TRAINING MANUAL

For the certification of pest control operators

IICA

IICA OFFICE IN SAINT LUCIA

WHAT IS IICA?

The Inter-American Institute for Cooperation on Agriculture (IICA) is the specialized agency for agriculture in the Inter-American system.

As a hemispheric technical cooperation agency, IICA can be flexible and creative in responding to needs for technical cooperation in the countries, through its thirty-four Technical Cooperation Agencies, its five Regional Centres and Headquarters, which coordinate the implementation of strategies tailored to the needs of each Region. The 1998-2002 Medium Term Plan (MTP) provides the strategic framework for orienting IICA's actions during this four-year period. Its general objective is to support the efforts of the Member States in achieving sustainable agricultural development, within the framework of hemispheric integration and as a contribution to human development in rural areas. The Institute's work is aimed at making changes in agricultural-production, trade and institutions and in the people who work in the sector, using an integrated and systematic approach to development, which is based on competitiveness, equity and solidarity as the key to achieving the sustainable development of agriculture and rural areas.

THE MEMBER STATES OF IICA ARE:

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The 14 Caribbean Regional Countries:
Antigua and Barbuda, Barbados, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts, and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago.

Its Permanent Observers are:
Arab Republic of Egypt, Austria, Belgium, Czech Republic, European Communities, France, Germany, Hungary, Israel, Italy, Japan, Kingdom of the Netherlands, Portugal, Republic of Korea, Republic of Poland, Romania Federation and Spain.

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Preface

This manual represents an attempt to establish a scheme for the certification of pest control operators as part of the efforts to ensure the proper management of pesticides in the member countries of the Coordinating Group of Pesticides Control Boards in the Caribbean. Persons who are not properly trained are applying pesticides. In the majority of cases, application of pesticides exposes the operator, other persons and the environment to the hazards associated with pesticide use. The scheme is designed to address the situation.

The Manual can be used not only by the commercial pest control operator but also by all persons who are trying to control pests.

Acknowledgments

The writers wish to thank the many persons who assisted in the production of this Manual. Special thanks go to Miss Deborah Bushell for reviewing the first draft and Dr Sandra Vokaty and the Members of the Coordinating Group of Pesticides Control Boards in the Caribbean for their valuable comments. Thanks also to Mrs Deborah Biscombe for typing and Mrs Rufina Paul for editing. Layout and art work was design/illustration by St Omer Art Magic - St Lucia.

1 Introduction to Pests

It is important that when action is to be taken against any problem or deviation from the normal, information is obtained on what is causing the problem.

Soil, water, nutrients, wind or a pest may cause the problem. This manual is devoted to problems caused by pests. A pest is any organism that competes with man, animals or crops for food, water or light, injures man, animals, crops and structures; spreads diseases to man, animals or crops; or annoys man or animals. Pests can be any of the following: insects, mites and ticks, fungi, bacteria, viruses, nematodes, weeds, rats or mice, birds, slugs and snails. The most common pests are insects.

Insects

Characteristics

Adult body is divided into three parts:

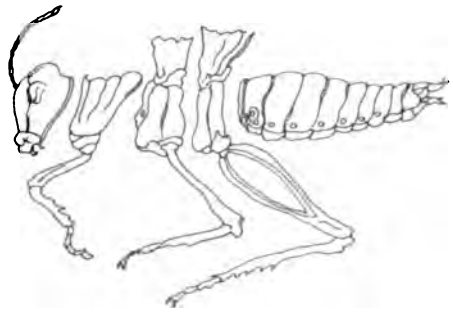
- Head
- Thorax
- Abdomen

most have wings
most have six legs
compared with spiders and mites
which have eight legs.

Development

The female insect after mating (sexual reproduction), lays eggs which hatch into worm-like larvae called grubs or caterpillars. Others after mating, bear young ones which resemble the adult but without developed wings. These are called nymphs. Some insects may lay fertile eggs or bear nymphs without mating (asexual reproduction).

Diagram or Drawing of:-



an insect

a mite.

a tick.

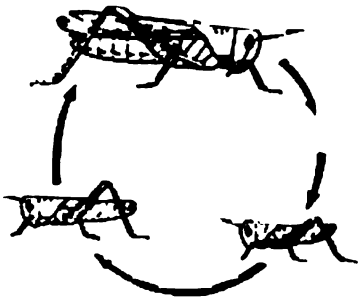
a spider.

a centipede.

a millipede.

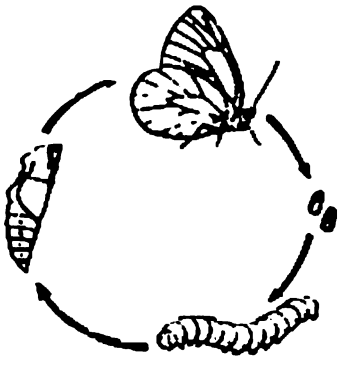
Insect Metamorphosis

Incomplete



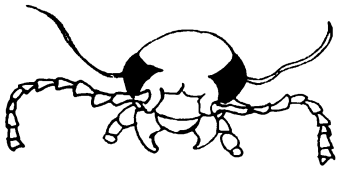
The life history of a grasshopper

Complete

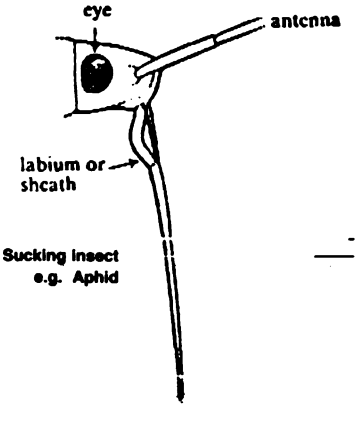


The life history of a butterfly

Insect mouth parts



A chewing insect: eg. Catapillers, Grasshoppers, cutworms



Sucking insect e.g. Aphid

The insects have no room to grow inside their skins. The skin is made up of a hard substance called chitin. This does not stretch, therefore, from time to time, the young insects have to throw off their skin to grow. There is new skin beneath the old one. The old skin splits and the insect climbs out of it with the new skin, which is soft at first but rapidly hardens upon exposure to air. The change the insect goes through as it gets older is called metamorphosis. When the nymphs or larvae shed the old skin, it is called moulting.

The larvae feed and grow and about the time they are ready to develop into adults they enter in a resting stage inside a protective case called a pupa or chrysalis. Inside the case, the larva develops into an adult and when fully developed splits open the case and emerges. This may take days, weeks or months depending on the insect and the weather conditions.

Insects vary in their life cycles, in what they eat and in where they live. They are adaptable to different conditions. Some insects chew food material , some suck plant sap and some carry disease agents. These are considered to be harmful. Some insects such as the honeybee and those that eat larvae of other pest are useful to man. When insects feed on the nectar in flowers they help to pollinate the flower and to produce seeds. A moth or butterfly may be beneficial even though its larva is harmful.

Feeding Habits

Insects feed on plants by chewing and sucking .

Chewing Insects

defoliators: chew portions of leaves or stems, stripping or chewing the foliage of plants

Example: caterpillars, grasshoppers, cut worms,

Sucking Insects

The insects suck the plant juice and take up food the plant has made by photosynthesis. This results in distorted plant growth, wilts, curling, transmission of diseases, burning of leaves, production of sugary wastes on which fungi grow.

Example: aphid, leaf hopper, scale insects, spider mite, thrips

Insect damage

Insects can become serious pests because they lay thousands of eggs and thus young ones in a short period. These young ones grow rapidly and need a large amount of food. Their great variety and adaptability enables them to take advantage of new conditions quickly. Growing the same crop over a large area provides ideal feeding and breeding opportunities for insects already adapted to other members of the same crop family.

Borers: bore into stems, fruits etc

Plant Pathogens and Diseases

A disease is a malfunctioning process caused by continuous irritation. Plant diseases can be divided into:

- Non-parasitic plant diseases - these are caused by non-living things. Example heat or cold, poisonous chemicals, too much or too little water, or a mineral imbalance.
- Parasitic plant diseases - these are caused by living organism called pathogens which live on or inside plants and eat them. Plant pathogens are micro-organisms, which cause the plant to be different from the normal plant. They can harm or destroy a plant by a disease. The micro organisms, which cause parasitic plant diseases, are outlined below.

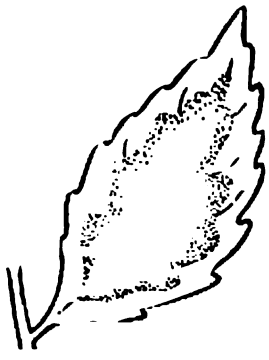
Leaf miner

Nematodes

Very small round worms. Most live on dead plant materials (saprophytes) but a few take food and water from living plants (parasites). They lay their eggs free in the soil or attached to roots. When the young parasites hatch they move to a host plant. Damage from nematodes is both by sucking the cell sap and by the wounds, which permit the entry of disease, causing organisms. Nematode infestation may be recognized by malformation on the roots - numerous swellings and bulges, individual lumps or damaged roots with several black spots. These usually cause yield loss renders some produce unmarketable but do not usually kill the plant.

Diagram of root knot, nematode damage

Damage by fungus



A leaf covered in a whitish dust.

Fungi

Parasitic plants, which are never green, have no leaves or flowers and have a mass of white threads in place of roots. They cannot produce their own food and so depend on food developed by other plants.

Many fungi grow on leaves, fruits and stems and are so small they are invisible without a microscope and only the disease they cause or the powdery mat that covers the diseased parts is seen. This powdery mat is composed of spores that serve the fungus as seed.

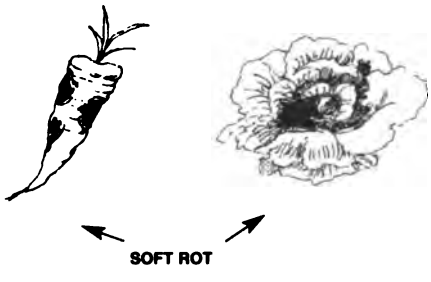
The signs of fungi damage - include yellowing, wilting, withering - are similar to those produced by poor nutrition, nematodes, bacteria and other factors.

Most microscopic fungi are saprophytes, breaking up dead plant parts and returning them to the soil. Others are parasites, feeding on living plants in the process causing wilts and other diseases.

Parasitic fungi can be roughly divided into:
Those that attack plants above ground level
Those that attack through the root system

The life cycle of the plant parasitic fungi is divided into growth stages and rest stages. In the growth stages, spores are produced that are spread by wind, rain - splash or insects. When the spores land on a suitable host, they grow by means of thread like cells, which enter the plant through leaf pores or through wounds, made by insects, nematodes or accidents. They grow to produce spores, which under suitable conditions produce further generations. The fungus can also develop a resting stage, which lies in the soil until conditions are suitable for germination.

Damage caused by bacteria



Carrot Cabbage

Bacteria

Tiny organisms which cannot be seen without a microscope. Most live in dead plant materials but some parasitize plants causing brown or black rots. When they destroy roots or block a plant's water conducting tubes, the plant wilts and dies.

They do not form spores but some can survive for a long time by surrounding themselves with protective coating which prevents them from drying out. They grow in wet conditions and disperse in water films and by rain splash. Some species are transmitted from plant to plant by insects and some by seeds.

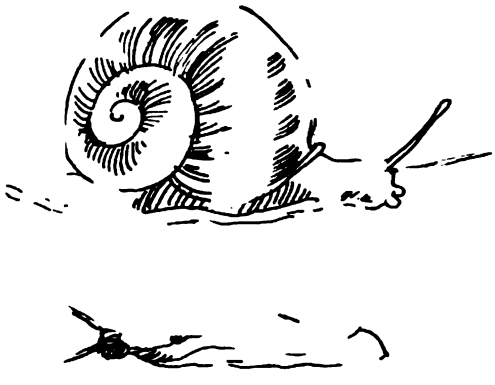
Viruses

Smaller than bacteria and can be seen only with a powerful electronic microscope. They exist in living cells. Their diseases may take a long time to be recognized as often the only effect on the crop is a gradual loss of vigour. Plants are smaller, yields are significantly reduced and in some cases the plant fail to produce. Some signs of infection include red or yellow streaks on grasses and blotchy mosaic markings on the leaves of other plants, curling and distortion of the leaves. It is sometimes difficult to distinguish a viral disease and mineral deficiency. Viruses may be spread when infected material is attacked by sucking insects and by nematodes. Some may also be spread by using infected instruments.

