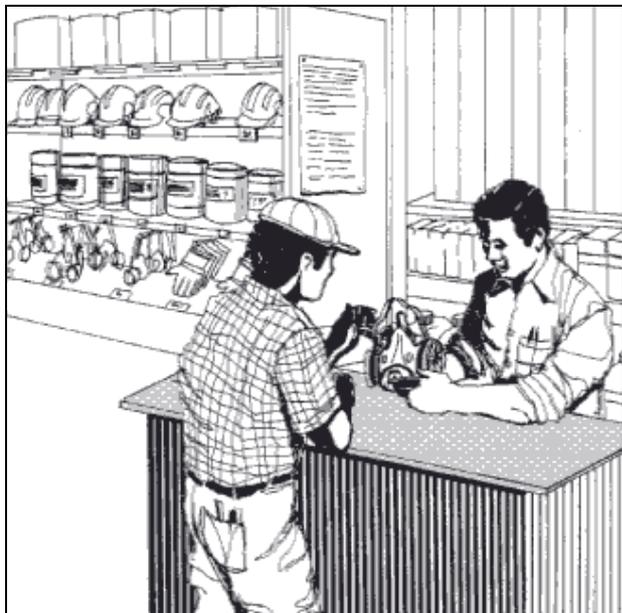
2.4.3.6. Selection, use and maintenance of personal protective equipment

When specified on the product label, the selection of appropriate personal protective equipment, its use and maintenance are essential for the protection of a person using hazardous agrochemicals. Advice should be sought (figure 38) and particular attention paid to the following:

- *Resistance to agrochemicals.* Protective clothing is produced in a variety of materials with varying capacity to resist penetration. The user should seek advice and select the appropriate ones by reading the instructions on the label or asking the supplier. In general, garments such as gloves made from neoprene, nitrile or viton material of at least 0.4 mm in thickness are resistant to most agrochemical formulations. Similarly, boots and aprons which are intended to resist contamination by concentrates should be equally resistant. Coveralls should be impermeable to liquids if subject to high levels of contamination, e.g. when the user is beneath the trees while spraying “top fruit”. If exposure is limited to occasional liquid spills or to dry powders or granules, a coverall made of a fabric material such as treated cotton or polyester may be sufficient.
- *Choice of garments.* Some garments, such as gloves or hats made from cotton, canvas, felt or leather, are particularly unsafe for use as protective equipment during work with very hazardous agrochemicals because they absorb liquids. These liquids in turn are absorbed through the skin of the wearer, resulting in poisoning. Clothing may also be unsafe because of repeated use which may wrinkle the protective surface, allowing liquids to seep through: it should be discarded as soon as a defect becomes noticeable. Some protective clothing is intended for other purposes, such as gloves for protection against

detergents at home or in the kitchen. This type of clothing may be unsuitable for work with very hazardous agrochemicals, and advice should be sought.

Figure 38. Select the appropriate type of personal protective equipment (ask someone who knows)



- *Tailoring.* Garments should preferably be made to measure, or ready-made ones should be well selected so that seams or welded joints do not pull apart or allow liquids to enter through stitch holes. There should be no trap points which hold agrochemicals and all pockets should be inside the garment or absent altogether. Garments should provide a good cover to those parts of the body which they are intended to protect. They should also allow freedom of movement to the wearer.
- *Correct matching.* In practice, several items of protective clothing are often worn at the same time. Each should be a correct match with the other in providing continuity of protection between, for example, a hood overlapping the shoulders of a coverall, the sleeves of the coverall overlapping gloves, and an apron overlapping boot tops.
- *User friendliness.* Protective clothing should not prevent the wearer from carrying out the necessary tasks associated with agrochemical work. Gloves should not be so big or rigid that the fingers cannot be manipulated to replace a sprayer nozzle. It should be possible for the wearer to move freely without being hindered by the sheer bulk or poor design of any garment. Similarly, garments should not be unduly heavy or hot when worn. Those for use in tropical countries should wherever possible be of lightweight material and coloured white or yellow so as to reflect heat. Users should learn how to select the appropriate protective equipment.
- *Washability.* All garments used at work with agrochemicals should be washable without any substance being retained in “trap points”. Absorbent garments such as untreated cotton may be particularly difficult to clean completely.
- *Suitability.* Each item of protective clothing should be suitable for its circumstances of use. Respirators, in particular, should be of a type approved by a responsible authority. They should be fitted with the appropriate cartridge or filter to give protection against the particular hazard. There are many different types of respirator. These include (a) those which are disposable and give protection against dust, fumes and mist; (b) chemical cartridge types; (c) canister types; (d) fully self-contained types; and (e) airline breathing units. The safe use of respirators depends upon a thorough knowledge of (i) how to wear them correctly; (ii) recognising that they fit the worker accurately; and (iii) the precautions to be observed. The user should receive specific training in all these aspects. There may be circumstances where there would be a choice of garments. These may include gauntlet gloves in preference to the shorter hand gloves, hats with broad rims or hoods, and goggles which are non-fogging. Advice should be sought.
- *Making a clean start.* Clothing to be worn at the start of each day should be clean, dry and in good condition. The various items should be checked for signs of wear and tear and repaired or replaced as necessary.
- *Wearing correctly.* When gloves are worn with an impermeable coverall, it is good practice to wear the cuffs of the gloves inside the shirt sleeves so that run-off of liquids sprayed does not drip inside the gloves. Similarly, the legs of coveralls should normally be worn outside boots so that run-off drips outside. Other garments should also be worn properly. This may include the correct fastening of buttons and zips and having face shields properly lowered into position (figure 39).
- *Decontamination after use.* Gloves and boots should be washed before removal to avoid self-contamination (figure 40). They should then be removed and the inside should be thoroughly washed with water and detergent, rinsed and allowed to dry. Goggles and face masks should be similarly washed and allowed to dry.
- *Safe storage.* Protective clothing should be stored in a clean, dry, well-ventilated room separate from other clothing or living accommodation (figure 41).

The FAO *Guidelines for personal protection when working with pesticides in tropical climates* (in preparation) will provide more detailed information.

Figure 39. Protective clothing and equipment should be worn and used correctly



Figure 41. Protective clothing and equipment should be stored in separate accommodation



Figure 40. Boots used during agrochemical application must be washed before removal to prevent contamination



2.4.4. The use of alternatives to agrochemicals

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

- *Cultural controls.* This is essentially the use of cultivation techniques for the benefit of the crop and to the disadvantage of pests of any kind. Crop rotation is the most effective cultural control. It avoids a build-up of crop-specific pests and a depletion of the plant nutrients in the soil. Crop rotation is also beneficial. It replenishes soil nutrients with decayed organic matter, improves the soil structure and helps weeding.
- *Biological controls.* The natural enemies of pests are known as insect predators. Biological controls seek to encourage those insect predators which are harmless to the crop but which destroy the pests in the same way as agrochemical insecticides. Insect predators are a valuable alternative to agrochemicals and may be bred in captivity for a timely release to control an insect population.
- *Breeding of pest-resistant plants.* Plant breeding seeks to develop improved varieties of crops such as rice,

wheat and maize, which will respond well to cultivation and produce good yields. A resistance to crop diseases, particularly those caused by micro-organisms such as viruses, fungi and bacteria, is an important part of this process. Information obtained during the breeding programme will also indicate ideal growing conditions and will be of value to the farmer. This may include information on nutritional requirements, planting density or the best time for planting and harvesting so as to avoid insect damage. Farmers should seek advice on varieties of crops resistant to pests in their locality.

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

In some countries different control methods will be subject to national standards that regulate the way in which the controls may be used.

2.4.5. Prevention of poisoning

The prevention of poisoning depends upon a responsible attitude of the user under all circumstances of use. Before beginning agrochemical application the user should read, understand and follow the information on the label, check the suitability of equipment, and ensure that he or she has the necessary competence. The user's responsibility will end only after use. Every item used should be safely decontaminated and any surplus returned to the store. Taken together the precautionary measures may be summarised as follows:

- *Use the least poisonous product.* Where there is a choice of different agrochemicals, the one selected should be the least poisonous.

- *Use as directed.* The agrochemical should be used only for the purpose for which it was intended and in compliance with the recommendations on the label.
- *Observe the precautions on the label.* Comply with such matters as protective clothing to be worn, application rates, re-entry period and protection of the general public.
- *Control exposure at source.* Where exposure can be controlled by an engineering control measure, this should be done first. Examples may include the use of closed systems, pre-mix bowls and suction probes, and the correct maintenance and repair of agrochemical application equipment.
- *Comply with the law.* Where legislation is in force to control the use of agrochemicals, this should be complied with.
- *Avoid unsafe practices.* Agrochemicals should be used with a sense of responsibility towards humans, animals and the environment. Irresponsible behaviour of any kind should be condemned and prohibited.
- *Education.* Training in the use of agrochemicals is necessary to develop the competence of the user. A knowledge of basic precautionary measures to prevent accidental poisoning should be included in training.
- *Cleanliness.* Protective clothing and equipment should be decontaminated after use, and inspected to see if any item needs repair or replacement. Unused agrochemicals should be returned to the store and empty containers disposed of safely.
- *Attention to personal hygiene.* Physical cleanliness, particularly after work and at mealtimes, will avoid absorption of agrochemicals due to careless use that could cause ill-health.
- *Seeking medical attention.* If poisoning is suspected, medical attention should be obtained as soon as possible in order to avoid a more serious illness. Remember the name of the product involved and tell the doctor, if for any reason it is not possible to take the labelled container of the product used. The doctor can then give prompt treatment or may seek advice, for example from a poison information centre.

2.5. Other applications

2.5.1. Work in greenhouses and similar structures

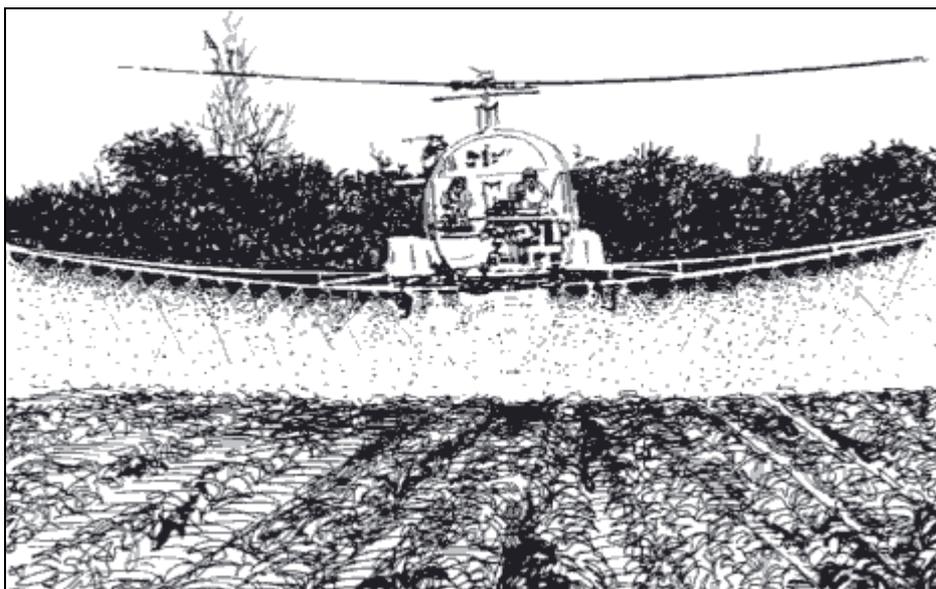
There are special problems associated with work in greenhouses (figure 42), where agrochemicals are used in a wide variety of circumstances. These may include the controlled feeding of plants with liquid nutrients, or the release of carbon dioxide to assist plant growth or as pesticides for crop protection.

Figure 42. Work in a greenhouse involves many risks associated with agrochemicals



To some extent agrochemical use under a protective covering has advantages; the user is insulated against wind and other weather conditions. There are, however, disadvantages such as the following, which require special consideration:

- *Plant congestion.* There is less space for manoeuvre within a building because growing plants are kept close together in order to maximise all available space. This increases the possibility of physical contact with treated surfaces and reinforces the need for adequate personal protection.
- *Frequency of application.* Fast-growing covered plants will generally need a more frequent application of agrochemicals than those growing in the open. There will also be a tendency to use several different, but similar pesticides in order to overcome insect resistance to a particular active ingredient. All this will increase the user's frequency of exposure to a wide range of agrochemicals and will call for a high standard of personal hygiene and strict compliance with precautionary measures.
- *Low ventilation.* Greenhouse ventilation is set to promote plant growth and is generally poor for the user. It is important to allow for this in determining re-entry times after spraying, particularly where
 - spray droplets may have vapourised after settling on heating pipes or similar hot surfaces.
 - *Close body contact with applicator.* Some agrochemical applicators, such as knapsack sprayers, are carried in greenhouses. Particular care should be taken because of the confined space. Inhalation risk is greater because the vapour concentration from any leaks or spills will be higher. Spray equipment should be properly serviced and repaired when necessary.
 - *Wear and tear of protective clothing.* The regular use of protective clothing requires a more frequent rate of servicing and replacement. Facilities for decontamination, washing and storage should also be available.
 - *Re-entry.* The use of pesticides as fumigants, mists or fog will make it dangerous for anyone to enter a building for some time afterwards. In these circumstances the building should be securely locked and a warning notice posted outside.