Damage by virus

Potato leaf roll

A snail and slug



Slugs and Snails

These are soft animals, which inhabit damp shady sites and swamps. They may be numerous in the rainy season. Snails have a characteristic coiled protective shelter whilst slugs have no shell.

They live in holes, coming out to graze at nights. They damage plants by feeding on the foliage and other succulent plant material.

Birds

Some birds feed on vegetables, fruits and can cause considerable damage. They contaminate food and decrease the amount of food available. Signs of possible damage include holes or peck marks, feathers and droppings.

Rats and Mice

Rats and mice feed on fruits and stored products. They can greatly reduce food, dirty or contaminate stored products. Signs of rodent include paths through grass or dirt, tiny foot print and tail marks, tiny dark shiny, wet looking droppings and a bad odour in and around grain.

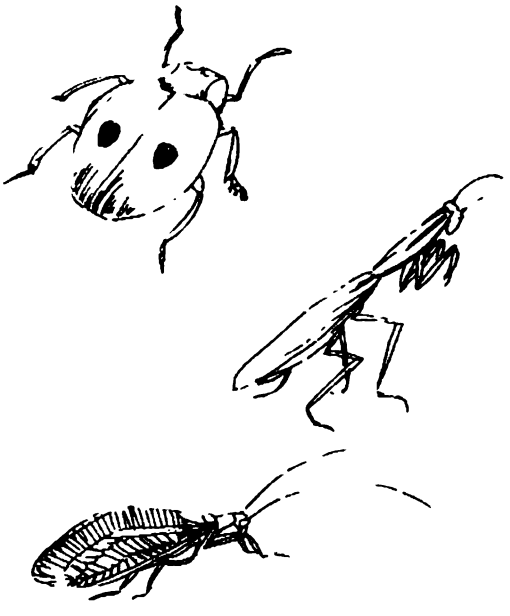
Weed

A weed is a plant growing out of place. It takes up water, nutrient and space that the planted crops need to live. They also harbour other pests. Weeds reduce the quantity and quality of the crop.

Weeds have life cycles that vary from one to several years. They are divided into three groups depending on how many years they live:

Annuals: weeds with one year cycles
Biennials: weeds, which live two years
Perennials: weeds, which live several years

Examples of benificial organisms:
Ladybird beetle,Mantis, Lacewings



2 Principles of Pest Control

Man is able to live with a large number of organisms some of which are not harmful to him, his food and his environment. The damage done by an individual pest is small and is unlikely to be of economic significance. Therefore, there must be large numbers of pest to account for the damage they do.

There are three groups of organisms:

1 Beneficial organisms
2 Organisms that are not of economic importance
3 Organisms that are of economic importance

Of the three groups of organisms, those that are not of economic importance have the most members followed by the beneficial group. Those of economic importance have the smallest number. Those not of economic importance do not really bother man or his crops. In fact, some assist in providing food for fish, birds and other plants and animals. When man tries to destroy the small number of few harmful organism, he destroys the beneficial ones and those that are not of economic importance.

The beneficial organisms help man since they eat organisms that are harmful. Without these organisms, we would not be able to control those economically important organisms (pests). Some such as the honey bee make products that are useful.

However, the economically important organisms (pests) must be prevented from causing economic losses to food or reduction in revenue. The numbers of the economically important group (pest) must be reduced. A species may be a pest in some situations and not in others. An organism should not be considered to be a pest until it is proven to be one. Pests may be:

continuous
if they are nearly always present and require regular control

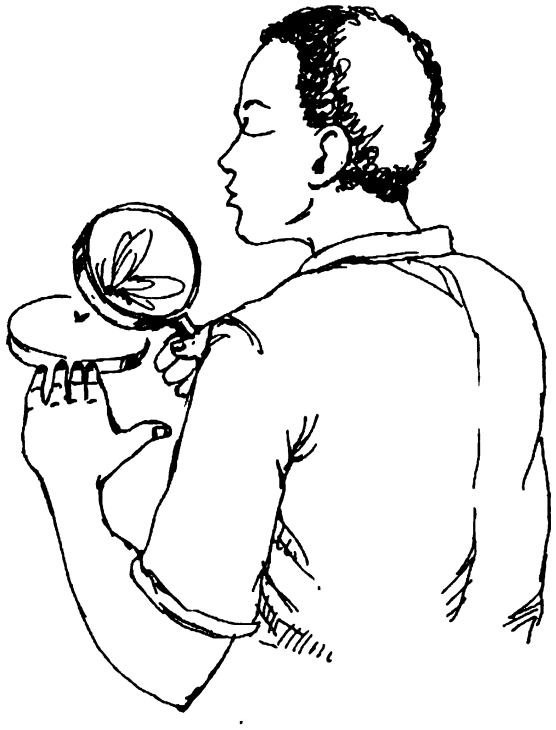
sporadic, migratory or cyclical
if they require control occasionally or intermittently

potential
if they do not require control under normal conditions but may require control in certain circumstances

The pest control decision taken must be carefully thought of and care should be taken in its implementation.

Accurate pest identification is the first step in an effective pest control programme. No pest control programme should be attempted until one is sure of the type of pest. Correct identification of a pest allows one to determine basic information like life cycle and the time that the pest is most susceptible to control.

In making the decision for pest control, it is important to accept that some loss will occur regardless of what is done. It must be certain that the crop loss is greater than an acceptable level and that the cost of pest control will be less than the additional revenue obtained (economic level). Use a control strategy that will reduce pest members to an acceptable level. Pest control costs money and involves time and effort, therefore, all these including the crop loss must be considered in the cost consideration. Even though a pest is present, it may not do much harm.



Person examning an insect.

Thus pest control should be viewed as pest management or as an ecological approach to pest reduction with economic and environmental considerations. Pest control should not be viewed as pest eradication.

The features of pest control are:

• orientation towards the entire pest populations rather than localized ones.

• objective is to lower the mean level of abundance of pest so that fluctuations above economic threshold levels are reduced or eliminated.

• method or combination of methods used are those to supplement natural control and so give the maximum long-term reliability with cheapest protection.

•The significance is that alleviation of the problem is general and long-term with minimum harmful side effects.

•The philosophy is to manage the pest population rather than to eliminate it.

In most pest control situations, the area to be protected should be monitored (checked or scouted) often.

Regular monitoring can answer:-

• type of pests present,
• need for control
• correct time to begin control
• effect of control methods

3 Pest Control Methods

In deciding on the pest control method, information must be obtained on the stages of the pest life cycle which are most susceptible.

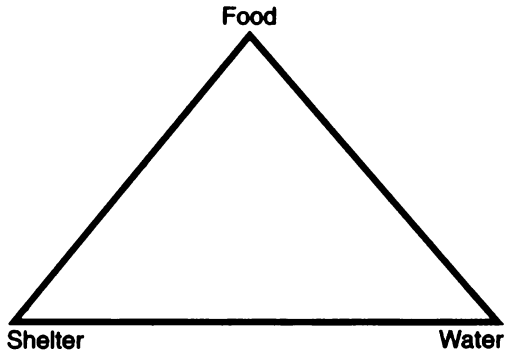
Once the pest problem is identified and a decision taken that it is serious enough to warrant control, then the decision has to be taken on the control method which is the best, most economical and safest.

In order for a pest problem to develop,

the following conditions must be present:

- food to eat and live on
- pleasant environment to live and grow
- right amount of light, moisture and warmth

If these conditions are not suitable the pest will not choose the area. Thus a pest problem can be prevented by careful examination of the crop environment. If the crop environment is altered to make conditions unsuitable for the pest to live in, it will not live there. Pest control should be viewed as the manipulation of the various techniques of management of the environment to keep pests at an economic level. There are several ways to do this:



Triangle of Life

CULTURAL CONTROL

Disruption of the pest life cycle by the manipulation of agricultural practices.

•Ploughing

Many pests live in the soil in suitable temperature and humidity conditions. Ploughing disturbs these ideal conditions by:

- Creating temporary dry conditions in the upper soil layers sometimes even exposing pests to full radiation of the sun. eg. nematodes, larvae of beetles.
- Larvae may be eaten by birds and pigs eg larvae of beetles.
- Immature stages may be buried to a depth from which the adult fail to reach the soil surface after emergence eg pupae, eggs.
- Some may be killed mechanically by contact with soil clumps.

• Sanitation

Destruction of crop residue removes remains of pest population and eliminates plant debris on the soil surface in which many pests find shelter. eg. removal of harvested cabbage remains infested with diamond back moth.

- Elimination of alternate host. eg **Commelina** spp host of nematodes.

• Roguing out-removal and destruction of infested material where there is a danger of spread - eg cabbage infested with cabbage white butterfly larvae.

• **Manuring**

Healthy plant growth compensates for damage by pests whereas weak poor growing plants may be easily killed by the same attack. However, fertilizing can also produce nutritious plants for insects. Aphids, leaf hoppers, mites all have been found to breed or develop more rapidly on plants given high nitrogen fertilization.

• **Irrigation**

Pest can be washed off plants and soil pests may be killed in saturated soil.

• **Strip Farming**

An intervening strip of non-suitable food prevents movement of pests from one strip of crop to another or to suitable hosts.

• **Crop Rotation and Isolation**

Separation of the pest from its host plant in time and space, reduces and delays attack.

• **Trap crops**

Spraying of attractants and or planting of attractive plant eg Crotalaria for nematodes

• **Sowing and Harvest Practice**

Sowing the crop to avoid the egg-laying period of the pest or allowing the plant to age to resistance by the time the pest appears.

• Increase the seed rate to compensate for the expected plant loss from pests.

MECHANICAL

• Physical destruction of the pests eg hand picking larvae, foot crushing, use of aluminum bands on coconut trees (rats).

• Hot water treatment for nematode control or fungi.

BIOLOGICAL CONTROL

Manipulation of parasites, pathogens and predators in reducing a pest population.

Advantages

- Beneficial organisms can seek and find the pest
- Organisms can increase in number
- Resistance is slow or will not develop
- Control is self-perpetuating

Disadvantages

- Control is slow
- Unpredictable
- Requires expert supervision
- The pest is not eradicated

Techniques

1: Conservation - the naturally occurring predator or parasites are encouraged by improving conditions for them.

2: Intervention - natural enemy is liberated in relatively small numbers in hope that it will establish itself.

3: Inundation or Inoculation - large numbers of natural enemies are reared in the laboratory and liberated on the crop.

RESISTANT VARIETIES

The aim is to reduce losses in the field caused by pest eg grafting a resistant variety to susceptible variety.

Legislative Control

Enforcement of control measures through legal means.

- Quarantine - Inspection and prevention of entry of all produce, which might harbour foreign pests.

Chemical Control

Use of pesticides for control. Pesticides may be of an inorganic nature or may consist of organic substances.

Integrated Pest Management

Integrated Pest Management (IPM) is a pest management strategy whereby multiple tactics are used in a compatible manner to maintain pest populations at levels below those causing economic injury while providing protection against hazards to humans, animals, plants and the environment. IPM recognizes that a certain amount of loss is to be expected when growing crops. The important principle is to ensure that the loss caused by the pest is greater than the money spent to control the pest.

4 Pesticide Labelling

A pesticide is a chemical used to kill or stop the action of harmful organisms we know as pests. Most pesticides kill the pest by poisoning it. Unfortunately, many pesticides are also poisonous to humans and other animals. Pesticides can kill humans and animals if misused or abused.

TYPES OF PESTICIDES

Insecticide: A chemical used to kill insects
Fungicide: A chemical used to kill fungi or molds
Nematicide: A chemical used to kill nematodes
Molluscicide: A chemical used to kill slugs and snails
Rodenticide: A chemical used to kill rats and mice

OTHERS INCLUDE

Plant growth regulator: A chemical used to stop, increase or otherwise change the normal plant process

Defoilant: A chemical used to remove unwanted plant leaves

Growth Repellent: A chemical used to keep pest away

Attractant: A chemical used to draw pest towards it

Pesticide Labelling

Pesticide product labelling is the main method of communication between a pesticide manufacturer and pesticide users. The information printed on or attached to the pesticide container is the label. Labelling includes the label itself, plus all other information received from the manufacturer about the product when it is brought. Pesticide label contains basic information or instructions that helps users identify and use the product. Always **read** the label before using the pesticide. Always **select** a pesticide with a label. Information on the label is outlined below.

Pesticide Label

a. Trade Name or Commercial Name

Each manufacturer has a trade name for each of its products. Different manufacturers may use different trade names for the same pesticide active ingredient. The trade name is the one used in advertisements and by company sales people.

b. Ingredients

List of ingredients with amounts as a % of the total product. The ingredient statement must list the official chemical name and/or common name for each active ingredient. The label should show the inert ingredients and the percentage of the total contents they make.

The chemical name is a complex name that identifies the chemical components and structure of the pesticide. This name is almost always listed in the ingredient statement of the label. Since pesticides have complex names, many are given a shorter common name.

c & d. Hazards Words and Symbols

The hazard word - DANGER, WARNING, or CAUTION must appear in large letters on the front panel of the pesticide label. It indicates how acutely toxic the product is to humans. The hazard word is immediately below the statement keep out of reach of children which also must appear on every label. The hazard word is based not only on the active ingredient, but on the contents of the formulated product. It reflects the hazard of any active ingredients, carriers, solvents, or inert ingredients. The hazard word indicates the risk of delayed acute effects from the four routes of exposure to a pesticide product (oral, dermal, inhalation, and eye) and is based on the one that is greatest. The hazard word does indicate the risk of delayed effects or allergic efforts.

Danger: signals highly toxic. Product is very likely to cause acute illness from oral, dermal or inhalation exposure or to cause severe eye or skin irritation.

PARTS OF A LABEL SECTION

Left	Centre	Right
Safety Precautions	Trade Name	Introduction
Symptoms of Poisoning and First Aid Treatment	Ingredient	Crop
	Hazard Words and Symbols	Pests Control
Environmental methods	Warnings or Precautions	General Dosage
	Company Name	
	Net Contents	PCB Registration Number

Poison / skull and cross bones:
All highly toxic pesticides that are likely to cause acute illness through oral, dermal or inhalation exposure also will have the word POISON printed in red and the skull and cross bones symbol. Products with the single word DANGER due to skin and eye irritation potential will not carry the word POISON or the skull and cross bones symbol.

Warning: The product is moderately likely to cause acute illness from oral, dermal, or inhalation exposure or that the product is likely to cause moderate eye or skin irritation.

Caution: Signals that the product is slightly toxic or relatively non toxic. The product has only slight potential to cause acute illness from oral, dermal or inhalation exposure.

e. Company name: Tells the name of the company who made the product. The name of the company who sold the product may also be found.

f. Net contents: Tells how much is in the container. This can be expressed as pounds (lbs) or ounces (oz) for dry formulations and as gallons, quarts, pints or fluid ounces for liquids. Liquids formulations may also list the pounds of active ingredients per gallon of product.

g. Safety precautions
Contains sections on storage, handling and disposal.

h. Symptoms of poisoning and first aid treatment
Gives instructions on how to respond to an emergency exposure involving the product. The instructions usually include first aid measures and may include instructions to seek medical help.

i. Environmental Hazards
Indicates precautions for protecting the environment when the pesticide is used.

j. Introduction
The type of pesticide is usually listed on the front page of the label. This refers to a short statement indicating generally what the product will control.

k. Directions for Use

Indicates that the: pest that the manufacturer claims the product will control; the plant, animal or site the product is intended to protect; form of application, the correct equipment to use, the dosage to use; mixing directions, whether the product can be mixed with other often used products; whether the product is likely to cause unwanted injuries; where the material should be applied, when and how often it should be applied.

l. Colour Band

The pesticide toxicity may be illustrated by a colour code.

IMPORTANCE OF LABELS

When a decision is taken to use a pesticide to control a pest problem, the choice of the pesticide to use must also be made. The label gives information on the choice of pesticide for the crop, the pest, how to use the product, how poisonous a particular pesticide is and what to do if someone gets poisoned. It also gives an indication of the time of application prior to harvest of the crop.

Person reading a pesticide label.

HOW TO USE A LABEL

The answer to the question, How to use the label? Or how can one get the best use of a label can be answered by the word **READ.**

• **READ the label** before buying the pesticide. You will identify the pesticide needed to treat a particular problem. It will alert you to any special dangers of the pesticide before purchase or use.

• **READ the label** before mixing and applying the pesticide. The label includes instructions for use and safety warnings.

• **READ the label** before storing the pesticides. The label lists any special storage instructions for the particular pesticide used. It also includes a section on special chemical and physical dangers that will alert to any storage hazard.

• **READ the label** before disposing of the empty containers. The label tells how to safely do this so that no harm comes to persons, animals and the environment.

• **READ the label** anytime an emergency occurs or in any situation involving the pesticide which you do not know how to handle. This includes a poisoning accident, a leak or a spill, or any natural disaster in which a pesticide is involved.

• **READ the label** any time you have a question or in doubt on how to deal with pesticides.

5 Pesticide Selection

Choosing the correct pesticide to use is very important to the implementation of an effective pest control programme. It will also have a direct bearing on the hazards one subjects oneself to as well as other persons and the environment.

Before selecting the pesticide, the pest problem should be identified, and decision taken as to whether the pest problem is of economic importance, has the potential of developing into a problem, is of health importance or is a nuisance and that other control methods have been considered.

After the pest has been properly identified, select a pesticide that will control the pest with a minimum of danger to other organisms. The pesticide should be one currently registered by the PCB.

In the selection of the pesticide consideration should be given to its formulation. Granular type formulations are less hazardous than sprays or dusts because they drift less. Formulations with the greatest drift and dispersion potential are likely to cause damage to useful plants under unfavourable conditions. These formulations can be of greater risk to the person applying, if a highly toxic pesticide is being used.

Emulsifiable concentrate pesticides with a petroleum base type carrier are generally more hazardous than water soluble ones because they penetrate the skin more rapidly and are difficult to wash off.

The amount of pesticide needed should be estimated and only enough of what is needed for the particular job should be purchased.

6 Pesticide Formulation

Pesticides may be purchased in different forms. Each form or formulation has specific characteristics, which make it either effective or ineffective for use in a particular situation.

The pure chemical that does the work is called the active ingredient. It is not usually in a form, which can be used and therefore must be mixed with other ingredients to make it effective, easy and safe to mix and apply. The mixture of active ingredients with other ingredients is called formulation. Some ingredients do nothing to help the active ingredient kill the pests. These are the inert ingredients. Some ingredients however help to increase the efficacy of the active ingredients.

There are many different kinds of formulations. Sometimes, the same pesticide will be available in several different formulations. Active ingredients are mixed with different combinations of inert ingredients to make different formulations.

Pesticide formulations must fulfil two requirements:

- Provide the user with a convenient, safe product, which will not deteriorate over a period of time.
- Try to obtain the maximum biological activity inherent in the pesticide.

Before choosing a formulation, the following should be determined:

- Availability of application equipment
- Condition in the application area to facilitate safe application
- Ability to reach the target
- Persistency
- Effect on the surface applied

Generally pesticides come into two broad categories of formulations - liquid and dry formulations.

Liquid formulations

Liquid formulations are made to be used for spray applications. With spray applications there is a problem of drift where particles are blown by the wind. Liquid formulations produce gases as they age. This creates a risk of container rupture. Thus pesticide containers used for storage of pesticides should be checked regularly for cracks and breaks.

Aerosols (A)

- are of two types, one with its active ingredients dissolved in a volatile solvent and contained in a can with pressurized gas for a propellant (ready to use). Activation of a trigger releases the solution in a fine mist. The other type of aerosol uses the same type of solution but the mist is produced in a heat fogging machine. The solvent in both cases is usually diesel.

Emulsifiable Concentrate (EC)

An emulsion is a liquid/liquid colloidal suspension. Water and oil will not mix but require the addition of an emulsifier to enable a colloidal suspension of oil in water. Emulsifiable concentrates consist of a solution of the pesticide in a petroleum based solvent and an emulsifier. When it is mixed with water it forms an emulsion. The mixture must be agitated or else it will settle to the bottom of the spray tank.

EC is a combination of two liquids, which will not totally mix but remain partly separated. The EC may loose some of its emulsifiability if exposed to high temperatures or high humidity. The two liquids lose some of their properties, which make them separate thus they may become ineffective, and damage crops.

Flowables (Flowable concentrates) F

This formulation is made up of a wettable powder mixed with a surfactant. Like a wettable powder, it forms a suspension with water, therefore constant agitation is required. The flowables require a ratio of water to concentrate of 3:1 as opposed to 6:1 ratio required for wettable powder.

F consist of finely grounded solid particles of active ingredient floating in liquid. They handle well and seldom clog the spray nozzle. There needs to be only a little agitation to be mixed and ready for application.

Liquefied Gases
Some gases become liquids when under pressure. Pesticides with active ingredients, which behave in this manner, are stored under pressure, for example - methyl bromide. Other active ingredients remain as liquid in an ordinary container but turn into a gas as soon as they are applied - DBCP.

Solution (S)
A solution is a homogeneous mixture of two liquid substances. There are two types

1 high concentrations which have a large amount of active ingredient. They may even contain only active ingredient with no other ingredients added
2 low concentrates have a small percentage of the active ingredient

High concentrated solutions contain chemicals that allow them to spread and stick well. These solutions may be used as they are or be diluted with oil solvents. Low concentrated solutions should not be diluted further. **Read the label.**

Ultra-Low Volume (ULV)
These concentrates have almost 100% active ingredient. They are designed to be used as they are, or to be diluted with only small quantities of specified solvents.

Invert Emulsions
These contain a water soluble pesticide dispersed in an oil carrier. They require a special kind of emulsifier that allows the pesticide to be mixed with a large volume of petroleum-based carrier, usually fuel oil. When applied, inverted emulsions form large droplets that do not drift easily.

Dry Formulations
Dry formulations tend to cake or become compacted when stored near high temperatures or humidity.

<u>Bait (B)</u>
A bait is a pesticide mixed with something, which the pest likes to eat. The amount of active ingredient in most baits is low usually less than 5%.

Dust (D)

A dust is a mixture of pesticide with a non hyposcopic carrier such talc, chalk or clay. It is applied by air blast. Dust generally has a low percentage of active ingredient (5-10)%.

Drift is a problem since dust can be easily blown or washed away from plant surfaces by wind or rain. This makes the time during which they are effective short. Dust tends to be less toxic when it comes into contact with the skin. However respiratory poisoning is a high risk if dust is inhaled. Dust should be used dry.

Granules (G)

A granule is made up of the active ingredient in the form of a liquid added to coarse particles or granules. The granules are either soaked in the active ingredient or become coated by it. They should be applied dry. Drift is not a problem. Granules should be applied directly to soil or over plants.

Pellets P

Most pellet formulations are similar to granular formulations except that the particles of the pellets are the same weight and shape.

Soluble Powder (SP)

Dry formulations, which can be added to water. The water acts as a solvent. The water and the soluble powder form a solution. The amount of active ingredient is usually high (15-95% usually over 50%). This does not have to be agitated periodically.

Wettable Powder (WP)

A mixture of a pesticide with a hygroscopic carrier such as clay. The percentage active ingredient is high (15-95% but usually 50% or more). When mixed with water, the powder soon begins to settle out or separate from the water. Thus this formulation must be stirred or agitated periodically. Wettable powders are safer than EC and if mixed properly will not clog nozzles.

Adjuvants

A chemical added to a pesticide formulation or tank mix to increase its effectiveness or safety. Some of the most common adjuvants are surfactants. Surfactants are surface acting ingredients that alter the dispersing, spreading, and wetting properties of spray droplets.