Figure 43. Aerial spraying of pesticides

2.5.2. Aerial spraying

Agrochemicals, particularly pesticides and fertilisers, are sometimes applied from helicopters and fixed-wing aircraft (figure 43). This is a common practice in plantations in several countries. The national aviation authority that permits the use of these aircraft prescribes additional controls when they are used for aerial spraying. These requirements have already been published by the ILO.¹ Some basic principles are listed in this guide.

The national aviation authority should specify:

- the levels of competence necessary for pilots and ground crews;
- a restricted list of only those pesticides which may be applied, together with further conditions on their approved circumstances of use and the precautions to be observed;
- prior consultations with persons responsible for potable water and land areas such as any kind of public or farm livestock water supply, water used for farming or rearing of aquatic life, or water used for the irrigation of crops or land on which there are susceptible plants or wildlife;
- that the following persons be notified:
 - (a) public authorities such as police, public health or enforcement agencies;
 - (b) hospital authorities, schools or other institutions in the vicinity of the aerial spraying site;
 - (c) the occupants of any building and persons responsible for livestock or crops surrounding the site;

(d) any keeper of pollinating insects such as bees;

- that warning signs be erected and ground markers employed;
- that records be maintained.

Discussion and activities (sections 2.4 and 2.5)

1. Identify the safety devices on the equipment that you use for agrochemical spraying. List them separately.
2. List ten basic rules of personal hygiene.
3. Personal protective equipment
 - 3.1 List the items of personal protective equipment that you use. Give the name and address of the retailer and date of purchase.
 - 3.2 When did you last inspect it?
 - 3.3 How do you ensure that each item has been properly cleaned? Do you keep a record?
 - 3.4 Who has trained you in the use of each kind of equipment?
 - 3.5 How do you ensure that you use the right equipment for each hazardous operation?
 - 3.6 Are you trained to check that each item is giving you adequate protection? If not, remember that it is a risk to use it, as it would give only a sense of false protection. Consult someone who knows.
 - 3.7 What discomfort do you experience working with personal protective equipment?
 - 3.8 Have you tried changing the time of day of application of chemicals, for example, by working very early in the morning when wearing the equipment? What is your experience ?

¹ Safe use of pesticides, Occupational Safety and Health Series No. 38 (Geneva, 1977), pp. 20-24.

- 3.9 Discuss with your trainer possible alternatives to working with personal protective equipment when spraying dilute solutions of pesticides, e.g. using a plastic bag to replace gloves; using smaller quantities and spraying for a quarter or less of the time.

Point to remember:

Do not try to experiment unless you have received the correct advice.

4. What is integrated pest control?
- 4.1 Have you any experience of using other methods of pest control? Describe it.
- 4.2 List examples of larger insects or animals that feed on your pests on the farm.
5. List eight precautionary measures you should take in organising the prevention of agrochemical poisoning.
6. If you have any experience of aerial spraying or working in greenhouses, explain to others in the group:
- the various risks involved; and
 - the precautions you have been instructed to take.

3. Poisoning by agrochemicals, its management and emergency response

As described in section 2.2.1, agrochemicals are toxic, harmful, irritant or corrosive. They have to be handled and used with adequate care. Inhalation, ingestion or skin absorption should be avoided. Poisoning would result if they entered the body through any of those three routes of absorption. Symptoms of poisoning will depend on the quantities absorbed during a given period of time. The human body has the capacity to detoxify and eliminate small amounts of toxic substances absorbed. Elimination is through exhaled breath, urine or excreta.

When the amount of toxic substance absorbed exceeds what it can eliminate, the body will accumulate the substance. Some agrochemicals are extremely toxic and small amounts could result in acute poisoning; symptoms could appear in a few seconds or minutes. Others that may be less toxic could accumulate in the body to produce chronic poisoning. Some organs of the body such as the liver, kidney, brain or nervous system could get damaged over a period of time. If the user is already suffering from other illnesses, exposure to agrochemicals could aggravate them. *Therefore, agrochemicals should be used with extreme care at all times.*

3.1. Types of poisoning and injury

The terms “acute” and “chronic” poisoning are used to describe the harmful effect of an agrochemical on the body. “Acute” means that the effect is either immediate or would appear within a day or two after exposure. Although the acute condition can be directly related to the agrochemical, the user may not be aware of this. The symptoms may appear as a general feeling of sickness, skin irritation or sudden and otherwise unexplained serious illness.

“Chronic” effects, on the other hand, take longer to emerge and are sometimes difficult to relate to agrochemicals or the use of one particular substance because different ones may have been used by the individual concerned. Also, when several agrochemicals accumulate in the body the chronic health effect may be caused by the cumulative effect of several chemicals. Medical practitioners and health personnel are generally aware of the chronic symptoms of agrochemical poisoning. It is therefore important to inform the doctor or the health worker of the agrochemicals one has worked with. Presenting the labels is the recommended way to consult the doctor. Injuries usually result from chemical burns when strong acids or alkalis are used without adequate precautions. Further, injuries could result from self-vaccination while treating animals.

While necessary precautions should always be taken to prevent or minimise exposure to agrochemicals, agrochemical poisoning is not uncommon. Therefore, a basic knowledge about the acute effects of the different types of poisoning is of value to the user. Examples of some different groups of agrochemicals with common signs and symptoms are listed in Annex E.

3.2. Symptoms of poisoning and injury

3.2.1. Poisoning

Symptoms of acute poisoning from pesticides and veterinary products will often develop shortly after exposure. They will depend on the concentration of the product, the toxic substances in it and the amount absorbed; they may be immediate if inhaled or may take longer if absorbed through the skin. Early symptoms commonly include one or several of the following: dizziness, headache, incoordination, nausea, diarrhoea, sweating, shaking and a feeling of weakness. The more toxic substances could also cause convulsions, irrational behaviour or unconsciousness.

3.2.2. Irritant injury

The severity of irritant injury is proportional to the concentration of the substance and the sensitivity or condition of the tissue affected. Mild symptoms may be a stinging or scratching of the skin or eyes which, if untreated, will develop into skin blistering or peeling (figure 44). Some gases such as ammonia could cause irritation of the nose and throat.

The relationship between cause and effect is generally self-evident but there are exceptions. Some pesticides are known skin irritants. Either an active ingredient or any other substance in the formulation may be the causative factor. Noticeable injury may be seen only after repeated exposure. Repeated exposure to substances in low concentration such as from handling grass or grain that have been recently sprayed may go unnoticed until skin blistering or peeling occurs.

In all cases of tissue damage it is important to avoid secondary infection of the affected tissue. Such infections are common in agriculture.

Figure 44. Irritant injury (blistering caused by contact with toxic agrochemicals)



3.3. First-aid treatment

First aid is the use of available skills and knowledge to treat any condition of poisoning or injury until the casualty is in the care of a medical practitioner.¹ It has three main objectives:

- to preserve life;
- to prevent the condition worsening;
- to promote recovery.

3.3.1. In case of poisoning

- Send for a doctor or ambulance, giving as much information as possible about the chemical from either its container label or accompanying leaflet.
- Remove the casualty to an uncontaminated place (figure 45), which should be cool, shaded and airy. Place him or her in a comfortable position, seated or lying on one side.
- Remove contaminated clothing, avoiding self-contamination. Remove loose-fitting dentures and any constriction such as a tie or a shirt button.
- Flush contaminated skin with plenty of water. If eyes are contaminated, wash them out with fresh clean water for at least ten minutes (figure 46).
- Cover the casualty with a blanket or a similar covering to keep warm but not overheated. Do not

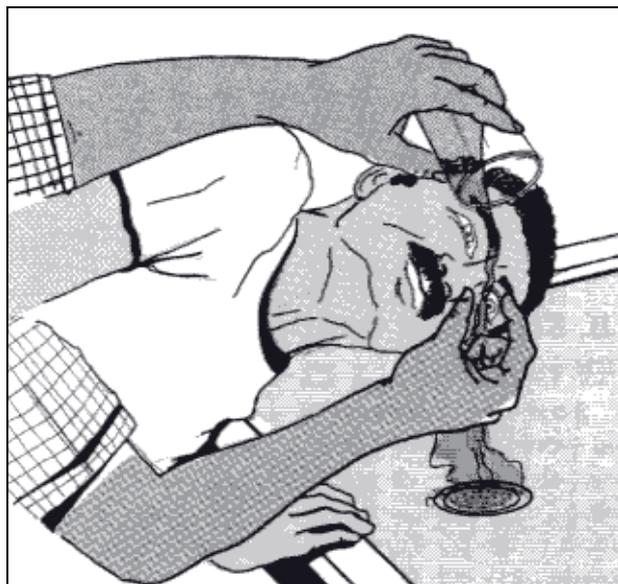
¹ A comprehensive guide to the organisation of first aid, and to the duties and training of first-aid personnel, has been published by the ILO: *The organisation of first aid in the workplace*, Occupational Safety and Health Series No. 63 (Geneva, 1989).

put contaminated clothing back on. Talk to the casualty so as to know whether he or she remains conscious. Keep him or her under surveillance.

Figure 45. Remove the casualty to an uncontaminated place



Figure 46. If agrochemicals enter the eyes, wash thoroughly with clean running water



- If the casualty becomes unconscious, place in the recovery position (figure 47) with head down and tongue forward so that any vomit or other fluid from the mouth will drain freely.
- If breathing stops or weakens, turn the casualty face upwards and ensure that breathing passages are clear by, if necessary, removing obstructions from face, mouth or throat and any constrictions from around the neck.
- Open the airway and start mouth-to-mouth resuscitation. If the mouth is contaminated with poison, a manual method of artificial ventilation may be preferable. If the heart stops, the first-aider must,

as instructed, initiate cardio-pulmonary resuscitation and continue until relieved by competent medical personnel.

- If the casualty is in a convulsion, loosen all clothing and prevent injury by gentle, not forced, restraint. When the convulsion stops, place the casualty in the recovery position to aid breathing.

Poisoning by some chemicals, such as those containing dinitro compounds, may cause a rise in body temperature. In such cases it is important to keep the casualty lying flat and at absolute rest with unnecessary clothing loosened or removed. The face and body should be sponged freely and frequently with cool water; fanning may also be considered if it will help. Anyone poisoned in this way who is conscious and can swallow should drink as much clean water as possible to minimise dehydration.

Figure 47. A casualty placed in the recovery position



3.3.2. In case of injury

As mentioned earlier, most injuries result from chemical burns. First aid should be given as quickly as possible:

- by immersing the affected skin area in clean running water for at least ten minutes. While this is taking place, contaminated clothing should be removed, avoiding self-contamination. If the burn is serious, send for a doctor or ambulance, giving as much information as possible about the chemical involved;
- if the eyes are affected, immerse them in clean, cold running water so that the water dilutes the chemical and drains away from the face (figure 46). Alternatively, immerse the eyes in a bowl of cold water, asking the casualty to blink. A further alternative is to pour water from a clean container to simulate the running water procedure. Both surfaces of the eyelids should be well irrigated; if shut because it is painful to open them, attempt to open them gently to ensure complete irrigation. After irrigation, lightly cover the eyes with sterile pads or clean non-fluffy material;
- in all circumstances where there are serious burns to the skin, do not: (a) remove anything sticking to the burn or apply lotions, ointment or fat; (b) break blisters; or (c) remove loose skin or otherwise interfere with the affected area.

The affected area may be gently covered with a sterile dressing if readily available.

Cases of accidental self-vaccination of veterinary products should be handled by a doctor or health worker

immediately. He or she should be told of the substance that caused the accident.

3.4. Role of poison information centres

A fair number of countries now have access to poison information centres which have been set up in response to the growing need for medical advice about agrochemical and pharmaceutical products.

The role of each centre is essentially to provide a support service to doctors, emergency services and other health workers who are called upon to treat cases of acute poisoning. The service operates by reference to an extensive computerised index of substances which describes their toxicity, diagnosis and treatment. Advice is almost always in response to a telephone call or other means of obtaining an urgent reply. In some countries centres are operated 24 hours a day throughout the year.

Centres may also provide further services such as:

- providing antidotes for poisons, particularly those which are not widely available;
- co-ordinating the activities of medical experts to treat particular cases;
- providing a laboratory service to analyse blood or other samples for poisons;
- identifying trends from all inquiries to determine causes of poisonings which point towards the need for a particular solution, such as improvements to labelling or packaging;
- analysing inquiries on behalf of government or manufacturers in respect of particular products;

- educating and informing others about their work and on improvements to enable better diagnosis and treatment.

Employers such as managers of plantations and others who employ a number of workers in agriculture, and community leaders, should establish contacts with poison information centres, where they exist. Such contacts have proved to be vital in saving lives in cases of agrochemical poisoning.