EXAMPLES:

- **Emulsifiers:** allow water to mix with the solvent
- **Sticker:** these increase the adhesion between pesticide and the treated surface eg Agral 90
- **Synergist:** work together with the pesticide and increase effectiveness eg Piperonyl butoxide
- **Penetrant:** allows the pesticide to get through the outer surface to the inside of the treated area.
- **Wetting agent:** allows wettable powders to mix with water.
- **Spreaders:** allows pesticides to form a uniform coating layer over the treated surface.
- **Defloculating agent:** these prevent the particles in solutions from clumping or settling down eg gum arabic

Smoke Generator

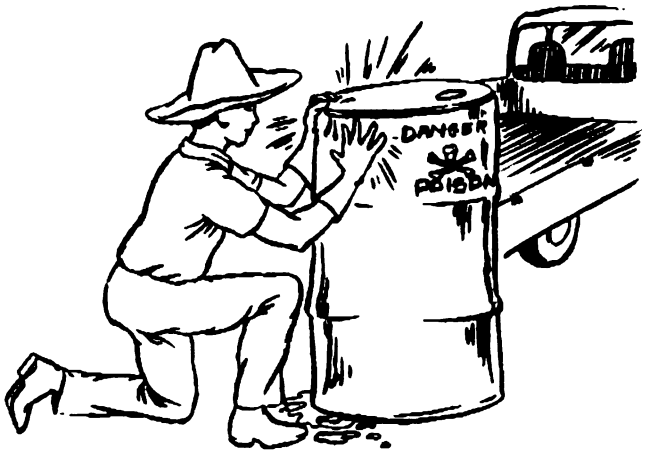
Used as space treatment for glasshouse crops and buildings. The active ingredient is mixed with a mixture that will ignite. The mosquito coil is a special form of smoke generator. The coils are made from an extruded ribbon of wood dust, starch and various other additives and colouring matter, often green, together with natural pyrethrins. It has been suggested that the sequence of effect of smoke from a coil on a mosquito entering a room is deterrgency, expellency, interference with host finding, bite inhibition, knock down and eventually death.

Microencapsulated Pesticides (M)

These are particles of pesticides liquid or dry formulations surrounded by a plastic coating. The formulated product is mixed with water and applied as a spray. Once applied the capsule slowly releases the pesticide. The encapsulation process can prolong the active life of the pesticide by providing a time release of the active ingredient.

7 Transportation of Pesticides

All pesticides should be considered as potential poisons. However, if handled carefully, many of the problems associated with their use can be avoided. The incidence of death and poisoning may be high because of the number of uninformed users, those who abuse pesticides and accidental misusers. It is important that all persons are fully aware of all the hazards associated with the movement of these toxic materials so that adequate precautions can be taken to minimise these risks.



Pesicide container being loaded onto a truck.

The movement of pesticides is associated with risks of leaks or spills from defective containers. All pesticide containers should be inspected for tightness of closure or seals and for any evidence of leakage before loading unto vehicles or movement from one place to another. Pesticides should not be transported together with passengers, animals, food, clothing and the like since these items can be contaminated by odours or spills. Also, loads should not be mixed, pesticides should be separated according to types and more importantly according to formulation.

Pesticide containers should be loaded in such a way that they are held in place securely without the possibility of damaging each other. When loading or unloading pesticide containers, equipment and tools used should be those which will not damage the containers. Hooks which may puncture or tear containers must not be used. At the same time, the carriage should be checked for protruding nails and metal strips which can damage containers. If these exist, they should be flattened or removed so that they do not pose a risk. All pesticide containers should be secured against movement when being transported.

All persons involved in loading, transporting and unloading of pesticides should be fully informed about the toxicity and hazard potential of the pesticide they are handling. These persons should be provided with information on how to deal with spills of the chemical they are carrying and whom to call for technical and medical information in case of emergency.

Heavy items should never be put on top of fragile containers and drivers should remember that they are carrying poisonous substances. They should drive carefully and avoid bumping and jerking.

All pesticides must be properly labelled and contained within the manufacturers original container. Containers which are not properly labelled or not labelled at all must never be accepted for transportation. Unlabelled materials tell nothing about the pesticide and this can cause delays in clean up procedures or when used with different pesticides can result in more dangerous materials than before.

All persons, especially supervisory persons, should be trained in first aid and rescue procedures. All necessary safety equipment should be available and readily accessible before handling pesticides. To prevent contamination, and depending on the toxicity of the materials there should be protective clothing for use. Smoking whilst loading or unloading pesticide material is forbidden.

8 Storage of Pesticides

Importance of Proper Storage

Whenever pesticides are stored near food in or near living space for people or animals, there is risk of making a deadly mistake. When pesticides are improperly stored there is the risk of damage to the environment. Leaky containers can spill pesticides. If lids are not put, the cans can release dangerous vapours into the air.

Pesicide storage.

Pesticides stored near a water supply can easily make the water poisonous killing fish and other animals that live in the water and harming animals and people who drink the water. Storing pesticides properly can make them last longer
(shelf life).

Proper storage procedures

Pesticides are poisons and should be treated as such. Proper storage is essential, not only to ensure a safe working environment, but also to assist in dealing with fires and spillage.

Some general principles are outlined:

• Storage sites should be away from other operations and in a location that should an accident occur, it will not result in contamination of water or areas that humans frequent.

• Storage areas should have concrete floors with smooth finish and drainage to sump or other holding area where contaminated water can be decontaminated before release. Earthen or wooden floors are not suitable because they cannot be adequately decontaminated.

• Storage areas should be dry and well ventilated.

• Pesticides must be stored in originally labelled containers with the labels plainly visible.

• Pesticides must not be stored near food, feed or other items which may become contaminated by spilled material, volatile pesticides, odours and the like.

• Do not permit smoking, eating or drinking in warehouses and storage areas.

• Appropriate fire-fighting and safety equipment of appropriate capacity and in adequate numbers and working condition should be available in the storage area.

• Storage areas of buildings should be clearly marked.

• Separate pesticides into product types (Insecticides, herbicides, fungicides etc) and allocate separate stacking areas for each type.

• Separate solid products from liquid products at least by segregated stacking.

• Storage building should be locked or other suitable steps be taken to prevent theft and to prevent unauthorized persons especially children, from entering.

• All operating personnel should be thoroughly familiarized with the use of fire-fighting and safety equipment not only in theory, but also by regular practice drills.

• Local police, fire department, public health and other concerned agencies should be familiarized with the pesticide storage area.

Trouble shooting

Potential storage problems are:

• Leaks,
• Fire
• Flooding

Leaks: check pesticide containers periodically to see if there are leaks or breaks. If a container is damaged transfer the contents to a container that has exactly the same pesticide. Clean up any spills immediately.

Fires: The risk of fires and explosions is very great with the storage of some pesticides. There are certain pesticides that have warnings on their labels.

EXAMPLES:

DANGER - EXTREMELY FLAMMABLE! KEEP AWAY FROM SPARKS AND HEATED SURFACES
OR

WARNING - FLAMMABLE! KEEP AWAY FROM HEAT AND OPEN FLAME.

OR
DO NOT USE OR STORE NEAR HEAT OR OPEN FLAME

OR
FLAMMABLE

These pesticides should not be exposed to over-heating or flame. Pesticide fires are hazardous since both fumes from the fire and the residue left after the fire are poisonous.

Once a fire begins, protective clothing should be worn and the following should be observed:
• Stay up wind of the fire

• Keep a safe distance from a fire in which pesticide containers are present since they may explode if they become over-heated.

• If the fire cannot be fought successfully from a position where air is suitable to breathe, people should move away and the property be allowed to burn. Sense of smell can serve as a warning here.

• Large, heavy hoses should be avoided since the force of their water streams can spread contamination.

•As much as possible, confine wastes for collecting and proper disposal. Run off water from a fire can contaminate streams.

• After the fire has been put out, the hot pesticide residues can give off dangerous vapours. No one should enter the area until these deposits of pesticides have cooled.

Floods: Stored pesticides create very serious problems if they are involved in floods. The flood water can become contaminated with pesticides, poisoning every thing and everyone with whom the flood water comes into contact.

Pesticides packaged in soaked paper or cardboard may be ruined and present problems of handling and disposal even after drying out. Even products stored in water-tight containers are not safe - they may float away, hit an obstacle and spill their contents. Store pesticides in an area where they can keep relatively dry during flooding.

If pesticides are involved in floods, follow these steps:

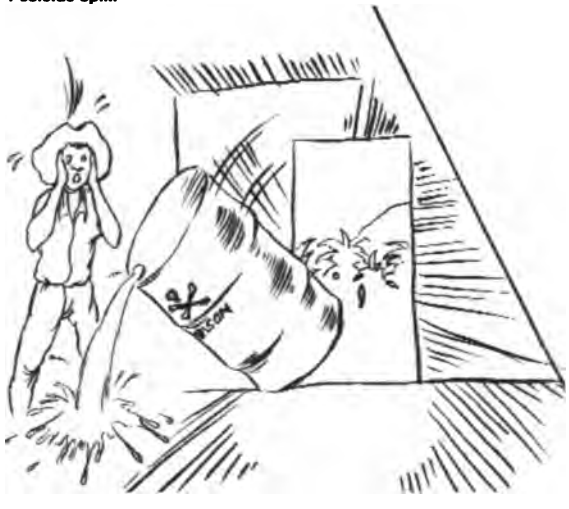
*keep an inventory of the pesticides stored; if any pesticide containers have been carried away from the storage site, try to locate them.

* If water has become contaminated, people or communities who have access to it should be notified.

9 Clean up of a Spill

The job of application is not over after the pesticide is bought, mixed and applied. Pesticide may be spilled during handling and some pesticide may be left in the container. The pesticide container in storage may break or crack resulting in a leak which must be cleaned. Equipment which appears to be in good working condition may suddenly begin to leak. The best way to deal with these kinds of accidents is to prevent them from occurring. Follow safety instructions and handle pesticides carefully. Also, to know what to do if the accident does occur, **READ THE LABEL.** Generally, instructions for disposal are given on the label.

Pesicide spill.



Wear Protective Clothing

If pesticide has spilled on someone. Stop working and remove affected clothing at once if the spill is on the clothing. Wash skin with soap and water. Get out of the area that the spill occurred in. Get medical attention.

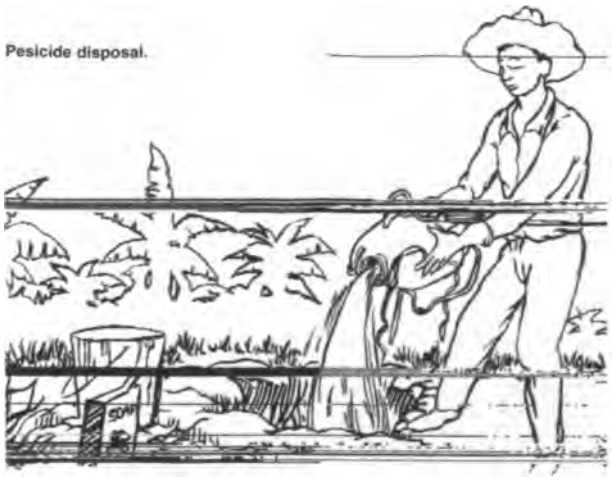
If a spill has occurred, first decide whether you can handle the situation by yourself. If not get help. Keep the spill from spreading. This can be done by sprinkling sand or soil around the edges. Block off the area to keep people away.

Use sand, lime, charcoal, soil or sawdust to soak up the wet spill. Pour the sand or soil into the spilled solution until it becomes thick enough so that it can be shovelled for disposal. DO NOT HOSE THE AREA WITH WATER.

The spilled pesticide at this point is dangerous because of its chemical action. This chemical action can be stopped by neutralization using lime or bleach. Then the dry lime or charcoal can be shovelled for disposal. Once the pesticide has been neutralized and picked up, the area should be watered down thoroughly. The rinse water should be collected and held for disposal if it will contaminate surrounding areas.

Dusts should not be swept with a broom or granules picked by hand. Cleaning of dust can be done by sprinkling over with sawdust to prevent it from becoming air borne when eased into a dustpan. Excess use of sawdust is preferable to risking inhalation of dust if enough saw dust is not used. A wet clean up may be conducted after the dry material is picked up for disposal.