3.5. Effects of temperature and fire emergencies

Situations involving the use of agrochemicals that would require emergency responses could result either from natural causes or human failure. Natural causes include the flooding of stores or the effects of temperature on agrochemicals. Safe storage has been dealt with earlier.

Overheating of agrochemicals could have serious consequences. Agrochemical users should take adequate steps to prevent such occurrences.

Fire is a more serious situation that the user has to deal with, or for which outside assistance must be sought. Again, while the first step is prevention, the user should know what to do in the case of a fire. This section deals with some basic principles of emergency response.

3.5.1. Effects of temperature on agrochemicals

Agrochemicals are stable at normal temperatures. Extremes of heat or cold may, however, cause deterioration of the container and its contents. This could result in the container leaking or bursting, and consequent spillages. If two or more containers begin to leak different agrochemicals simultaneously, these substances may react and produce gaseous vapours or even heat and fire. In addition, the contents of an apparently sound container may decompose owing to the effect of temperature so that they are no longer suitable for their original purpose. Climatic conditions such as high humidity and direct sunlight may speed up the rate of damage. Agrochemicals should be stored in a manner so as to avoid their being affected by fluctuations of temperature.

3.5.2. Fire prevention and fire-fighting

All possible measures should be taken to avoid fires involving agrochemicals. These will include:

- banning smoking or the use of naked flames where agrochemicals are stored or used;
- keeping flammable products away from heat sources such as direct sunlight;

- keeping glass containers out of direct sunlight as they could act as magnifying glasses and focus the sun's rays on flammable material to cause a fire;
- arranging the storage area so that it does not adjoin other sites with a risk of fire such as those storing hay, straw or petroleum fuel;
- avoiding the cause of a fire from an unsafe electrical installation or sparks from nearby welding or grinding activities;
- having a pre-arranged fire-fighting plan with ready access to a source of water and other extinguishing equipment to deal with emergencies.

In the event of fire:

- do not put lives at risk. Get everyone except fire-fighters away from the site and beyond the line of smoke and chemical discharge;
- call for help if needed, including the firefighting services if the fire cannot be extinguished with available equipment;
- inform fire-fighters and other helpers about any agrochemical which may react dangerously such as those which are flammable, toxic or in pressurised containers;
- attempt to contain the fire and any run-off from agrochemicals or water so that the wider environment is not contaminated;
- after extinguishing the fire, clean up appropriate protective clothing and dispose safely of all damaged or contaminated material to avoid exposing others to agrochemical risk.

3.5.2.1. Emission of toxic gases

The extent of toxic gas emission from an agrochemical fire is proportional to the number and type of the products involved. In practice, however, it is always best to assume that an agrochemical fire will produce toxic gases, which may be lethal, from burning chemicals or plastic containers. There are also particular circumstances such as fires involving non-toxic fertilisers which give off toxic fumes when exposed to fire. Ammonium nitrate is one such example. Fire-fighters should take necessary precautions for fighting fires where toxic gases are released. They should position themselves on the windward side and use self-contained breathing apparatus.

3.5.2.2. Choice of fire-extinguishing agents

The type of extinguishing agent must be the most appropriate (table 1). It must be safe and not react dangerously with flammable materials or conduct electricity.

Most fires develop slowly. A bucket of sand or a portable fire extinguisher may be all that is initially needed. Larger fires should be fought by professional fire-fighters.

Table 1. Which fire-extinguishing agent to use

Class of fire	Water	Carbon Dioxide gas	Dry chemical powder
A Paper	✓	–	✓
Wood	✓	–	✓
Textile	✓	–	✓
Fabric	✓	–	✓
B Flammable liquids	–	✓	✓
C Flammable gases	–	✓	✓
Electrical hazards	–	✓	✓

The agrochemical user should be prepared by having portable extinguishers at the storage site and being trained to use them. Fire extinguishers should be of an adequate size and positioned where they will be readily available.

Table 2. Action of fire-extinguishing agents

Type	How fire-extinguishing agents put out fires	Best for
Water	Mainly by cooling burning material	Class A fires involving solids. Danger – do not use on live electrical appliances or on burning fat or oil
Multi-purpose dry powder	Knocks down flames and, on burning solids, the powder melts to form a “skin” smothering the fire. Some cooling effects	Class A fires involving solids and Class B fires involving liquids. Safe on live electrical equipment although does not readily penetrate the spaces inside equipment and the fire may flare up again
Standard dry powder	Knocks down flames	Class B fires involving liquids. Safe on live electrical equipment although does not readily penetrate the spaces inside equipment and the fire may flare up again
AFFF (Aqueous film-forming foam)	Forms a fire-extinguishing film on the surface of a burning liquid. Has a cooling action with a wider extinguishing application than water on solid combustible materials	Class A fires involving solids and Class B fires involving liquids
Carbon dioxide (CO ₂)	Vaporising liquefied gas which smothers flames by displacing oxygen in the air	Class B fires involving liquids. Clean, effective and safe on live electrical equipment

Table 2 lists the different types of fire-extinguishing agents and their uses. The most suitable portable extinguisher for an agrochemical fire is the dry chemical type. It is effective against fires involving combustible flammable liquids and gases. There are, however, other

extinguishers which, according to circumstances, may also be suitable.

Fighting large agrochemical fires with water alone has been successful, but there are disadvantages. The first is that water used on a fire may wash out poisonous material to contaminate the wider environment. Bunding or the construction of a small earth wall around the store will help to prevent this by containing the polluted water. This should be an essential feature of all larger stores. The second disadvantage concerns those agrochemicals which react with water to produce poisonous gases. However, most agrochemicals are compatible with water, the exceptions are some cyanide compounds and phosphide. These substances, which are extremely toxic gases used as fumigants, release hydrogen cyanide gas and phosphine respectively in contact with water.

Discussion and activities

- Have you, or anyone in the neighborhood, fallen ill from working with agrochemicals?
 - What were the symptoms?
 - What was the treatment?
 - What were the consequences?
- Point to remember:**
Remember always to take the containers of agrochemicals used, along with their labels, if a case of acute poisoning is taken to a hospital, doctor or other health worker. Take extreme precautions in transporting the containers. The doctor or other health worker consulted may then read the label and give prompt treatment.
- Try to remember and list the products that caused these illnesses.
 - Could you list the products to which you would attribute any cases of illness that may have occurred after several years of exposure?
 - Record the name and address of the trained first-aid-er nearest to your home.
 - How often do you consult the first-aid-er?
 - List the instructions you have received from the first-aid-er.
 - What are the differences, if any, in giving first aid to a person who is: (a) poisoned and unconscious; (b) poisoned but conscious; or (c) burnt with agrochemicals?
 - Is there a poison information centre in your country? If yes, (a) record the name and address; (b) list ways in which it could help you; (c) draft a telegram for advice assuming that a person in your locality was poisoned with a new pesticide, and the label does not give information about any antidote. Aside from such a centre, do you know anywhere you can seek advice about poisoning?

6. Have you ever seen or heard about a fire in an agrochemical store in your locality or any other locality?
 - 6.1 Do you have any fire-fighting equipment?
 - 6.2 Who trained you in its use?
 - 6.3 How often do you inspect it?
 - 6.4 List six steps in attempting to fight a fire in your store.
 - 6.5 Record the name and address of the firefighting authority nearest to your home.
 - 6.6 Prepare a chart to illustrate the different types of fire-fighting agent you would use for different classes of fire. Describe how different agents act to extinguish a fire.

Point to remember:

Fire extinguishers are very important and should be readily available. You should always be trained on how and when to use the various types of extinguisher.

4. Roles and responsibilities

4.1. Role of manufacturers

Manufacturers have a major role to play with regard to safety and health in the use of agrochemicals. There is a trend towards developing less toxic but effective products and improved techniques in packaging, and steps are being taken to ensure that agrochemicals advertised and marketed also contain essential information on safety precautions. These are some of the key roles of manufacturers.

4.1.1. Development and packaging

Agrochemicals are produced from either naturally occurring materials or from substances developed in laboratories. Natural products such as lime, rock phosphate and guana are extracted and processed ready for application as fertiliser to the soil. Laboratory work is performed to determine the concentration of the active ingredient so that the user can calculate the rate of application.

Most synthetic agrochemicals are developed on a laboratory scale and are investigated for many years, in some cases before manufacture on a commercial scale. Rigorous tests are required at each stage of development.

Figure 48 describes the development of a typical agrochemical. Apart from testing for its effectiveness as an agrochemical, tests are carried out on agrochemicals to determine its toxicity before marketing. The user should remember, therefore, that agrochemicals may be used safely by carefully following the instructions on the label or accompanying information sheets.

Having developed a pesticide in the manner described, the manufacturers, formulators and suppliers have other important duties to perform before marketing their product. These include the following:

- The manufacturer, formulator or supplier should be responsible for labelling and registration of the agrochemical with the national authority. If there is no national authority, the regulations in the exporting country should be followed.
- The manufacturer should ensure that every product offered for sale:
 - (a) has been investigated to determine hazardous properties and the hazards it would present when used as an agrochemical;
 - (b) is packaged in accordance with international or national regulations and that the containers will withstand transport and handling without leaks;
 - (c) is labelled so as to provide essential information in the language of the region and according to international or national

regulations; and that a chemical safety data sheet is provided along with the package to employers and others who request it;

- (d) is provided with an information sheet if it is not labelled.

Labelling, packaging and supply of information and data sheets have already been dealt with in this guide.

4.1.2. Advertising and marketing of agrochemicals

The agrochemical market is very competitive and advertising is an important part of commercial success. Users need to be reminded of this fact. At the same time they should recognise that those who advertise and market different products have a duty and responsibility to provide essential information on the hazards they present and safety precautions to be observed. Users should find an opportunity to discuss with suppliers, agricultural extension workers and other community leaders the following merits in advertisements. Advertisements should contain statements or visual presentation which give precise and explicit information to the buyer, in particular with regard to the safety of the product, its nature, composition or suitability for use, or official recognition or approval by the competent authority. Safety and health should not be compromised for commercial success. Advertising or promotional material should draw attention to the appropriate warning phrases and symbols.

4.2. Role of government agencies

More than one government department or agency is usually responsible for the management of agrochemical supply and use. The various responsibilities include: export and import; registration and approval; transport, marketing and sale; safety and health at work; public health aspects and environmental impact. Product registration, regulation and enforcement are important aspects of government action in safety and health in the use of agrochemicals.

4.2.1. Product registration

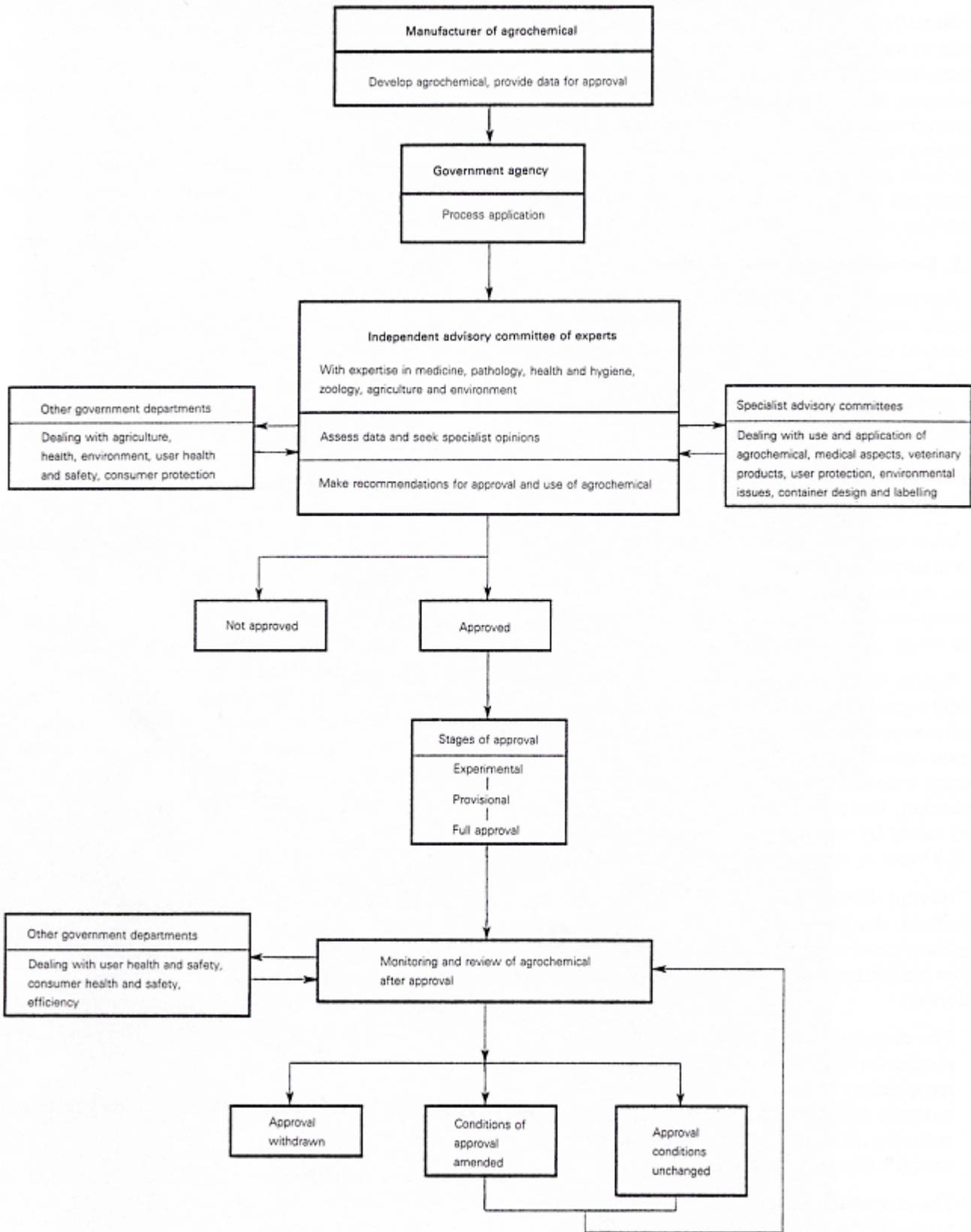
The registration, evaluation and approval of an agrochemical is necessary to control its use and to ban or restrict the use of other agrochemicals which may be unsafe.

Users may not be familiar with the detailed procedure for government approval of a product before it is marketed. However, they should be aware that such a procedure exists in many countries (figure 48). Knowledge and information about the national agrochemical registration authority would be an advantage. This government authority or agency should

also have the capability to provide information about training, first aid and arrangements for the safe disposal

of waste. The *FAO Guidelines for the registration and control of pesticides* (Rome, 1985) give further details.

Figure 48. Progress chart for the registration and approval of agrochemicals for safety and efficiency



4.2.2. Promulgating regulations

Regulations are legal instruments made by governments to control various activities. They set standards, provide for enforcement and impose penalties of fines or imprisonment for those who fail to comply.

Users should know the national regulations and comply with them. If they contravene the law, penalties will be imposed for each contravention. In general, regulations on the use of agrochemicals may prescribe:

- that all agrochemicals are approved by the government before advertisement, sale, supply, storage or use;
- that conditions of approval are complied with. These may include such matters as: restricting the use only to specified crops, animals, types of premises, or land; specifying levels of competence of the user; stipulating maximum application/dose rates and minimum harvest/slaughter intervals; and designating the categories of work that require protective clothing;
- the products specifically approved for aerial spraying;
- that employers ensure that their employees have reached the required standards of competence and are equipped to perform safely any task assigned to them;
- that agrochemicals are not transferred from one container to another unless the receiving container is of the same quality as the original and is labelled;
- that any surplus agrochemical, tank washing or contaminated protective clothing is treated or disposed of so as to be without risk;
- that anyone involved in the sale, supply, storage or use of agrochemicals should take all reasonable precautions to protect human beings, animals and plants and to safeguard the environment, in particular to avoid the pollution of water.

Users should remember to study the national regulations before starting to use agrochemicals. Further information on international action is available in the *FAO Guidelines for legislation on the control of pesticides* (Rome, 1989).

4.2.3. Provisions for enforcement and advisory services

Enforcement is the action necessary to ensure compliance with the law. Safety and health laws and regulations are prescribed to protect workers, including self-employed persons such as farmers, against hazards at work. Therefore, many people might be persuaded to comply once they have been properly informed. Consequently, a first step of the law-enforcing authority is to provide advice and publicity on what the law is about, what it seeks to achieve and what people have to do to comply with it. Agrochemical users should always seek the advice and guidance of enforcement authorities,

who should perform their advisory role seriously and effectively.

Enforcement is carried out by agricultural inspectors. Inspectors have the power to: enter agricultural land or buildings; make inquiries, take samples and carry out inspections; investigate any accident or dangerous occurrence; and such other actions as may be specified. Enforcement authorities also have the important task of providing technical advisory services to community leaders, employers and workers and their organisations (figures 49 and 50).

Figure 49. Enforcement authorities should provide technical advice on safety and health in the use of agrochemicals

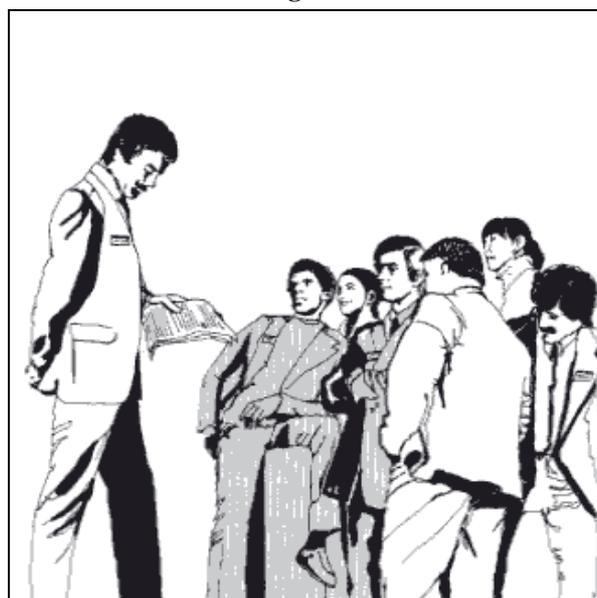


Figure 50. A community leader receives information and documentation from an enforcement/agricultural extension officer



4.2.4. International exchange of information

There are international procedures for exchange of information on hazardous agrochemicals. *Prior informed consent* is an agreement to ensure that countries importing agrochemicals, particularly pesticides, are notified about any product which may be banned or severely restricted in the exporting country. The purpose of this notification is to give the competent authorities the opportunity to assess the risks associated with the agrochemicals, and to make appropriate decisions as to their importation and use. The arrangement is particularly helpful to developing countries who may unknowingly import a dangerous agrochemical and allow its use in circumstances where there is a serious risk to health.

4.3. Role of retailers

Retailers and their assistants need to recognise the significance of providing information on safety and health in the use of agrochemicals to all customers. In addition, they should be familiar with safety provisions in the transport, storage and handling and use of agrochemicals, and disposal of empty containers and waste.

A retailer of agrochemicals should:

- be licensed by the competent authority to receive stocks from a supplier, store and sell them;
- sell agrochemicals only in the original packages. Packages should not be opened to sell in small quantities; fertilisers received in bulk in plastic or jute bags may be sold in small quantities, but the buyer should be told of any health risks involved;
- arrange for the agrochemicals stored to be inspected and certified by the supplier and any competent person as to safe storage;
- comply with the regulations restricting the sale of more hazardous agrochemicals only to licensed users;
- keep a record of sales, including the name and address of the purchaser;
- obtain the data sheets and information sheets from the supplier; if these are in a language that the retailer does not understand, he or she should request the supplier to interpret the essential safety and health information that the retailer is obliged to provide to the purchaser;
- give all essential information on safety and health in the use of agrochemicals to the purchaser, who should read and understand the label, data sheets and information sheets.

Further details are available in the *FAO Guidelines on retail distribution of pesticides with particular*

reference to storage and handling at the point of supply to users in developing countries (Rome, 1988).

4.4. Role of employers and their organisations

Employers could be managers of plantations, farmers or others who employ workers in the use of agrochemicals. They should:

- ensure that agrochemicals are stored safely, and unauthorised access is prevented;
- employ only workers who have been trained or licensed, as may be necessary, with some agrochemicals such as more hazardous pesticides;
- ensure that workers are protected against accidents, injury and poisoning at work by:
 - (a) choosing the appropriate equipment and machinery for work with agrochemicals;
 - (b) instructing all workers, particularly those who are new or functionally illiterate, about the hazards and the safety precautions;
 - (c) effective supervision of all agrochemical operations to ensure correct operation and prevent any hazards that may result from lack of knowledge or experience of workers;
 - (d) maintenance, repair and periodic inspection of equipment and machinery and workplaces;
 - (e) complying with safety and health regulations and safe working practices.

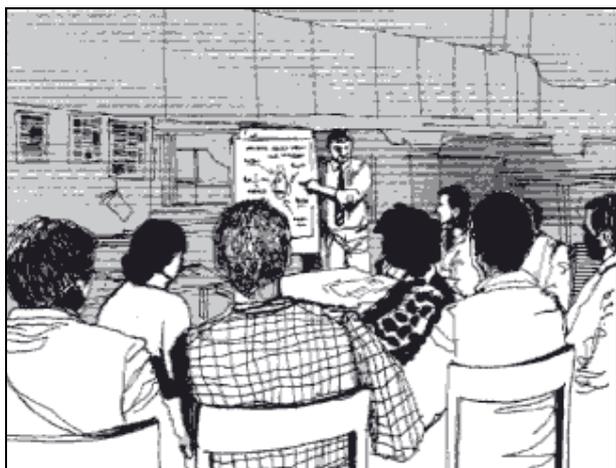
Employers, in discharging their duties, should co-operate with workers and their representatives with regard to safety in the use of agrochemicals at work.

Employers' organisations such as planters' organisations and farmers' associations could promote safety and health in the use of agrochemicals by various activities such as safety and health campaigns and competitions, and publicity programmes. They could also take a leading role in awareness-creating activities such as organising seminars and workshops with community leaders, agricultural extension workers, schoolteachers and primary health-care workers (figure 51).

4.5. Role of workers and their organisations

Workers should co-operate with their employers in carrying out their duties and should comply with all procedures and practices relating to safety in the use of agrochemicals at work. They should note and follow the instructions given by the manufacturer, supplier, employer or supervisor. Workers should take all reasonable steps to minimise risk to themselves, other workers, employers, farm animals, crops and the environment. Additionally, they should:

Figure 51. Training workshop at a community centre



- use properly all devices provided for their protection or the protection of others;
- examine the equipment before beginning work and report forthwith to their immediate supervisor any situation which they believe could present a risk, and which they cannot properly deal with themselves.

Agricultural workers' organisations have an important role in the improvement of working conditions of their members. This may include

- campaigning for the use of less hazardous agrochemicals or for safer alternatives such as biological or integrated pest control systems;
- functioning as a point of contact and source of information to members about safety and health issues;
- acting as safety representatives at the enterprise and visiting members at their place of work;
- communicating regularly with all members informing them of recent activities and encouraging compliance with good standards in occupational safety and health;
- organising training courses for members and other workers on safety and health in the use of agrochemicals;
- representing members in discussions with the government, and employers' and other organisations on matters relating to safety and health;
- campaigning for improvements in working conditions.

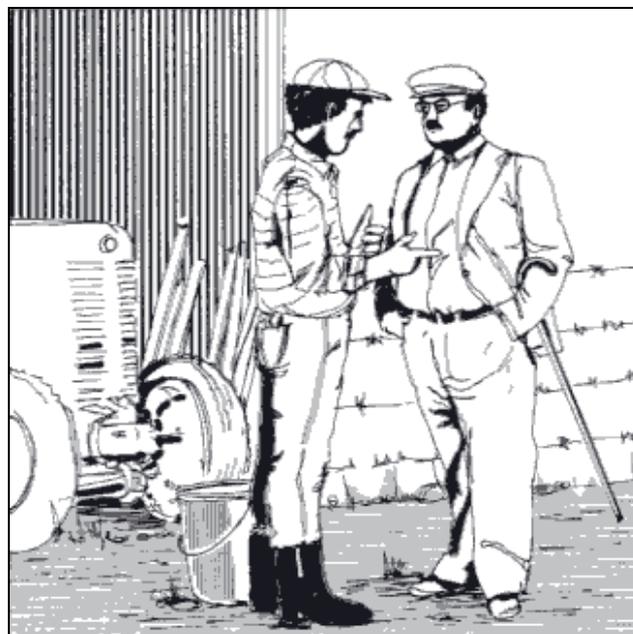
4.6. Role of the public

The use of agrochemicals has implications for the public as well as for the user. Areas treated with pesticides may be unsafe to walk through; wild fruit in hedgerows may be unsafe to eat and agrochemicals may

pollute waterways and the environment. Users should warn the public about the farmland to be sprayed or recently sprayed with agrochemicals, if necessary by erecting a warning sign.

Community leaders, teachers and primary health-care workers should ask the retailer or the supplier to supply chemical safety data sheets and information sheets on agrochemicals used in the locality. They should take a leading role in creating awareness among the members of the community about the hazards involved in the use of agrochemicals and in giving necessary instructions to users on their safe use (figure 52). Community leaders could arrange for regular discussions and group meetings in schools, places of worship or community centres, providing for exchange of information on safe practices.

Figure 52. Community leaders have an important role to play in educating farmers



The public should remember:

- to observe any warning to keep out of treated areas (or to keep to assigned footpaths);
- to prevent children from playing in treated areas, and to keep pets away (figure 53);
- not to touch anything treated with agrochemicals or any container or application equipment, unless one has a good reason to do so and is aware of the risks involved, taking all necessary precautions;
- to avoid contamination from any agrochemical, for example by collecting a paper bag or used clothing which may have been blown by the wind;
- to inform the agrochemical user or other responsible person about anything that seems wrong, such as empty containers being carelessly discarded or signs of illness among domestic animals;

- to obtain prompt medical attention for anyone who handles agrochemicals and becomes ill, remembering to mention the name of the agrochemical used;
- not to use empty agrochemical containers for household purposes – they may contain small amounts of poison that could kill people.