Cleaning a spill of granules is less problematic but safety equipment should still be used. Addition of sawdust will help pick up most fine particles. Wet cleaning should follow the dry clean up.



Pesicide disposal.

10 Disposal

The pesticide disposal method used must be adapted to the facilities available and the prevailing conditions so as not to create problems of human exposure or environmental pollution.

One way to avoid disposal is to plan carefully. Buy and mix only what is needed. If extra pesticide has been mixed use it to spray another crop approved on the pesticide label. If it cannot be used, it has to be disposed of in another way.

When a surplus of pesticide cannot be avoided, it should be disposed of in the following ways:

- Return to the agent, if possible
- Dilute or weaken the surplus and spray small amounts in an area where it will do no harm. You can add the same quantity of lime to the left over tank mixture as there is pesticide in the mix of water and pesticide.

Disposal of Empty Containers

Empty pesticide containers should not be used to store food, feed or seed. If possible, they should be returned to the agent.

There are several ways to dispose of empty containers. The right one depends on the kind of container and the kind of pesticide it has stored. Do not reuse pesticide containers.

Pesticide containers may be divided into three types.

Containers that will burn - these are usually made of wood, cardboard or paper. Rinse the container several times with water or oil whichever is the most convenient solvent for the pesticide formulation.

Containers that will not burn - these are usually made of glass, plastic or metal. If the manufacturer will not take them back, crush or break them so that they will be smaller and easier to store. Metal can be crushed, glass can be broken and plastic can be cut apart. Crushed containers can be disposed of by burying away from water ways and living things.

Containers that have been used to store mercury, lead or other inorganic pesticides, should never be burnt. Disposal can be by encapsulation. This means that the containers may be stored in a sealed water proof container so that the contents cannot escape.

11 Pesticides and the Environment

The environment consists of the air, soil, water, plants, animals, houses and all that they contain. Pesticides can harm all types of environments if they are not used correctly. When contamination occurs the source may not be identifiable.

What Happens to Applied Pesticides

When pesticides are applied, some reach the target area and remain there for some time. However, those that do not fall on the target are quickly absorbed into the environment.

One problem that persons frequently face when applying pesticides is that of drift. Drift is what happens when pesticide spray droplets or dust particles are picked up by air currents and carried through the air away from the target area to other places. When drift occurs, the pesticides may never reach the crop area but is carried away to an area not intended to be sprayed. The pesticides, that is left on the surface of the target area right after application is called the deposit. The deposit may breakdown in the environment by heat, light, moisture and living things in the soil, causing the pesticides to be quickly absorbed by air, ground or nearby sources of water.

Absorption into the surrounding atmosphere may occur after vaporization as the pesticide changes into the vapour or gaseous form. Absorption may also take place after decomposition when the pesticide is broken down or decomposed. Additionally, the pesticide deposit is washed off the target area.

When a pesticide deposit remains on the surface of the crop area for a period of time, it is called a residue. Drift, vaporization, decomposition and runoff work to quickly destroy the pesticide deposit and there is little or no residue. However, some deposits resist breakdown. They leave a long lasting residue on or in the crop or in the environment. A long lasting residue means that the pesticide will not have to be applied frequently. However, a long lasting residue may seriously affect the environment.

The longer the residue lingers on the crop, the greater the chance for contact with the poison.

Residues affect water, soil and air. Run off, spills or drift into rivers, lakes and streams can kill fish and make the water unsafe to drink or even wash in. Large doses of pesticides that remain in the soil for a long time can ruin the soil. Crops may absorb the pesticide from the soil and be poisonous to eat once they are harvested. Pesticides in the soil can kill plant life and make land useless for farming. Pesticide particles carried in the air during drift and the pesticide gases that mix with the air during vaporization can make air unsafe and dangerous to breathe. Pesticides once in the air cannot be controlled and they may be carried away to settle into water sources and living areas. Pesticides can be poisonous to wildlife.

Careless use of pesticides can destroy natural enemies of a pest resulting in an upset in the balance of pest natural enemy populations. When pesticides are misused, pests are actually helped since the pesticides may destroy the organisms that naturally control the pest numbers.

Organisms useful to man may be injured by contact with pesticide residues. Pesticide contact may be either directly or indirectly in food or drink. Organisms must eat to live and some organisms eat other organisms. The dependency of one organism on other organisms for food is called the food chain. Organisms that eat plants (herbivores), are at the bottom of the chain. Organisms, which eat plant eaters, primary predators, form the next level on the chain. The organisms, which eat the meat of the other organisms, secondary predators, are at the top of the chain. Each organism is important in the chain. If any link was missing from the chain, it would be broken and disruption would result.

Levels of some pesticides can build up in the body of an organism and therefore accumulate in the food chain. Organisms at the lower level of the chain may eat pesticide residues, which do not affect them.

These organisms in turn maybe eaten by the organisms at higher levels of the chain. The meat eaters feeding on other organisms with built up pesticides may be feeding on high doses of poison. In this way, the meat eaters may be poisoned without ever coming into direct contact with the pesticide.

What We Can Do

Firstly, it is important to obtain information about the pesticide to be used since all pesticides are not alike. It is important to know how the pesticide will react in the environment when it is applied. Choose the pesticide which is the least hazardous to people and animals. **READ THE LABEL.** Then consider what can happen to the pesticide once applied.

CONSIDER:

Drift:

Wind can increase the ability of the air to carry pesticide spray droplets or dust particles. Drift can be reduced by spraying on a less windy day or less windy part of the day. The size of the nozzle orifice used can affect the amount of drift that occurs. A larger nozzle orifice will produce larger and heavier droplets that are not easily carried by the wind. Like wise if there is too much pressure in the spray tank the droplets will be very fine and easily carried by the wind.

Deposits and residues:

For protection from deposits and residues:

- pay attention to re-entry periods recommended on the label. The label should tell the number of days that must be allowed to pass before workers can safely re-enter the crop area. A 24-hour period should be considered as a minimum re-entry period. Even when the pesticide residue is no longer dangerous to workers who come in contact with it, enough of the deposit may stay on the plant to be dangerous if eaten. Many times, residues remain on food or feed crops at harvest time.

The maximum amount of pesticide residue that can remain on a harvested crop is called tolerance. Tolerance is measured by the weight of the residue compared to the weight of the crop. For example, the tolerance for a particular pesticide may be one part per million (1 ppm). This means that the safe tolerance level is one part of the pesticide to one million parts of crop. Tolerance is different for different crops.

Crops with a negligible residue are safe to eat. If the residue is greater than the given tolerance, the crop should not be eaten or marketed.

12 Pesticides and their effect on people

Pesticides are useful because they kill the pests that damage the crops. However, just as pesticides kill pests they can also kill people. Fortunately, people usually can avoid harmful effects by avoiding exposure to pesticides.

Although all pesticides will kill people, some pesticides are more dangerous than others.

Pesticides that are chemically similar to one another cause the same type of harmful effects to people. These effects may be mild or severe depending on the pesticide involved and the amount of exposure. The pattern of illness or injury caused by each chemical group is usually the same.

Some pesticides are very toxic to people and only a few drops can cause extreme harmful effects. Other pesticides are less toxic but long exposure to them will cause harmful effects also.

Hazard = Toxicity x Exposure
Hazard is the risk of harmful effects from pesticides.

Scientists have a way to rate pesticides according to how poisonous or toxic they are. Scientists apply the pesticides to test animals (usually rats or rabbits). The chemical is applied to the skin, fed to or breathed by

the animal. Scientists then determine the amount of the pesticide that is needed to kill one-half or (50%) of the animals tested. This amount is called the lethal dose to 50% or LD50 and lethal concentration to 50% , or LC50 if the pesticide is breathed in by the animal. The LD50 or LC50 is lower for pesticides that are more poisonous because it takes less of the pesticide to kill the animals. Therefore, the lower the LD50 value or number, the more toxic or poisonous is the pesticide. The hazard or danger in a pesticide depends on its toxicity, the type of formulation, percentage of active ingredient and how long a person is exposed to the pesticide.

The World Health Organisation (WHO) classifies pesticides into Ia, Ib, II, III depending on their hazard level, Ia being the most dangerous and III being the least dangerous.

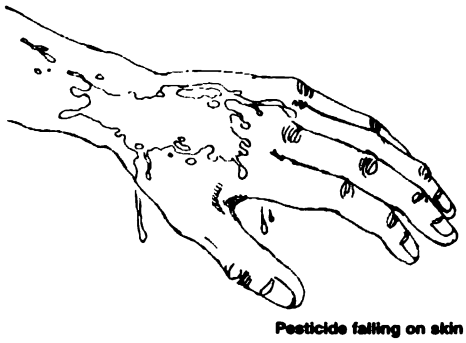
Table ...1.. rates LD50's according to how dangerous they are to man. WHO Hazard Classification.

able _1_ WHO Recommended :lassification By Hazard

Class	Toxic Level	Toxicity			
		Oral		Dermal	
		Solid* LD50	Liquid* LD50	Solid* LD50	Liquid* LD50
Ia	Extremely hazardous	5 or less	20 or less	10 or less	40 or less
Ib	Highly hazardous	5-50	20-200	10-100	40-400
II	Moderately hazardous	50-500	200-2000	100-1000	400-4000
III	Slightly hazardous	500-2000	2000-3000	>1000	>4000
roducts unlikely present hazard normal use		>2000	>3000		

;olids and liquids refer to the physical state of ıe product or formulation being classified.

;ource - Guidelines on Good Labelling 'ractices for Pesticides - FAO.



Pesticide falling on skin

How Poisoning Occurs

There are four ways in which pesticides can enter the body and make one sick:

1 through the skin (dermal)
2 through the mouth (oral)
3 through the nose
4 through the eyes

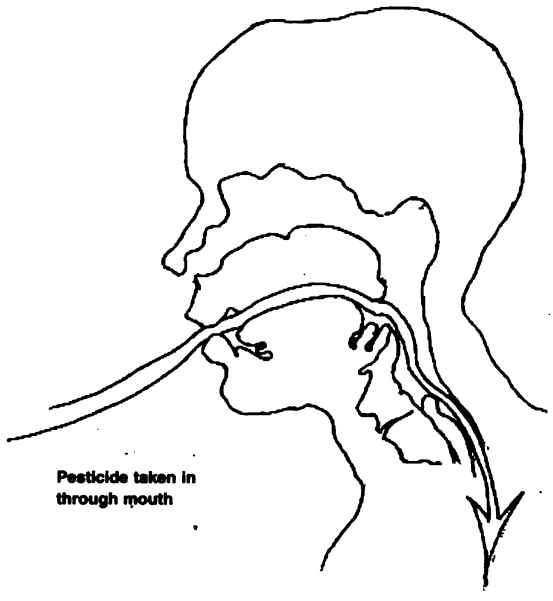
Through the skin

This is the most common way for pesticides to enter the body. A pesticide may be splashed or spilled on the skin during mixing, loading or disposal. Certain parts of the body are more easily damaged by the pesticide when it touches the skin. These parts let poison in at a faster rate and are considered to have a high degree of absorption. Example scrotum, ear canal and forehead.

Through the mouth

Persons who want to kill themselves sometimes swallow pesticides. However, pesticides can also be swallowed by accident. Many times a pesticide is taken out of its labelled container and put into another bottle or container. People may forget and drink the pesticide thinking it is water, coke or liquor.

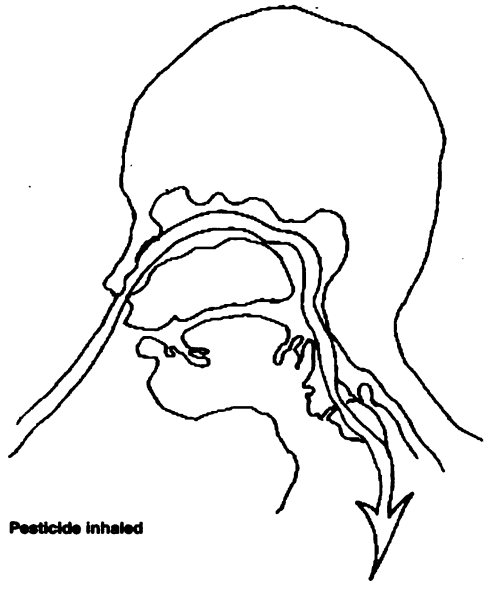
Pesticides can also enter the mouth when a worker eats, drinks or smokes during pesticide application or after he has handled pesticides.