There will be other times in which the circumstances of agrochemical use are unusual or specific to a particular situation. The public should be guided by the general precautions described and adapt them where it appears necessary.

Figure 53. Prevent children from playing in treated areas



Discussion and activities

1. List how the actions of each of the following persons or groups would help you in ensuring safety and health in the use of agrochemicals:
 - 1.1 Manufacturers with regard to packaging, marketing and advertising.
 - 1.2 Government agencies concerning registration of products and implementation of regulations.
 - 1.3 Retailers in providing relevant information.
 - 1.4 Employers and their organisations in protecting the health of workers.
 - 1.5 Workers and their organisations in co-operating with employers and others to implement a safety and health programme.
 - 1.6 Community leaders, teachers and other members of the public in promoting safety and health in the use of agrochemicals.

5. Education and training

Agrochemical users have a responsibility to ensure that they are competent for all tasks that may be carried out. Such competence will only be achieved by an appropriate level of education and training. Consistent effort is also needed to identify and implement cost-effective programmes of education and training. These should be organised with the co-operation of all concerned and should be adjusted to the needs of each target group. Training should be dynamic and action oriented to encourage the planning of potential improvements and their implementation to achieve successful results.

5.1. Information

Information about agrochemicals and how they may be used safely and efficiently is available in most countries. It is produced by authorities such as international agencies and government, by associations representing manufacturers, suppliers and users, and also by agricultural experts, schools and colleges. Most of this information is presented in an easy-to-read form and is often free of charge. An increasing amount of information is now being made available in the form of videos, which are especially useful to users with reading difficulties. The distribution of this information is often a problem because of the distance and remoteness of some users. Users should, however, make inquiries through local agricultural associations, community leaders, government offices, agrochemical suppliers, schoolteachers and primary health-care workers.

Manufacturers also have a responsibility to ensure that people involved in the transport, marketing and use of their products are properly informed about safety procedures. There have been many initiatives to disseminate this information in the form of free leaflets, posters and booklets. The series of booklets published by the GIFAP (International Group of National Associations of Manufacturers of Agrochemical Products) is a good example of what can be achieved internationally.

5.2. Workers' education

Agrochemical use may be self-taught or taught in agricultural schools. In some countries the law requires pesticide users to complete a period of training followed by a practical test which requires demonstration of competence.

Education and training should ensure that the user:

- understands the national law and regulations on the use of agrochemicals. The law regulates the use of agrochemicals so that they are without risk to people, livestock, wildlife and the environment. The user should know the law and comply with it;
- understands and follows labelled and other product information on the calibration of agrochemical application equipment, and the correct sequence and procedure for diluting concentrated substances and mixing the various formulations of emulsions, wettable powders, adjuvants and others;
- understands and uses safety devices on application equipment. This will include the use of equipment stands for safe storage together with machinery guards for power-driven components. Knowledge is also required about the correct use of engineering controls designed to prevent operator contamination. On tractor sprayers these may comprise a closed system, or the incorporation of pre-mix bowls, filling devices or a tractor cab filtration unit. Maintenance procedures for any type of applicator will need to be followed in order to avoid leakage. This is particularly important with knapsack sprayers where there is close body contact with the applicator;
- understands correct procedures for the safe storage of agrochemicals and procedures for the disposal of empty containers and surplus products;
- knows what to do in an emergency. There may be circumstances when emergency action is necessary to deal with accidental spillage which may threaten food or water supplies. There may also be a need to decontaminate someone who has been careless, or to recognise symptoms of poisoning and provide first aid;
- knows when to be particularly careful. Agrochemical application is a potential threat to areas adjoining the application site. The user should know about the avoidance of dust or spray drift and the need to observe separation distances between the site of application and any sensitive areas such as sources of food or water supplies, or places where people, livestock, wildlife or the environment are at particular risk;
- observes standards of good personal hygiene. These are important measures which require an observance of basic rules to ensure that agrochemical exposure is kept to a minimum. It includes such matters as washing thoroughly before meals and after work, avoiding self-contamination from careless or dangerous practices, and ensuring that contaminated clothing and material are thoroughly cleaned;
- identifies, selects and maintains protective clothing. The agrochemical user should be able to understand hazard information on any product and then identify the appropriate level of personal protection. Knowledge will be required of the meaning of hazard symbols, together with an understanding of labelled information and data sheets. The user should also be able to select items of protective clothing of the required quality. This will include respiratory

protective equipment, where necessary. The user must know how to correctly decontaminate, safely launder and replace protective clothing, and provide suitable ventilated accommodation for its storage;

- keeps records when required. This may be necessary in order to observe harvesting intervals, and diagnose and treat illness, or to improve agrochemical use in the knowledge of recorded information. Figure 54 shows a sample record of agrochemical application.

Because of the variations in the level of literacy and the increasing number of agrochemicals entering the market, training of workers and other users could be facilitated by the use of pictograms.¹ GIFAP, in cooperation with FAO, has devised a set of pictograms with a recommendation to incorporate them in labels (figure 55).² These illustrations may be used as artwork for the production of pictograms and of audio-visual aids.

Figure 54. Sample record of agrochemical application

Name of user					
Date	Product used/ dilution and application rate	Crop. material or structure treated	Site of application	Reason for treatment	Hours product used

5.3. Public awareness

The use of agrochemicals will often have implications for the general public living in the vicinity. They should be aware of impending use so that those who wish to take precautions may do so. That is not to say that agrochemicals may be applied without regard to the public interest, but advance warning would permit windows and doors to be closed against dust, pets to be taken indoors and washing removed from the drying line. The public should also be told not to walk into recently treated areas until after any restriction on re-

¹ Pictograms are symbols to convey a message without the use of words.

² GIFAP: Pictograms for agrochemical labels, in cooperation with FAO (Brussels, 1988).

entry has lapsed. This will be determined by the hazard classification of the product.

The general public is becoming increasingly aware about agrochemical use. This is because the effects of such use are not always confined to the area of land treated. Nitrates and fertilisers may seep into sources of drinking-water, and pesticides may contaminate river water or be carried as spray drift on to public land. Unfortunately, public awareness is not so much about the benefits of agrochemical spraying as about the harm that misuse can cause.

Agrochemical users should be alert to public concern and answer criticism by their own example of good safety practice. Public awareness should be created about the benefits of the judicious use of agrochemicals.

5.4. School education

In many rural communities where most parents may be functionally illiterate, primary-school children could contribute to society by serving as communication links. This is not unrealistic, as some endemic diseases such as hookworm disease have been virtually eradicated by schoolchildren "educating" the parents about good personal hygiene.

Basic safety and health matters and personal hygiene with regard to the use of agrochemicals can be incorporated in the primary school curriculum. This could include simple information about:

- pests in the garden (e.g. insects and weeds);
- how they are killed or controlled;
- the minute quantity of pesticides in concentrated form needed to destroy pests;
- extreme precautions to be taken when handling concentrated agrochemicals that are toxic;
- how to dilute agrochemicals according to the instructions, in case someone seeks a child's help in reading the label;
- *the fact that the same poison that killed an insect could harm a child or an adult; if small quantities enter the body in its concentrated form it could even cause death.*

Safety and health in the use of agrochemicals could be integrated with the natural science subjects in the secondary and post-secondary school curriculum. Practical exercises on safe use could be demonstrated. Safety and health projects such as surveys of cases of agrochemical poisoning in the local community, lessons learnt and measures taken to prevent recurrence are some examples. Safety, poster and slogan competitions with the involvement of parents would motivate both groups and would encourage total commitment by the community to promoting safety and health in the use of agrochemicals.

STORAGE pictogram

Keep locked away and out of reach of children



The illustrations on this page may be used as artwork for the production of pictograms.

ACTIVITY pictograms

Handling liquid concentrate

Handling dry concentrate

Application



ADVICE pictograms

Wear gloves

Wear eye protection

Wash after use



Wear boots

Wear protection over nose and mouth

Wear respirator



WARNING pictograms

Dangerous/harmful to animals

Dangerous/harmful to fish – do not contaminate lakes, rivers, ponds or streams



Figure 55. Pictogram for agrochemical labels

Discussion and activities

1. Collect press cuttings or information sheets, or record from radio or television broadcasts essential information on safety and health in the use of agrochemicals.
2. Ask the retailer or any other supplier for chemical safety data sheets on the agrochemicals you use regularly. Try to read and understand them or ask for help. Are you aware of any courses on safety in the use of agrochemicals in your area?
 - 2.1 If yes, have you attended a course? List ten important points which you have learnt that would help you to improve safety and health at work.
 - 2.2 If there are no courses in your area, try to prepare an outline for one based on real needs in your area, with the assistance of the extension officer.
3. Prepare and give a talk at the community centre about safety in the use of agrochemicals. Seek the help of the extension worker or any other community leader to draft it.
4. List the examples you can find in the curriculum of your local school that relate to safety and health in the use of agrochemicals.

6. Safety and health in developing countries

The use of agrochemicals in developing countries will continue to grow in the coming decades, mainly because of the economic advantages they bring. Increased yield of agricultural products with the controlled use of agrochemicals will help sustain the agricultural economies of many countries. Nevertheless, the hazards associated with the use of agrochemicals and the particular safety and health problems in developing countries need to be identified for appropriate action to be taken.

Users of agrochemicals, both in industrially developed and developing countries, are exposed to certain risks from the use of hazardous chemicals at work.

In developed countries workers and other users are afforded greater protection by factors such as:

- the enforcement of regulations;
- workers' education;
- encouraging the use of less toxic substances and more appropriate equipment;
- better awareness about personal protective equipment and its ready availability;
- temperate climatic conditions where the wearing of personal protective equipment would not cause much discomfort;
- easier access to health-care facilities and social security benefits;
- general status of health and nutrition;
- support through mass media and other organisations for the protection of workers, the general public and the environment from the adverse effects of hazardous chemicals, including agrochemicals.

On the contrary, safety and health problems associated with the use of agrochemicals in developing countries are confounded by adverse factors such as:

- lack of enforcement machinery that would lead to the indiscriminate use of even very toxic substances whose use is banned or restricted in developed countries;
- low levels of functional literacy among workers and other users;
- propaganda by some importers and suppliers to sell more toxic agrochemicals as “more effective” products because of a highly competitive market;
- high comparative cost of personal protective equipment compared with income, its scarcity, lack of training in its use, repair and maintenance, and scarcity of replacements for disposable components such as filters;

- tropical climatic conditions that greatly hinder working with protective clothing and equipment even if supplied;
- poor health-care facilities, remoteness of health centres from workplaces and primitive modes of transport that prevent the provision of prompt medical attention in case of serious illness;
- lack of social security or health insurance schemes;
- poor status of health and nutrition that may be further aggravated by endemic diseases, large family size, low income and unemployment.

All these factors tend to expose workers and users in developing countries to greater health hazards from the use of agrochemicals. Inducements such as “risk allowances” tend to encourage the workers to take greater risks. Their functional illiteracy may also be exploited: they see the immediate benefits of earning more as casual or contract workers with disregard for subsequent chronic health effects.

Agrochemicals are clearly of value in agricultural production. However, the indiscriminate use of these products in developing countries has had disastrous consequences at times. With several case histories this guide highlights the root causes of fatalities and serious injuries from improper use of agrochemicals and attempts to set some basic rules for preventing the recurrence of such events.

Case histories

Case 1. Ignorance confounded by sales advertisements

A woman had toothache. In her local culture, a toothache is described as “a worm eating the tooth”. She had heard that pesticides killed worms, so she soaked a small piece of cotton with a concentrated pesticide solution and inserted it into the cavity of the tooth. She was dead before admission to hospital.

This is a case of sheer ignorance. A cultural and linguistic information barrier has come into play. This sad death would not have occurred if the mass media that advertised the product had made it explicitly clear that: pesticides are made to destroy pests – insects, animals and plants. A small quantity of a pesticide in its concentrated form can kill you if breathed in or swallowed or allowed to be absorbed through the skin.

Please note that the pesticides you normally purchase are highly concentrated. Therefore they should be handled

with extreme care. The concentrated pesticides have to be diluted according to instructions. Even diluted pesticides used to destroy pests can harm you. Therefore take all necessary precautions to avoid breathing in or swallowing or skin absorption.

Case 2. Non-disposal of empty containers

Several young girls were poisoned and paralysed below the waist. They had consumed a vegetable oil supplied to them by their parents, who believed that drinking the oil on reaching puberty would make them beautiful. The cause of poisoning was traced. The oil, contaminated with an organophosphorus pesticide, had been bought from the same boutique in the locality. The boutique owner, who had purchased the oil from the city in a discarded pesticide drum, was unaware of the consequences.

A case of neglect. The user of that pesticide – whether supplier, formulator, retailer or farmer – had failed in his duty to dispose of empty containers safely. There was no system of recycling used drums. The user must rinse the drum taking necessary precautions, puncture it in several places and bury it as already described in the guide, or else return it to the retailer for safe disposal. Empty drums have a good saleable value, mostly for dangerous practices as in the case in point. This practice must be banned.

Case 3. Lack of supervision

Four workers who sprayed dinitro ortho cresole – a weedkiller – in a plantation felt very thirsty immediately after work. They staggered to a nearby stream to drink and collapsed. The only worker who recovered in hospital related the story. The supervisor was absent. The workers decided to spray without diluting the pesticide properly because they wanted to complete the work in half a day and go home. To those workers, diluting with little water meant spraying a small quantity in a shorter time. They were not instructed about the hazards and precautions.

This is a case of neglect by the employer or the supervisor. Supervisors should always satisfy themselves that workers are adequately instructed and licensed if required by the regulations. Employers must ensure that workers are prohibited from working with dangerous substances without adequate supervision. They should also ensure that relevant safety regulations and safe working practices are adhered to.

Pesticides should only be used for their intended purpose by competent persons using application equipment in good condition. Labelled instructions

should be followed to the letter making sure that the pesticide does not go outside the target area or contaminate the environment, a source of drinking-water, for example. Self-contamination should be avoided by careful handling and the avoidance of careless practices such as wiping the face or mouth with a gloved band.

Case 4. Inappropriate personal protective clothing and equipment

A casual worker employed in an organophosphorus formulation factory was walking home for lunch after half a day's work; it was his first day at work. He felt sick, vomited and was rushed to hospital. He succumbed to the effects of severe pesticide poisoning. During investigations the employer demonstrated the type of respirator provided. They were gauze masks. Water vapour in the exhaled breath condensed on the mask and partly evaporated during subsequent breathing. This evaporation caused the cooling of the outside of the mask. Organophosphorus vapours in the working environment condensed on the cooler surface of the mask. The workers were virtually inhaling more toxic vapours! In addition, the impervious aprons provided were too short. The workbench was too low, and heavily contaminated with pesticide. Consequently, the working clothes below the short aprons were soaked with a very toxic substance and workers absorbed large quantities of the substance through the skin around the thighs.

Personal protective equipment and clothing of the approved type and appropriate for the task must always be supplied when handling or using agrochemicals, particularly the concentrates marked as “toxic”, “harmful” or “corrosive”. It is important and relevant to reiterate other safety precautions as a follow-up to this case.

Training

Training in safety in the use of agrochemicals is essential for managers, employers and farmers. Your training should ensure that you are competent to use an agrochemical safely without risk to other people and the environment. Of particular importance is your ability to understand labelled information and how to operate any application equipment safely.

Labels

Read the label on the container of the agrochemical before use. If you have reading difficulty, get someone to explain it to you. Labelled instructions, particularly about your own protection, should be followed exactly. Employers must read, understand and follow the details given in chemical safety data sheets and information sheets. Necessary precautions must be taken to protect the workers, other people, livestock and the environment.

Cleaning up

Thoroughly decontaminate after use so as to remove agrochemicals from your body, the workplace and protective clothing. All washings should be confined to a tank, soak-away or safe land area to contain the toxic substances without risk of wider pollution. Contaminated clothing of any kind should never be taken home ' it should be washed separately to avoid the contamination of family clothes or placing others at home at risk.

First aid

If anyone else becomes ill, call a doctor at once, giving the name of the agrochemical used. The casualty should rest in a clean, cool, shaded but airy place with protective clothing removed and personal clothing comfortably loose. Any deposits on the body should be washed away. Avoid self-contamination. If the casualty becomes unconscious, place him or her in a comfortable recovery position as already described and follow all other instructions as well.

Case 5. Lack of warning signs and disregard for re-entry

Fruit pickers were poisoned after harvesting ripe fruit from a crop sprayed earlier the same day. They may have eaten some fruit while picking.

Warning signs should be displayed after spraying. Re-entry periods as given in the label or instruction sheets must be strictly followed.

Employers must ensure that workers are protected against hazards. Workers and other users must be instructed never to breathe in toxic substances or allow them to come into contact with their skin, and never to eat or drink contaminated food such as treated seed or recently sprayed crops.

Never eat or drink while using pesticides and always wash first. Places for eating and drinking should be outside the application area so as to avoid contamination of anything eaten or used with the meal.

Case 6. Negligent retailing

Children were poisoned after drinking pesticide from a soft drinks bottle which was used to dispense that very toxic substance.

An agrochemical retailer should never sell products other than in the original container in which they were supplied and a user should not transfer them to another receptacle. Toxic substances must always be kept out of the reach of children.

Agrochemicals should always be stored in a secure, weatherproof, well-ventilated building or cabinet. This should be separate from where you live or keep food.

All agrochemical users must learn from these case histories. They, or similar careless actions that would cause suffering and death, should never be repeated.

Discussion and activities

1. Study each case history in detail. Do you know of similar incidents?
2. After studying each case history list all the points you consider should be taken to prevent a recurrence of similar events in your locality.
3. List as many points as you can that you consider would ensure the active co-operation of all those in your locality who are concerned with safety and health in the use of agrochemicals. Try to prepare a poster for public display to accompany the list you have established.

Glossary

Annex A*

Active ingredient (ai)	That component of an agrochemical which produces the required effect, e.g. destroys pests.	Dose	The weight of active ingredient or volume of formulated product applied.
Acute poisoning	Ill-health with pronounced symptoms which develop soon after exposure to a poisonous substance.	Enzyme	An essential component of living body cells responsible for promoting biochemical reactions.
Adjuvant	A substance other than water, without significant pesticide properties, which enhances or is intended to enhance the effectiveness of a pesticide, when it is added to that pesticide.	Face shield	A shield covering the whole of the forehead and face, so designed as to protect them from being splashed.
Aerial application	The release from any aircraft in flight of an agrochemical in whatever form.	First aid	The use of available skills and knowledge to treat any condition of poisoning or injury until the casualty is in the care of a medical practitioner.
Aircraft	Includes both fixed and rotary wing (helicopters and autogyros) and any other airborne craft controlled either manually or remotely in flight.	Fumigation	An operation in which a substance is released into the atmosphere so as to form a gas to control or kill pests or other undesirable organisms.
Approval	Approval given by government agencies for the advertisement; sale, supply, storage and use of a pesticide.	Gloves	Protective gloves not less than 300 mm in length measured from the tip of the second finger to the edge of the cuff.
Apron	A protective apron covering the front and sides of the body from immediately below the shoulders to at least 70 mm below the tops of any boots that are being worn.	Goggles	Eye protection having a one-piece protective lens (box type) or individual protective lenses (cup type) designed to enclose the eyes and held in position by a head band.
Boots	Protective boots extending from the feet upwards to at least immediately below the knees.	Hood	A hat or other covering to the head, so designed as to protect the forehead, back and sides of the head and the neck from contamination by pesticide in the circumstances in which it is being used.
Chronic poisoning	Ill-health which develops slowly after long or frequent exposure to a poisonous substance.	Ingest	To pass through the mouth and swallow.
Coverall	A protective garment or combination of garments close fitting at the neck and wrist, and offering no less protection than a single garment which: <i>(a)</i> covers the whole body and all clothing other than that which is covered by a hood, face shield, goggles, respiratory protective equipment, footwear and gloves, and which minimises thermal stress to the operator when worn; <i>(b)</i> when required to be worn in connection with the use of a pesticide in the form of a granule or dust has all its external pockets covered and has its sleeves over the tops of gloves which are worn.	Inhale	To pass through the nose or mouth by breathing in.
		Irritation	Sensation of scratching of the skin or burning of the eyes, nose and throat.
		Respirable	A substance of extremely small particles which can be breathed deeply into the lungs.
		Spray drift	That part of a pesticide application which is carried by air currents outside the area of application.
		Tank mix	A mixture comprised of two or more pesticides.
		User	Anyone using an agrochemical or carrying out any task associated with its use, storage or disposal.

* Note. Explanations are given in simple and easily understood language; they are not necessarily textbook definitions.

Grouping of agrochemicals

Annex B

Examples of pesticides which kill or control

<i>Name</i>	<i>Target</i>	<i>Agrochemical</i>
Acaricide	Spiders	Fenbutatin oxide, fenpropathrin, endosulfan
Adjuvant	An additive to improve the effectiveness of a pesticide when added to the spray tank	Pheromones, de-foaming agent, sticker/extender, wetter/spreader, drift reduction agent, penetrating agent
Algicide	Algae	Quinonamid, sodium hypochlorite
Attractant	Attracts insects to trap or kill	Pheromones
Desiccant	Aids rapid drying of plant	Diquat sulphuric acid, sodium chlorate
Fungicide	Fungi: blight, mildew, rust and rot	Captan, dinocap, propiconazole
Growth regulator	Controls plant growth	Mefluidide, 2-naphthyloxy acetic acid, sodium silver thiosulphate
Herbicide	Weeds and other unwanted plants	MCPA, 2,4-D, paraquat, glyphosate
Insecticide	Insects: aphids, caterpillars, whitefly	Nicotine, demeton-S-methyl, triazophos
Molluscicide	Slugs and snails	Metaldehyde, methiocarb
Nematocide	Nematodes	Methyl bromide, chloropicrin, dazomet
Repellent	Repels insects, rabbits and birds	Thiram, ziram
Rodenticide	Rodents: rabbits and rats	Warfarin, coumatetralyl, sodium cyanide

Examples of on-farm veterinary products

<i>Therapeutic group</i>	<i>Medicinal purpose</i>	<i>Example</i>
Anthelmintic	Control of flukes, cestodes, nematodes and other internal worms	Benzamidazoles
Anti-inflammatory	Treatment of conditions involving inflammation	Antihistamines, corticosteroids
Antimicrobial	Prevention or treatment of bacterial infections (e.g. swine dysentery)	Chloramphenicol, oxytetracycline, penicillin
Antimycotic	Treatment of fungal infections (e.g. ringworm)	Griseofulvin, natamycin
Antiprotozoal	Control or treatment of protozoal infections (e.g. coccidiosis)	Dimetridazole
Antiseptic	Used for general prevention of infection or disinfection	Formalin, iodophor
Ectoparasiticide	Control of or protection against external parasites (e.g. warble flies, lice)	Organophosphorus compounds, carbamates, pyrethroids, organochlorines
Growth promoters	Used to improve the rate of growth of treated animals (e.g. probiotics, repartitioning agents)	Virginiamycin
Hormones	Used to stimulate or control hormonally controlled body functions in treated animals (e.g. oestrus cycle, parturition)	Prostaglandins, steroids
Skin preparations	Used to treat or prevent skin disorders (e.g. udder cream)	Caladryl, camphor
Vaccines	Used to stimulate the immune system	Liver vaccines, inactivated vaccines, mixed vaccines

Examples of commodity chemicals

<i>Name</i>	<i>Use</i>
Caustic soda	To soften cereal straw for feeding to cattle
Formic acid	As a preservative in grass harvested as silage for animal feed
Nitric acid	To remove residues deposited on pipelines in milking sheds
Propionic acid	As a preservative in moist grain intended for animal feed
Sulphuric acid	A potato haulm desiccant

Examples of fertilisers

<i>Name</i>	<i>Purpose</i>	<i>Example</i>
<i>(1) Straights</i>		
Lime	Controls soil acidity/ neutrality	Calcium oxide, calcium carbonate
Nitrogen (N)	Promotes leafy growth	Anhydrous ammonia, aqueous ammonia, ammonium nitrates, ammonium sulphate, nitro chalk
Phosphates (P)	Promotes root growth	Super phosphate, basic slag
Potash (K)	Promotes vigour and fruiting	Muriate of potash

(2) Compounds

Various mixtures of N, P and K	Promotes good all-round growth and fertility	Various – each compound being formulated for the needs of a specific crop
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(3) Secondary nutrient and trace element fertilisers

Various mixtures of N, P and K plus nutrients and trace elements	Promotes good all-round growth plus a supplement to meet the needs of a specific crop or to overcome soil deficiency	Various N, P, K mixtures plus, for example, boron, cobalt, manganese, magnesium sulphur or calcium
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Chemical safety data sheets

Annex C

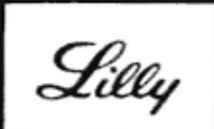
This is the common name for data sheets that are published under names such as:

Material safety data sheets (MSDS)

Product safety data sheets

Health and safety data

Some examples are given in this annex.

**ELANCO**

Material Safety Data Sheet

TRIFLURALIN + LINURON (24 + 12)EC**ID 5009, EAF 190**

TRADEMARK: CHANDOR®

TRIFLURALIN + LINURON (24 + 12)EC, emulsifiable concentrate, is a residual herbicide for the control of annual grasses and many broad-leaved weeds in a wide range of crops.