Pesticide taken in through mouth

Through the nose

Persons can be poisoned if they breathe pesticide vapour or dust, or when pesticide enters the body through the nose. Breathing pesticides can damage the nose, throat and lungs. When workers do not use proper safety equipment they may breathe the pesticides. Working with pesticides in poorly ventilated areas inside buildings also increases this type of exposure.



Pesticide inhaled

Through the eyes

A fourth way that a person can be poisoned by pesticide is when the pesticide enters the eyes. Pesticides that enter the eyes can make a person sick or cause blindness or death. Workers can easily get pesticide in the eyes if they do not cover or protect their eyes during handling operations. If a person rubs the eyes with the contaminated hands, there is a high risk of pesticide poisoning.

Signs and Symptoms

There are two types of indications to a pesticide poisoning.

1 symptoms

2 signs

Symptoms

are feelings that only the person who has been poisoned can notice - eg. stomach ache or head ache.

Signs

can also be noticed by someone else eg. fainting or vomiting.

A person may be poisoned after just one contact with the pesticide. This is called **acute poisoning**. However, a person can be poisoned if exposed to small

amounts of the pesticide continuously. These small amounts are not harmful at first but they add up in the body's system and cause sickness. This is called **chronic poisoning**.

Every pesticide user should know what kinds of sickness are caused by each kind of pesticide used. All pesticides in the same chemical group cause the same signs and symptoms. Pesticides in different chemical groups cause different signs and symptoms.

The sickness may be mild or severe, depending on the pesticide and the amount absorbed.

Some of the chemical groups that are commonly used:

- organochlorines
- organophosphates
- carbamates
- synthetic pyrethroids
- bipyridyls

Organochlorines

tend to build up in the fatty tissues of the body over a long period of time. They are commonly chronic poisons eg:

- **Chlordane**
- **Toxaphene**
- **BHC**
- **Kelthane**
- **DDT**

Early Signs and Symptoms

Symptoms	**Signs**
general discomfort	nausea
headache	vomiting
dizziness	

Later the victim may suffer:

- breathing problems
- convulsions and trembling
- coma

Organophosphates and carbamates are commonly involved in acute poisoning cases. They are fast acting and are considered more dangerous than the organo-chlorine.

Examples:

Organo-phosphate	Carbamate
Malathion	Vydate
Metasystox	Furadan
Primicid	Pirimor
Nemacur	Sevin
Diazinon	Lannate
Vapona	

Because of the different effects organophosphates have on the body, different signs and symptoms are produced by these pesticides. Poisoning by carbamates is similar to organophosphates but tends to be quicker and of a shorter duration.

EARLY STAGES

Symptoms	**Signs**
headaches	sweating
dizziness	salivation
fatigue	nausea and vomiting
blurred vision	diarrhoea
stomach cramps	

and then:

- weakness
- inability to walk
- chest discomfort
- muscle twitches
- very small, non-reactive pupils

LATER STAGE

unconsciousness
secretions from mouth and nose
breathing difficulty
pinpoint pupils
dead if not treated

Synthetic pyrethroids

are fast acting and have relatively low mammalian toxicity.

Examples:

Permethrin
Decis
Karate
Danatol

Signs and symptoms of synthetic pyrethoids

Symptoms	Signs
Irritation of mouth lining	stuff, runny nose
Convulsive seizures	salivation
Facial burning sensation	

Bipyridyls

Examples -

Gramoxone
Reglone
Diquat
Herbiquat

Signs and Symptoms

Symptoms	Signs
Abdominal pain	nausea and vomiting
	diarrhoea (often bloody)
	kidney and liver damage
	mouth and throat ulceration

Poison on skin

13 First Aid

The aim of first aid is to relieve the patient until medical help is available. General steps to take for all kinds of pesticide poisoning.

1 Stop contact with the poison immediately. Move the victim away from the pesticide. Wash it off the skin, and out of the eyes.

2 Notify a doctor, hospital or clinic at once.

3 Read the label of the pesticide involved, it should indicate the practical treatment.

4 Save the pesticide container and any material left. Take it to the doctor or clinic. If the poison is not known, save a sample of the material vomit and take it to the doctor.

Poison to skin

Wash off immediately preferably with soap
Remove contaminated clothing
Wash hair and finger nails

Poison in the mouth

1 Rinse the victim's mouth with water and have the victim spit it out. Read the pesticides label to find out if vomiting should be induced.

2 DO NOT TRY TO MAKE THE VICTIM VOMIT IF:

- **a** unconscious or,
- **b** in convulsions, or
- **c** has swallowed petroleum products (kerosene or gasoline) or
- **d** when the pesticide swallowed, causes pain and burning sensations in the mouth and throat
- **e** if an acid or alkaline product has been swallowed. Give the victim milk or water.

3 INDUCE VOMITING IF THE VICTIM

- **a** is conscious or,
- **b** is not in convulsions and
- **c** has not swallowed petroleum products (kerosene or gasoline) and
- **d** the pesticide swallowed, does not cause pain and burning sensations in the mouth and throat and
- **e** the product swallowed is not strong acid or alkaline

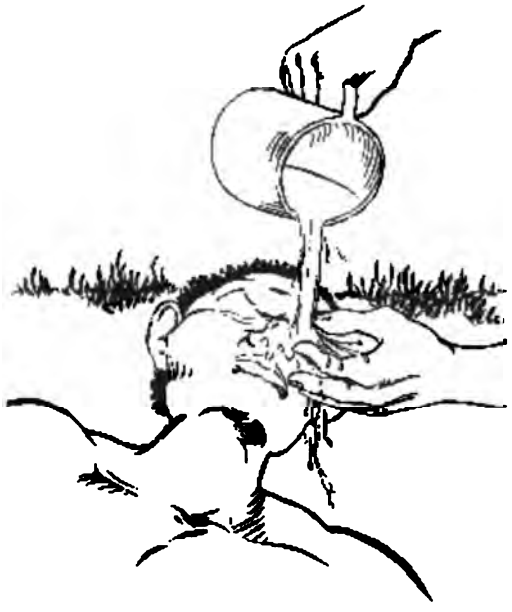
Give the patient milk or water to drink. Induce vomiting, by placing a finger at the back of the victim's throat. The patient should be placed face down with the head lowered to prevent vomit from entering the lungs. Collect some of the vomit to take to the doctor.

Through the nose and mouth

- Remove the victim from the source of the pesticide
- the rescuer should wear proper respiratory equipment
- victims who have breathed pesticides should be treated as follows:

1 the victim should be placed in an open area with fresh air

2 any tight clothing worn by the victim should be loosened



3 the victim should be wrapped in blankets to prevent chilling but not to the point of causing over-heating
4 the victim should lie down and be kept quiet. The neck should be extended with chin up to keep airways open for breathing. Do not give alcohol.
Call the doctor.

Poison in the eyes
If the person is poisoned in the eyes
1 Hold the eyelids open. Wash eyes immediately with a gentle stream of running water for at least 15 minutes. Do not add anything to the eyes or water.
2 Take victim for medical treatment.

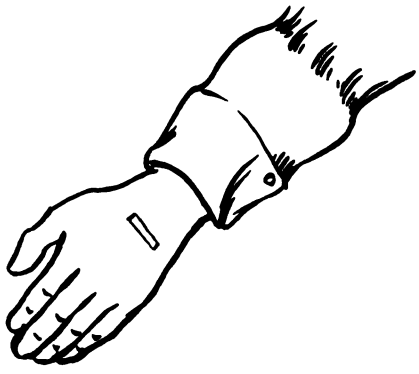
14 Worker Safety

Importance of Safety During Mixing and Application
Mixers and those applying pesticides are two groups of people at special risk of pesticide poisoning. During both mixing and application, direct contact with pesticides often occurs. It is at these times that the pesticide or poison is handled in its most concentrated and dangerous form. This is before it has been mixed with water or other materials to dilute or weaken its strength. A pesticide is so strong that it can poison a worker instantly if he breathes it into his lungs or accidentally spills it on his skin (acute poisoning).

Poisoning can happen slowly over a period of time. Anyone who handles a pesticide or is around it for a long time gradually collects the poison inside the body when the pesticide is breathed in or is touched. The amount of pesticide in the body slowly increases over time until it adds together to make a large amount of poison (chronic poisoning). A pesticide worker or any one near a pesticide for long periods of time is very likely to suffer this kind of poisoning.

Clothing and Safety Equipment

The most common cause of pesticide poisoning for mixers and persons applying is through the skin. This though is the easiest form of contact to prevent. With the right clothing and some simple articles of safety equipment, a worker can protect himself against the high risk
of poisoning.



Protection of feet and legs (dermal):

Coveralls or pants legs should be worn outside boots. Boots should be of rubber and unlined.

Protection of hands and arms (dermal):

Rubber gloves should be worn. Gloves made of cloth or leather should never be worn. Check gloves for holes by filling with water and gently squeezing. Wear long sleeved shirt or long sleeved coverall. Sleeves should be worn outside gloves.

A large sheet of plastic will protect the mixer against splatters and spills.

Protection of nose and throat (ingestion and inhalation):

The nose and throat should be protected with a respiratory device.

a cartridge respirator covers the mouth and nose and filters air that comes through it to remove poisonous vapours

b supplied air respirator has clean air pumped through a hose to the face mask. The worker breathes this air instead of the poisoned chemical vapour

c self-contained breathing apparatus supplies clean air from a cylinder carried on the back

The respirator should fit properly and should be worn tightly enough to form a seal all around the face but not so tightly that it hurts.

Protection of the eyes (dermal):

Tight fitting goggles with a rubber strap.

Protection of neck, head, and face (dermal):

A washable rubber or plastic hat with wide brims. Avoid cloth and straw hats since they can absorb the pesticide.

Before Starting

When mixing stay away from the pesticide:
Keep the pesticide below eye level to avoid contact with eyes

- Always mix outdoors where excess fumes can escape out and away from the mixer.

- Use a long utensil rather than a short one that will cause the mixer's hands to be close to the mixture.

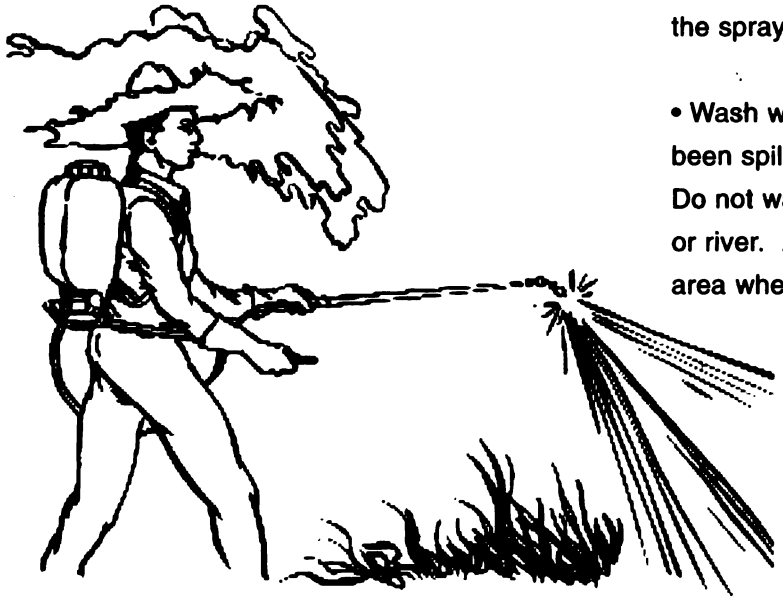
- When applying pesticides, avoid drift of spray in the wind or run off of pesticide from plants being treated.

- Do not wipe hands on clothing, if pesticide has been spilled on the gloves.

- Do not use the mouth to clear clogged hoses or nozzles.

- Never smoke, eat or drink when handling pesticides or even when pesticides are near.