1. PHYSICAL AND CHEMICAL PROPERTIES

- A. Active ingredients generic names:**
Trifluralin (BSI, ISO, ANSI, WSSA).
Linuron (BSI, ISO, ANSI, WSSA).
- B. Active ingredients chemical names:**
2, 6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine + N'-(3,4-dichlorophenyl)-N-methoxyN-methylurea (CA).
- C. C.A.S. Registry Numbers:**
Trifluralin – 26644-46-2.
Linuron -330-55-2.
- D. Product Components:**
- | | |
|-------------------------|-----------|
| Trifluralin (100% pure) | 24.0% |
| Linuron (100% pure) | 12.0% |
| Surfactants | 10.0% |
| Isophorone | 15.0% |
| Ortho-chlorotoluene | to 100.0% |
- E. Description:**
Clear orange liquid.
- F. Melting point:**
Not applicable.
- G. Boiling point:**
Greater than 130°C.
- H. Auto-ignition temperature:**
Not determined.
- I. Flashpoint:**
56°C (133°F).
- J. Explosive limit:**
Not determined.
- K. pH (aqueous 50%):**
6.0 to 7.0.
- L. Specific gravity:**
1.121 to 1.131 at 20°C.

2. STABILITY AND STORAGE

Avoid freezing. Store above 0°C in a cool, dry place. Store in original container. Protect from heat, open flame and sparks. Do not store adjacent to food, drink, animal feeding stuffs, pharmaceuticals, cosmetics or fertilisers.

3. UNUSUAL FIRE AND EXPLOSION HAZARDS

Classified as a flammable liquid (flashpoint 56°C/133°F). Closed containers may explode due to pressure build-up when subjected to excessive heat or intense fire.

4. GENERAL HAZARD STATEMENT

Under EEC directives on the classification, packaging and labelling of dangerous substances and dangerous preparations (pesticides) TRIFLURALIN/LINURON EC requires the following hazard symbol and associated risk phrases:



Irritating to eyes
May cause sensitization by skin contact
Flammable liquid
Contains isophorone and orthochlorotoluene

Irritant**5. SPILL INFORMATION**

In case of leak or spill, eliminate all possible ignition sources. Prevent the spillage entering nearby land, water courses or drainage systems, covering the spillage with a suitable absorbent material (e.g. sand, vermiculite). Advise the POLICE if the spillage has entered nearby land, water courses or drainage systems. Wear faceshield, rubber gloves and protective clothing. In a confined area, use full face air-supplied breathing apparatus. Ventilate the area. Collect all waste material and place in closable, marked containers. Dispose of in accordance with applicable regulations. If further assistance is required, telephone the Emergency Contact number.

6. PROTECTIVE EQUIPMENT REQUIREMENTS

Wear faceshield, rubber gloves and protective clothing when handling the concentrate.

7. FIRE FIGHTING INFORMATION

Use water, dry inert powder or CO₂ to extinguish. Keep containers cool by spraying them with water. Toxic and irritant fumes will be produced and require the use of full face air-supplied breathing apparatus. Do not allow run-off from the fire site to enter nearby land, water courses or drainage systems.

8. TRANSPORTATION

UN Classification: Flammable liquid N.O.S. contains orthochlorotoluene. Class 3, packing group III.
UN Number: 1993.

®Registered trademark of Eli Lilly and COMDanv. U.S.A.

9. TOXICOLOGY

A. ACUTE EXPOSURE

(TRIFLURALIN/LINURON EC, EAF 190)

1. **Eyes** – Based on findings with other TRIFLURALIN/ LINURON EC's, this product is likely to be an eye irritant.
2. **Skin** – TRIFLURALIN/LINURON EC is not a skin irritant. Minimal erythema and oedema were observed after the application of 500 mg TRIFLURALIN/LINURON EC to the skin of rabbits. In a separate study, systemic toxicity, characterised by lack of appetite and piloerection, was observed after the application of a 4000 mg/kg dose of TRIFLURALIN/LINURON EC to the skin of rabbits.
3. **Inhalation** – TRIFLURALIN/LINURON EC has not been tested for toxicity due to inhalation. However, the product contains isophorone and ortho-chlorotoluene and signs of toxicity are most likely to be due to these solvents.
4. **Ingestion** – The acute oral median lethal dose for TRIFLURALIN/LINURON EC in rats was 2.5 ml/kg in males and 2.2ml/kg in females.
5. **Sensitization** – When tested for sensitization by the Buehler topical patch method, atypical production lot of TRIFLURALIN TECHNICAL elicited a positive response. Therefore, TRIFLURALIN/LINURON EC must be considered a potential contact allergen.

B. CHRONIC EXPOSURE (TRIFLURALIN TECHNICAL)

Six studies have been conducted, four in rats and two in mice, in which animals were exposed for up to two years to daily doses of trifluralin as high as 200,000 to 800,000 times greater than the expected exposure of applicators using trifluralin products. The adverse effects observed in the animals were generally those signs associated with overdosage of non-toxic materials to rodents such as depression of appetite, weight loss and lack of vigour. In four of the studies, there was no effect on the incidence of tumours. In two studies, one in rats and one in mice, there was an increase in the incidence of certain tumours in animals treated with trifluralin. In the mouse study, the sample of trifluralin used was contaminated with a high level of nitrosamine, a known animal carcinogen. In the second study, in rats, evidence indicated that the effect was secondary to the effect of treatment. An analysis of the data from all of the lifetime studies supports the conclusion that trifluralin is not carcinogenic. The administration of 25 mg/kg to dogs for two years resulted in no toxicologic effects. The reproductive capacity of rats fed dietary concentrations of trifluralin as high as 10 mg/kg was unimpaired through four successive generations and no abnormalities were detected in the parents or the offspring. Trifluralin administered to pregnant rabbits at doses as high as 100 mg/kg and to rats at doses as high as 225 mg/kg produced no adverse effects on either mothers or offspring.

C. MUTAGENICITY

TRIFLURALIN TECHNICAL was found to be nonmutagenic *in vivo* and *in vitro* mutagenicity tests.

Note: Information on the chronic toxicity and mutagenicity of the active ingredient linuron may be obtained by reference to the manufacturer's safety sheet for this product.

10. FATE AND EXCRETION

Animal studies indicate that trifluralin is absorbed only in very small amounts after ingestion, passing unchanged through the gastro-intestinal tract. Trifluralin is tightly bound to soil and is extremely resistant to leaching and elution. Trifluralin is lost from the soil by volatilisation, photodegradation and aerobic and anaerobic mechanisms with a half-life of between 25 and 36 days.

Note: Information on the fate and excretion of linuron may be obtained from the manufacturer of this active ingredient.

11. HUMAN HEALTH

There are no known antidotes for trifluralin or linuron. However, due to the low order of oral toxicity of TRIFLURALIN/LINURON EC, antidotal treatment is not likely to be required. While there are laboratory animal studies that indicate trifluralin and linuron may be oncogenic at exaggerated levels of exposure, ELI LILLY AND COMPANY and regulatory authorities have concluded that the product does not represent a health hazard when recommended handling procedures are followed.*

12. FIRST AID

- A. Eyes** – Immediately wash eyes with running water for 15 minutes. The eyelids should be held gently open during the washing process. If irritation develops, call a doctor.
- B. Skin** – Wash exposed areas with plenty of soap and water. Call a doctor if irritation develops.
- C. Inhalation** – If discomfort occurs, remove individual to fresh air. If breathing difficulty occurs, get medical assistance immediately.
- D. Ingestion** – Do not induce vomiting. Wash out the mouth with plenty of water, being careful not to swallow the washings. Treat symptomatically and call a doctor.

13. CONTAINER DISPOSAL

Wash out the container thoroughly, emptying the washings into the spray tank. Dispose of empty container according to applicable regulations.

14. CAUTIONS

1. **Human** – Keep out of reach of children. Irritating to eyes. May cause sensitization by skin contact. Harmful if swallowed, inhaled or absorbed through

* For user handling procedures, refer to the product label; for manufacturing handling procedures, refer to the GIFAP Guidelines for the safe handling of pesticides during their formulation, packing, storage and transport.

the skin. Do not get in eyes, on skin or on clothing. Do not breathe spray mist. Wear faceshield, rubber gloves and protective clothing when handling the concentrate. Remove contaminated clothing and wash before reuse. Wash hands and exposed skin before meals and after work. When using do not eat, drink or smoke. Keep away from food, drink and animal feeding stuffs. Keep in original container, tightly closed, in a safe place.

2. **Environmental** – Trifluralin is highly toxic to various fish species. Do not discharge effluent containing this product into water courses or drainage systems.



IDENTIFICATION

Common name: paraquat dichloride
CAS number: 1910-42-5
MAFF number: 02455
Packing group: III
UN number: 3016
Class number: (IMDG) 6.1 (Harmful substance)

FORMULATION

SCYTHE is an aqueous solution containing 200 g/litre paraquat dichloride.

USE

SCYTHE is recommended for use only as an agricultural and horticultural herbicide for non-selective destruction of green plant tissue.

PROPERTIES

Nature: green liquid with stench agent. No flash point. Not flammable.

HAZARD



TOXIC

TOXIC IF SWALLOWED
HARMFUL IN CONTACT WITH SKIN
IRRITATING TO EYES AND SKIN

IMPORTANT – The Poisons Act 1972, available from Her Majesty's Stationery Office applies to this product.

TOXICITY

Acute oral LD50: 643 mg/kg (rat).
Acute dermal LD50: 684 mg/kg (rat).
SCYTHE is toxic by oral ingestion and if absorbed through the skin. SCYTHE is not irritating to rabbit eyes and skin. Minimum lethal dose in humans is 35 mg/kg body weight, a fatal dose of 2.5 g has been recorded. Toxicity depends on how much is absorbed, since in many cases profuse vomiting occurs after ingestion.

PRECAUTIONS

WEAR SUITABLE PROTECTIVE GLOVES AND FACE PROTECTION (FACE SHIELD) when handling the concentrate
WEAR SUITABLE FACE PROTECTION (FACE SHIELD) when handling or applying diluted solution
TAKE OFF IMMEDIATELY heavily contaminated clothing and wash underlying skin
WASH CLOTHES before re-use
WASH SPLASHES from skin or eyes immediately
WHEN USING DO NOT EAT, DRINK OR SMOKE
DO NOT BREATHE SPRAY
WASH HANDS AND EXPOSED SKIN before eating, drinking or smoking and after work
KEEP AWAY FROM FOOD, DRINK AND ANIMAL FEEDINGSTUFFS
KEEP OUT OF REACH OF CHILDREN
HARMFUL TO ANIMALS. Keep all livestock out of treated areas for at least 24 hours. Paraquat can be harmful to hares; where possible, spray stubbles early in the day
KEEP IN ORIGINAL CONTAINER, tightly closed in a safe place under lock and key
WASH OUT CONTAINER THOROUGHLY, empty washings into spray tank and dispose of safely
DO NOT RE-USE CONTAINER for any purpose.
IN CASE OF ACCIDENT OR IF YOU FEEL UNWELL, seek medical advice (show the label where possible)

SPILLAGE

Wear protective clothing as per precautions section. Absorb spillage with an inert material such as sand or earth. Wash area thoroughly with full-strength liquid household bleach. Do not flush away with water. Prevent liquid from entering drains, sewers, watercourses or ponds. Place absorbed material in a labelled, covered container. Dispose in accordance with local regulations (local authorities will give advice or may accept waste).

FIRST AID

IF SWALLOWED: do not give anything by mouth or induce vomiting to an unconscious person. Take patient to hospital **IMMEDIATELY** with this data sheet.
IF ON SKIN: wash with plenty of soap and water. Get medical attention.
IF IN EYES: hold eyelids open and flush with a steady, gentle stream of water for 15 minutes. Get medical attention.

GUIDELINES FOR DOCTORS

SYMPTOMS: ingestion: vomiting, diarrhoea, soreness of mouth, difficulty swallowing.

Skin contact: irritation, inflammation, blistering. **Eye contact:** severe inflammation.

ADVICE: stomach washout/emetic providing there is no evidence of corrosive injury to the throat. Give Fullers Earth 100 to 200 mls (15% solution) or mannitol (200 mls, 20% solution in water) every two hours until Fullers Earth appears in the stools. Contact your nearest Poisons Information Centre for all cases of definite ingestion. Do a urine spot test to confirm ingestion, if positive measure paraquat levels in blood.

EMERGENCY ACTION

FIRE: extinguish with water, foam (alcohol foam is recommended), dry chemical or carbon dioxide (CO₂). Isolate the hazard area and prevent entry. Wear self-contained, positive pressure breathing apparatus and full fire fighting protective clothing. Decontaminate emergency personnel when leaving the fire area. **Use as little water as possible.** Dyke the area of the fire to prevent pesticide runoff.

STORAGE

Stores should be secure and locked; dry and protected from frost and extremes of temperatures. Store separately, away from children, animals, water supplies and other materials, especially food and feedingstuffs. Keep product in the original container, with the original label, tightly closed. Store away from flammable materials and possible sources of fire.

TRANSPORT

Shipping name: bipyridilium pesticide, liquid, toxic, NOS. Packing group III. IMDG class number 6.1 UN number 3016.

Pack size: 4 x 5 litre aluminium bottles in fibreboard outer pack. 36 packs per pallet. Maximum of 4 packs (height) per pallet. Maximum stack of two pallets. When loading/unloading, handle products carefully to avoid damage, especially by fork lift trucks. Do not transport with other materials, especially food and feedingstuffs, etc. Ensure loads are adequately secured and protected from exposure to rainfall and excessive sunlight. Where advice is required in the event of a traffic accident, contact the Transport, Warehousing and Distribution Manager at Cyanamid.

DISPOSAL

SURPLUS SPRAY MIXTURE: only mix the amount of chemical required. If it is difficult to estimate the exact amount, underestimate and recalculate the amount needed for the remaining area. Small amounts may be disposed of, **after further dilution**, 1) via a soakaway, if approved by the local Water Authority; or 2) by application to an uncropped area of minimum wildlife value. **This area must be signposted and fenced** to exclude people and animals, and must carry the volume of waste **without runoff**. Advice may be obtained from the local Water Authority.

FORMULATED PRODUCT: consult Cyanamid if disposal is necessary.

USED CONTAINERS: these may be burnt under controlled conditions. Puncture containers. When dry, burn on a very hot fire, away from buildings. Do not breathe the smoke. Do not burn within 15 metres of a public highway, or where smoke will drift over people, stock, houses, business premises. Keep fire under control and do not leave until packs are completely burnt.

COLLECTION OF UNWANTED MATERIAL OR USED CONTAINERS may be arranged through local authorities (Environmental Health Departments), who will recommend a reputable waste disposal contractor. If in doubt consult the Draft Code of Practice, issued under the Food and Environment Protection Act 1985, available from MAFF.

IN CASE OF DOUBT OR QUERY:

contact the Transport, Warehousing and Distribution Manager or the Technical Services Manager, Agricultural Chemicals Division:
Cyanamid (UK)
Fareham Road
Gosport
Hampshire PO13 0AS
Telephone: Fareham (0329) 224000
Date of issue: May 1989

Health and Safety Data

SCHERING

1st MAY 1987

Gramoxone® 100

Primary Ingredients

Paraquat dichloride 276 g/l (equivalent to paraquat 200 g/l)

Formulation

Aqueous concentrate

Application/Use

Herbicide

Classification

MAFF and CPLR (Supply): Toxic. Harmful. Irritant. CPLR (Conveyance): Harmful. Scheduled in The Poisons List and in the Poisonous Substances In Agriculture Regulations 1984.

Hazard Summary

Toxic. Harmful. Irritant.

Physical and Chemical Characteristics

A clear blue malodourous liquid, miscible with water to give a solution of pH 6.5 to 7.5. Density at @ 20°C 1.07 to 1.10 gm/ml Stable at normal temperatures but on heating to decomposition will evolve toxic fumes.

Toxicity

Inhalation

Low toxicity.

Skin and Eye Contact

Harmful in contact with skin, rat dermal LD50 about 0.33-0.40 ml/kg. Irritating to skin and eyes. Damages finger nails.

Ingestion

Toxic if swallowed, rat oral LD50 probably about 0.82-1.03 ml/kg. May cause irreversible lung damage.

Ecotoxicity

Hares are a hypersensitive species. Harmful to animals.

Precautions

Usage (MAFF Approved) Wording on rear leaflet pocket: wear protective gloves and face shield when handling the concentrate. Wear face shield when handling and applying the diluted formulation. Take off immediately heavily contaminated clothing and wash underlying skin. Wash clothes before re-use. When using do not eat, drink or smoke. Wash splashes from skin and eyes immediately. Do not breathe spray mist. Wash hands and exposed skin before meals and after work. Keep away from food, drink and animal feedingstuffs. Keep out of reach of children. Harmful to animals. Keep all livestock out of treated areas for at least 24 hours. Paraquat may be harmful to hares; where possible spray stubbles early in the day. Do not contaminate ponds, waterways or ditches with chemical or used container. Keep in original container, tightly closed, in a safe place under lock and key. Wash out container thoroughly and dispose of safely. Do not re-use this container for any purpose. In case of accident or if you feel unwell, seek medical advice **immediately** (show this leaflet where possible). Wording on front label: Paraquat can kill if swallowed. Do not put in food or drinks container. Keep out of reach of children.

(continued)

Read the label before you buy: Use pesticides safely.

Schering Agrochemicals Limited

Hauxton, Cambridge CB2 5HU, England. Telephone: (0223) 870312. Telex: 81654.

Telefax: (0223) 872142

Schering Agriculture is a trading style of Schering Agrochemicals Limited, a subsidiary of Sobering AG, West Germany



Gramoxone 100

CPLR (Supply) Toxic if swallowed. Harmful in contact with skin. Irritating to eyes and skin. Keep out of reach of children. Keep away from food, drink and animal feedingstuffs. When using do not eat, drink or smoke. In case of accident or if you feel unwell, seek medical advice immediately (show label where possible). Do not breathe spray. Take off immediately all contaminated clothing. Wear suitable protective clothing.

Spillage Keep people away. Do not breathe mist or spray. Avoid contact with skin and eyes. Wear protective gloves, overalls, goggles and boots.

Emergency Procedures

Spillage and Disposal Observe precautions above. Use sand or earth to absorb and contain the spillage, do not allow spillage to enter public drains, sewers or watercourses. Collect up contaminated sand or earth, transfer to heavy-duty plastic bags and store in strong containers. Dispose of properly at a waste disposal site (contact Local Authority) or through a waste disposal contractor.

N.B. If spillage should enter a drain or watercourse, inform the Local Water Authority immediately.

Fire Product packaging will melt and collapse in a fire, product is not combustible but will give off toxic fumes when heated to decomposition. Spray containers with water to keep cool if involved in a fire. Wear breathing apparatus when fighting fires which are large or in confined spaces. Water, foam, dry powder or CO₂ may be used to extinguish fire.

First Aid In case of contact with eyes, irrigate immediately with water for at least 15 minutes and obtain immediate medical aid. In case of contact with skin, remove contaminated clothing and wash affected area with soap and water. If swallowed, wash out mouth with water. If not already occurred, induce vomiting, keep patient at rest and get immediate medical aid. Show label, leaflet or this data sheet to doctor rendering assistance.

Emergency Advice:

Contact: ICI Plant Protection Division, Yalding, Kent. Telephone: Maidstone (0622) 812511.

ICI Mond Division, Emergency Centre Runcorn. Telephone: Runcorn (09285)72000

Storage

Keep this product in a separate, locked storage area well away from seeds, fertilizers and animal feedstuffs in a safe, dry place designated as an agrochemical store. Within the store, keep segregated from other agrochemical products. Protect from frost.

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“The above information is intended to give general guidance as to health and safety when the Product is used strictly in accordance with the instructions and recommendations shown on the relevant Product Label and Technical Usage Leaflet and in compliance with any conditions applicable under the Control of Pesticides Regulations 1986. Users are warned that when the Product is not used strictly in accordance with such instructions, recommendations and conditions, then the information may not be applicable or adequate and no responsibility will be accepted for any resulting injury, loss or damage.”



Glove performance

Annex D

Gloves with a minimum thickness of 0.4 mm	Nature of concentrated formulation		
	Emulsifiable concentrates (e.g. formulations containing)	Oil-based spray liquids (including ULV formulations)	Acids (a.g. silage additives, sulphuric acid)
Natural rubber	*	**	**
Neoprene	**	****	***
Nitrile	**	****	**
Butyl	**	**	****
PVC-supported (1 mm thick)	**	****	**
Viton (fluoropolymer)	***	****	**

Note: See the table below for category keys, breakthrough times and probable applications.

Category key	Breakthrough time	Probable application
*	Less than 12 minutes	Low-hazard chemicals – single-use item
**	Not less than 12 minutes	Repeated use only if contaminants washed off immediately
***	Not less than two hours	Repeated use provided contaminants washed off at end of each operation
****	Not less than six hours	Repeated use provided contaminants washed off at the end of each day

Examples of agrochemicals with symptoms of poisoning

Annex E

- *Arsenicals* such as copper aceto-arsenite (Paris Green), sodium arsenite (Acme weed killer): An all-body poison with the rate of illness determined by formulation. Early symptoms are stomach pain, vomiting and diarrhoea followed by severe hypertension and muscle cramps. Death may follow.
- *Bipyridilium compounds* such as paraquat and diquat herbicides: Irritating to skin and eyes, especially around sensitive body areas such as the lips. The concentrated solution will cause cracking and shredding of fingernails. It is most toxic if ingested, causing vomiting, stomachache and diarrhoea leading to lung, kidney and liver damage. High doses cause multi-organ failure and death after ten to 20 days.
- *Carbamates* such as aldicarb (Temik), carbofuran (Furadan), methomyl (Lannate, Nudrin) and propxox (Baygon): These are used as insecticides that depress acetylcholinesterase activity to produce symptoms similar to those of organophosphorus compounds.
- *Carbon tetrachloride*: Used as a fumigant generally in mixtures with other hazardous substances. Low concentrations cause damage to skin tissue and internal organs. High levels of exposure produce narcotic effects and headache, dizziness, mental confusion, nausea and vomiting. Alcohol aggravates the condition.
- *Chlorophenoxyacetates and related compounds* such as MCPA, MCPB and 2,4-DEP, and herbicides: Poisonous by ingestion to cause burning and mouth watering, stomach cramps, vomiting and diarrhoea. May exceptionally lead to convulsions, mental confusion and dizziness.
- *Chloropicrin*: A fumigant and powerful irritant of eyes and all body surfaces. If inhaled will cause breathing difficulties and vomiting. Also known as vomiting gas.
- *Dinitro compounds* such as dinitro-orthoeresol (DNOC), dinoseb (DNBP) and dinosam (DNAP) are used as herbicides. They usually produce yellow stains wherever contact occurs. They are toxic to the liver, kidney and brain and interfere with the normal activities of the human cells in different tissues. Early symptoms are fatigue, excessive sweating and thirst. If exposure continues unchecked it will lead to increasing anxiety, restlessness, an increased rate of breathing, rapid heartbeat and raised temperature. Death may occur.
- Other agrochemicals such as pentachlorophenol, bromoxynil and ioxynil have similar effects to those of dinitro compounds.
- *Ethylene dichloride*: A fumigant and powerful narcotic with a potential for kidney and liver damage. Causes dizziness and vomiting similar to sea-sickness. Dermatitis may occur because of its drying-out effect on the skin. Symptoms may occur suddenly after a delay of several hours.
- *Hydrogen cyanide*: A fumigant affecting vital respiratory enzymes. Low exposure may produce irritation of nose and throat, dizziness, nausea, headache, tightness of the chest, weakness of the limbs and a sensation of lack of air. High exposure levels produce unconsciousness, possibly convulsions and death.
- *Mercurials* such as (a) organic compounds, e.g. phenyl mercury acetate and methoxyethyl mercury acetate; and (b) inorganic compounds, e.g. mercurous chloride and mercuric oxide: These are all-body poisons with rate of illness determined by formulation. They accumulate in the body and could lead to a breakdown in essential body functions. The more toxic compounds will cause rapid death.
- *Methyl bromide*: A very hazardous fumigant. If inhaled in small quantities it may produce headache, weakness, smarting of the eyes and stomach-ache. Low concentrations may seriously affect the central nervous system and other essential body organs. May cause death or irreversible symptoms of mental confusion.
- *Organochlorine compounds* such as aldrin, dieldrin and DDT: Act on the central nervous system to cause apprehension and excitement leading to tremors, convulsions and coma; nausea and vomiting are common.
- *Organophosphorus compounds* such as azinphos/methyl, phensulphothion (Demeton), ethylparathion (Parathion, Thiopos) and methyl parathion (Dalf): Depress activity of an enzyme in the body called “acetylcholinesterase” responsible for the transmission of nerve impulses to muscles. This causes muscular twitching and weakness. If exposure continues it could lead to blurred vision, dizziness, convulsions, nausea, vomiting, diarrhoea and a general breakdown in essential body functions. Those affected may suddenly stop breathing. Antidotes are atropine and pralidoxime. These are usually given by injection.
- *Phosphine*: A highly poisonous fumigant (gas) affecting the stomach and central nervous system. Causes nausea, stomach pains, vomiting and diarrhoea possibly leading to convulsions, loss of consciousness and death within 24 hours of exposure.
- *Pyrethrins and synthetic pyrethroids* such as decamethrin, cypermethrin and permethrin: Natural pyrethrins are generally of low toxicity but may cause allergic reactions. Synthetic pyrethroids are more significantly toxic and in large doses act on the central nervous system to cause convulsions. Lower doses cause a sensation of heat on the exposed skin.

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- **classification, labelling and identification**
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- **engineering control measures**
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- **poisoning and its treatment**
- **fire emergencies**
- **roles and responsibilities**
- **education and training**
- **case histories**

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