- After application do not return to the field too soon. Pay attention to re-entry guidelines on the pesticide label. If none appear on the label, do not re-enter into the sprayed area before at least 24 hours.



- Wash work clothes especially if the pesticide has been spilled. Washing should be done in a special tub. Do not wash in natural water sources such as a stream or river. All wash water should be disposed of in an area where it will not run directly into waterways.

• Bathe after working with pesticides ensuring that the hair and under finger nails are scrubbed.

• After using spraying equipment clean them thoroughly with fresh water. Check for leaks, breaks and malfunctions.

15 Ethics and Pesticide use

It may be effective but is it right. The question of right and wrong introduces the topic of ethics in our approach to handling and use of pesticides. Would I be exploiting others, treating them fairly or otherwise affecting them without their free and informed consent? Would I be harming someone to whom I have a general or specific obligation as a professional or as a human being? Should I be preventing harm, removing harm or even providing positive benefits to others? These are some questions that should be posed as we attempt to deal with the ethics and responsibilities of pesticide use.

Responsibility of the International Organizations

All pesticides are poisonous but their toxic nature varies not only as a result of their composition but also as a result of the amount that is required to bring about the required control.

With the increase in the movement of these chemicals around the world concerns were raised about the dangers of these hazardous chemicals which led to the development of the International Code of Conduct on the Distribution and Use of Pesticides. Later, a procedure known as Prior Informed Consent (PIC) was included to assist in the control of unwanted chemicals.

The responsibilities of International Organizations therefore are:

• To encourage responsible and generally accepted trade practices.

• Assist countries which do not have the capability, to pass legislation that will control and regulate the quality and suitability of pesticide products needed and to promote practices which encourage the safe and efficient use of pesticide, including minimizing adverse effects on humans and the environment. (FAO Code of Conduct 1985).

Responsibility of Governments

The primary objective of Governments is to plan, direct and implement policies. In doing so, they must have control over importation, production, formulation, transport and use of chemicals in their countries.

As such Governments must:

• Ensure that pesticides are used effectively for the improvement of agricultural production and of human and animal health.

• Ensure that export and import of pesticides follow the set international standards.

•Take action in coordinating efforts to disseminate educational material to pesticide users, farmers, and other interested persons.

• Put in place programs to develop and promote integrated pest management systems and the use of safe, efficient, cost effective methods for the application of pesticides offered for sale, the quantity of the active ingredient and the suitability of their formulation.

• Have pesticide legislation and registration programmes.

• Review from time to time, the pesticides to be marketed in their country, their acceptable uses and their availability to the public.

• Implement programs that will have extension and advisory services, as well as farmers organizations, adequately informed about the range of pesticide products available for use in the area.

• Implement measures to protect the health and safety of technicians, operators, consumers and the environment.

• Pass legislation on the control and the availability of pesticides.

• Provide facilities and training for persons involved in the sale of any pesticide to ensure that they are capable of providing the buyer with advice on safe and efficient use of the product.

Responsibilities of the Manufacturers

The decision by a company to undertake production of a pesticide means that the company shall have to make substantial investments in human and financial resources with the possibility of failing. In the conduct of this research certain criteria must be considered that the product when applied will reduce pest populations and increase output, that it must be acceptable in the marketplace and as such there must be a return on the investment. In attempting to achieve these desired goals, the responsibility of manufacturers should be to:

• Produce pesticides which poses minimum risk to the health of individuals, fauna and the environment.

• Have pesticides containers clearly labelled.

• Ensure that packaging, storage and disposal of pesticides conform with international guidelines.

• Ensure that the product is effective, ie giving users adequate return on their investment.

• Provide programs, guidelines and training materials for all users of the products.

Responsibility of the Certified Pest Control Operator

A Certified Pest Control Operator means any individual who is certified to use or supervise the user of pesticides. These can be farmers, household pest controllers, public's health pest control operators, and forest pest control operators.

After training operators should be able to:
Recognize the most important pests (insects, mites, fungi and weeds).

• Have a general idea on the more adequate methods for controlling these pests.

• Read the labels of pesticide products and understand them, their hazards and restrictions.

• Know where to get information on the most appropriate pesticides for the most common pests in the country.

• Correctly apply pesticides, preventing acute poisoning of the person applying and bystanders.

• Know how to give first aid in case of poisoning by pesticides.

• Correctly handle and service different types of pesticides spraying equipment, extending their period of usefulness.

• Calibrate different types of spray cans to obtain the most effective and efficient coverage.

• Keep appropriate records of pesticide use.

16 Common Spray Equipment

Selection

In selecting spray equipment for the application of a pesticide the following characteristics should be considered:-

Design

A well designed sprayer should have a large tank outlet to facilitate easy cleaning and filling. The control should be readily accessible. The sprayer should be light and should be able to stand up-right for ease of loading, cleaning and storage.

There should be proper padding and contouring to minimise operator fatigue. Strap length should be adjustable. Additionally, consider the following:

• Type of pesticide formulation to be used liquid, granules or dust

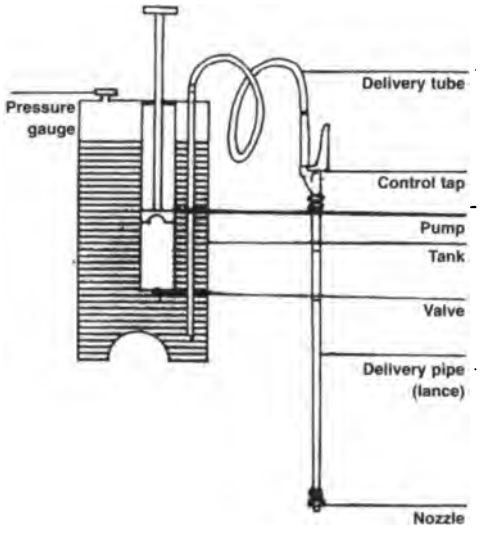
• What will the pesticide be applied to - large or small plants

• Cost of equipment - the availability of spare parts, ease of maintenance, durability and after sales service
• Cost of operation
• Time required to treat an area
• Characteristics of the area to be sprayed - flat, sloping, rocky etc
• Size of area to be treated - large or small
• Availability and cost of labour considering time taken to treat area, ease of use, size of area to cover
• Availability of diluent

Parts of a sprayer

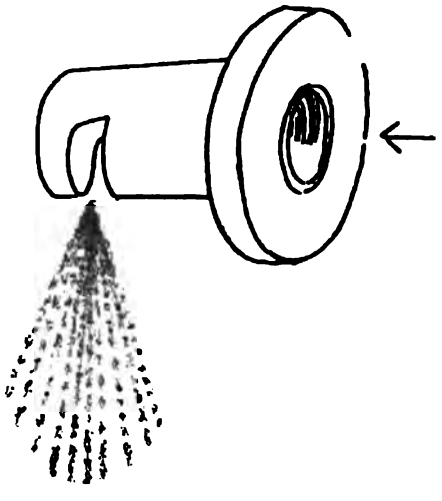
• Nozzle (metering device)
• Pump (means of applying pressure)
• Delivery pipe and control tap
• Reservoir (tank)

Sprayer



Nozzle

The nozzle is the most important part of the sprayer. It is a device through which liquid flows, broken up into droplets and forms a spray pattern. It meters the quantity of material to be sprayed. The flow rate of the liquid increases as abrasion and erosion increases the size of the orifice. Energy is required to break up the liquid passing through the nozzle into droplets and therefore nozzles are classified according to the energy used.



Energy hydraulic nozzle

The types of nozzle are:

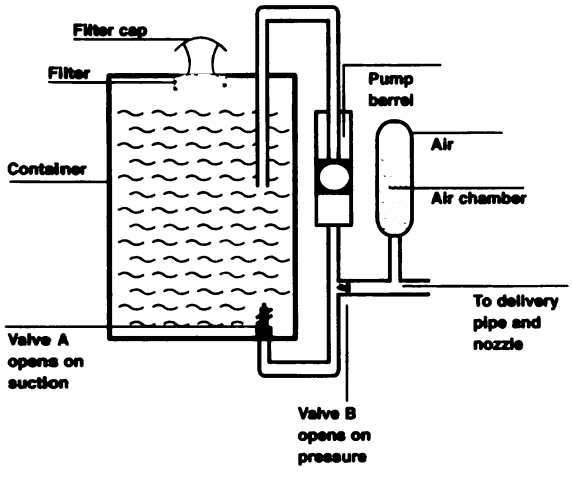
a hydraulic;
b gaseous;
c centrifugal;
d kinetic
e thermal.

Nozzles are made of different types of materials. The most common are plastic and brass.

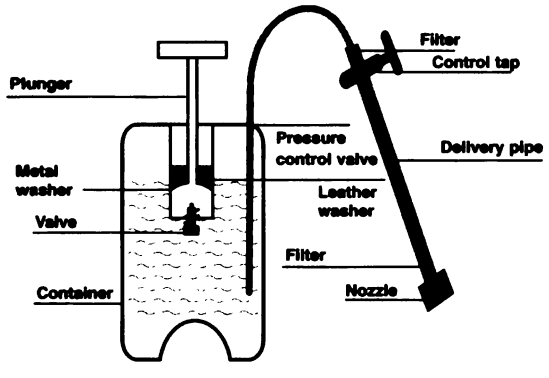
Sprayer with Hydraulic Pumps

Liquid is forced through a fine hole (orifice) in the nozzle and comes out in tiny droplets. The pressure is created by the operator working a lever up and down. The sprayer can be worked either by piston or diaphragm pumps.

Continuos pumping sprayer Diagram a



Compression sprayer Diagram b.



Piston:
creates high pressure and a mist of very fine droplets. Pistons are vulnerable to grit and abrasion. They are more suitable for application of insecticides and fungicides.

Diaphragm:
creates medium pressure and larger droplets. It is preferred when suspensions which are liable to erosion are being applied.

How the sprayer works

Lever Operated - Continuous pumping
Tank is carried on the back with pumping lever connected on the side.

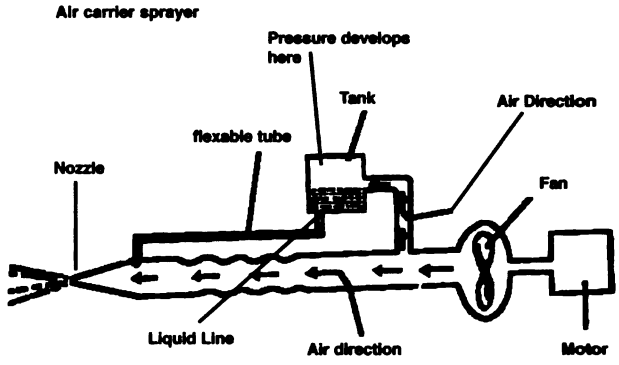
The pump is connected by a system of linkage to a lever which is pivoted at some point on the tank. With the upstroke of the lever, valve A (Diagram ..a..) opens and liquid is drawn into the pump chamber or barrel. Valve B is closed. With the downstroke of the lever to the original position, valve B (Diagram ..a..) then opens and liquid in the pump chamber is forced through Valve B into a pressure chamber and delivery tube to the nozzle. Valve A between the pump and the tank is closed during this return stroke of the lever to prevent the return to the tank.

Air is trapped in the pressure chamber and is compressed as liquid is forced into the chamber. The compressed air expands and forces liquid from the pressure chamber through the delivery tube to the nozzle. Valve B between the pump and the pressure chamber is closed during this operation to prevent the return of liquid to the pump. A cup wash or ring gives a good seal between the pump piston and the cylinder.

Compression or Pneumatic Sprayers
These sprayers (Diagram ..b..) have an air pump to pressurize the spray tank. The tank should never be completely filled with liquid. A space is needed above the liquid so that air can be pumped into the tank, thereby creating pressure to maintain the flow of liquid

to the nozzle. If no agitation is provided, these sprayers need to be shaken occasionally, particularly when using wettable powder formulations to prevent the suspension settling out.

The sprayer has a large tank (reservoir) opening to facilitate filing and cleaning. Sometimes, the pump is screwed in as part of the lid of a tank. There is a pressure gauge at the end of the tank so that the operator knows what pressure is in the tank. A delivery tube outlet is usually placed at the base of the tank or may be attached to a dip tube which is fitted inside the tank.



The valve on the pump opens on the downward stroke of the pump and closes on the upward stroke. Air is pumped into the container until there is compressed air above the liquid. Liquid is forced through the delivery tube to the nozzle when the control valve is opened.

Air Carrier Sprayers

Air carrier sprayers provide an air-stream in which droplets are projected towards the target. The airstream is used to break up liquid into droplets. These are used to apply the same quantity of pesticide in one-tenth of the volume normally applied with hydraulic sprayer. The main feature of an air carrier sprayer is the fan unit which provides the air stream. The fan is usually driven by a two stroke engine.

Using Knap-Sack Mistblower

The correct petrol / oil mixture is poured into the petrol tank through a wiremesh filter and the tank lid replaced tightly. Any ON/OFF switch on the engine is turned on, the petrol tap opened and the carburettor allowed to fill with fuel. The choke is moved to the 'closed' position and with the throttle closed, the engine is started by pulling sharply but evenly on the recoil starter. The starter rope should be allowed to rewind slowly and not released to snap back. When the engine starts, the choke can be moved to the 'open' position and the throttle opened up to allow the engine speed to

increase to maximum revs. While spraying, the engine should be run at full throttle and not allowed to idle for long periods. When the engine is running smoothly, the sprayer is put on the operators back. This can be accomplished by the operator holding the harness with crossed hands and swinging the sprayer up on his back.

The nozzle should be directed downwind so that natural air movement assist dispersal of the droplets away from the operator. The operator should walk at an even pace through the crop and close the spray liquid tap whenever he stops, to avoid overdosing part of the crop.

Maintenance of Sprayer

Nozzle

Use a filter at the inlet of the spray tank and before each nozzle.

• The filter mesh at the nozzle should be smaller than the orifice diameter.

• No spray mix should be left in the tank, hose or nozzle after spraying as settling out of the pesticides is liable to cause blockage.

• Sprayers must be washed thoroughly at the end of each days spraying.

• When the water based sprays have been used, several washes using a small volume are better than merely filling the spray tank once with clean water.

• All filters on the sprayer should be removed, cleaned and replaced.

• If possible, use separate equipment for applying herbicides such as 24D since these can affect other crops when different pesticides are being used. Alternatively, decontaminate spray equipment thoroughly and replace the hose.

• If the nozzle blocks in the field, the nozzle tip and filter should be cleaned with water, air pressure or a soft object. Never use a hard object such as a pin or nail or blow with the mouth.
• If there are several blockages then the whole system should be checked and cleaned.

Pump

The seal can be damaged by particles suspended in the spray liquid, it should be checked regularly.

Leather seals dry out and shrink if a sprayer is not used so they should be kept supple with vegetable oil.
Some synthetic materials are affected by the solvents in pesticide formulations. If swelling occurs, the pump may become stiff and difficult to operate.
Poor pump performance may be due to faulty valves. Ball valves and their seating can be pitted or coated with sediment, debris or pesticides, and synthetic materials used in diaphragm valves may swell and fail to seal and open properly.

Leaks

Leaks can cause loss of pesticides and contamination of operator. These problems can be minimized by being aware of the following:

• O-ring washers and other types of seals are liable to wear or be damaged when hose connection, trigger valves and other components are unscrewed.

• Seals around tank lid in the pump assembly can be damaged whenever the connection is broken.

• Some connections, eg. nozzle caps, may not have a washer and rely on direct contact of smooth surfaces to seal.

• Any dirt on the nozzle cap or damage to the threads may prevent a proper seal.

• Small air leaks from the lid or other fittings to the tank can be detected by smearing a soap solution over the joint.

Problems with the Engine

To minimise problems with the engine, follow these tips:

• Ensure the correct type of oil is used and that the fuel is properly mixed.

• After spraying, turn off the fuel tap and allow the engine to continue running until it is starved of fuel. Preferably, the fuel tank should also be drained to avoid the ratio of oil to petrol increasing.

• After use, drain the fuel to avoid gumming up of the engine with oil when the petrol evaporates.

• The plastic fuel line from the tank to the carburettor should be inspected regularly and replaced if necessary to avoid fuel leaking on to a hot engine and causing a fire.

• The spark plug should be inspected regularly. The plugs should be replaced after 20 hours as a routine.

• The air filter should be examined at the end of each days spraying and cleaned, as a routine, according to the manufacturers recommendations.

Storage

After each days work:

• Check the equipment completely and store in a dry place.

• Store all sprayers away from children, food and animals and measures should be taken to prevent rats from chewing hoses and other parts.

• Small hydraulic sprayers are preferably stored upside down with the lid removed to allow complete drainage of the container.

• If engine is to be stored without use for a long period of time, the spark plug should be removed and, some oil poured into the crank case and engine turned over several times to spread the oil.

17 Calibration

Calibration is the determination of the amount of pesticide to be applied when the equipment is operated under a given set of conditions. With this information, the data supplied for the particular pesticide and crop to be sprayed, the correct amount of pesticide to spray can be determined. Calibration should be carried out under the same conditions as actually occurring during application. There are three basic considerations to be determined - forward speed, nozzle selection and operating pressure with swath width.

Steps: involved in calibration

For herbicides

- Measure and mark off a convenient distance, say 200 ft.

- Put some water in the tank, pressurize and spray through the nozzle to fill the delivery system.

- Pour off excess water in the tank.

- Pour a known volume of water in the tank.

- Walk the designate distance (200 ft) at the normal spraying speed with the sprayer operating at the same pressure normally used. Then measure the volume of water sprayed out. For example, 2000 ml of water.

- Measure the swath width, say 3 ft.

- Using our example of 2000 ml of water, 3 ft swath width and the distance of 200 ft the application rate can be determined as follows:

$$\frac{2000 \text{ ml}}{200 \text{ ft} \times 3 \text{ ft}} \quad \text{or} \quad \frac{2000}{600 \text{ sq ft}} = 3.33$$

Application rate for one acre (43560 square ft) is therefore

3.33 x 43560 = 145200 cc or 32 gal. Imp/acre

For insecticide fungicides on plants
Put some water in the tank, pressurize and spray through the nozzle to fill the delivery system.

• Pour off excess water in the tank.

• Spray one plant out of the plants to be sprayed and measure the volume of water sprayed out. For example 200 ml water.

• Based on the number of plants present or the number per acre calculated from the spacings, the insecticide or fungicides requirements can be determined as follows:
• 200 ml of water were sprayed onto one plant
If there are 600 plants/acre. The 600 x 200 =
120000 ml or 26.2, imp gal of liquid required

18 Pesticide Legislation

The term legislation includes the statues enacted by the national legislative body - Acts, Laws, and Ordinances - and the respective enactments such as regulations, decrees, rules, notices and other relevant instruments, passed by the Government.

Legislation deals with specific problems applicable in the country, taking into account the economic and social conditions of the country as well as specific technical requirements such as the crops grown, pest problems, level of literacy, climatic and environmental considerations necessary for that scheme as well as the legal framework and the degree of support which the Government of the country is able to provide.

Title and Date
There must be a title and the date the law becomes operable.

Definition

It is important that key words used are defined. The words described as "key" are those whose dictionary definition may not be sufficient to clearly understand the meaning but whose meaning must be clearly understood by all reading and having to comply with the law.

Primary Authority

The primary authority responsible for the legislation is the Ministry of Agriculture. However, decision making is the collected responsibility of representatives from several agencies.

Inspectors, Analysts, Medical Examiners

To enable the law to be enforced, it is necessary to appoint inspectors, analysts and medical examiners. Appointment of such persons is necessary to facilitate registration and post-registration activities. Besides, ensuring that the requirements of the law are met, inspectors should conduct regular inspections and should ensure that product sampling is done in accordance with the legislation. The sample required should be described to receive and analyse samples in a prescribed manner. Powers to be given to the inspector and analysts must be specified.

Fees

Provisions should be made for setting fees for the various activities specified in the legislation. Such fees could cover applications for registration, approval of containers, registration and licensing of pest control operators and pesticide dealers, analysis of formulations and any other activities specified in the legislation.

Appeal Procedures

Provisions for appeal of decisions made by the authorities should be included. Such provisions should be channelled either through the normal legal system in the country or through special arrangements as specified in the legislation.

Registration

The procedure for obtaining registration or a provisional clearance should be described in the legislation. Registration requirements should cover:

• if the pesticide has not been marketed previously, an application for registration or a provisional clearance should be required.
• if the pesticide is registered already or a provisional clearance has been granted, an application for a change in a label claim or an upgrading in the clearance status should be required

Legislation should specify who may apply for registration. The legislation should list in general terms, the data required as part of the application for registration and should include:

• proposed distinguishing name of the formulation
• composition
• toxicological data
• reports of efficacy trials
• reports of residue trials following use of crops
• reports of environmental effects
• information on disposal methods for the used container and surplus pesticide
• a copy of the proposed label

All information submitted should be treated as proprietary data by the responsible authority and some may be confidential.

Legislation should also require that a label which has been approved by the PCB or Authority be firmly affixed to the package before the pesticide can be sold or offered for sale, or given as a free sample.

Legislation should allow the registrar to specify the technical requirements for safe and effective packaging of pesticides. Legislation may contain provisions with regards to the pesticide or operations which present a high or unusual degree of hazard and may include the authority to:

• prescribe conditions for field evaluation of the experimental compound

• temporarily prohibit the importation, sale, distribution and use of such pesticides, even if they are registered

• restrict the importation, sale and distribution of such pesticides to ensure their use by only authorized organizations or persons

• make any other provisions concerning marketing and/or distribution of such pesticides as may be necessary to safe guard third parties, the environment and wild life resources.

• Legislation should require the registrar to make timely decision on the application, after considering the evidence.

The decision may be:
a accept a pesticide for registration
b issue a provisional clearance
c hold the application until further data requested from the applicant are provided
d reject the application

When the registration is granted, a certificate of registration should be issued, to which is attached a copy of the accepted label. No change in the label should be allowed without the approval of the PCB.

Registration may be granted for a specified period. The law should provide for the PCB to review the registration in light of subsequent knowledge about any unfavourable or unforeseen side effects arising from the normal use of the pesticide. Likewise, the PCB should have the authority to require additional conditions for the manufacture or handling, including application of a pesticide, or even to revoke that registration when it has been determined that the continued use of the pesticide is not desirable for technical reasons.

Control of Imports
Legislation should provide that no importation of pesticides be allowed without an appropriate permit from the responsible authority. The PCB should coordinate with Customs in the exercise of this responsibility.

Licensing and Certification
Legislation may provide for the licensing of various

groups of people associated with the manufacture, formulation, repacking, importation, distribution, sale and application of pesticides.

Advertising

Claims made by advertising of a pesticide should not be in conflict with, or at variance to those claims accepted by the PCB. Only pesticides which are registered may be advertised.

Maximum Residue Limits (MRLs)

Legislation may set MRLs in consultation with the national authority responsible for food quality.

Record-keeping and Reporting

Legislation should require that persons dealing in pesticides keep records for a specific period. These books and records must be available for inspection at all reasonable times.

Enforcement

Legislation should make it unlawful for any person or corporation who contravenes the provisions of the legislation.

Monitoring

Legislation should provide the PCB with powers to carry out post-registration monitoring to enable it to measure the effects of pesticide use.

Training

The PCB should have the power to become involved with training programmes for users of pesticides.

19 Pesticide Record Keeping

Need for Records

Records of pesticide usage are important. In many cases, pesticide usage history of a piece of property is as important as the cropping history.

Records will help to:

- Improve pest control practices and efficiency
- Avoid pesticide misuse

- Compare applications made with results obtained
- Purchase only amounts of pesticide needed
- Reduce inventory carry over
- Establish proper use in case of residue questions
- Establish proof of use of recommended procedures
- Plan cropping procedures for next year
- Plan pesticide needs for next year

How to Keep Records

Different forms can be devised for keeping pesticide application records. Carry a pocket book and write down information as it happens. The information recorded can be transferred to a permanent record.

Information to be kept:

- Crop, animal or building treated
- Crop variety or animal species treated
- Pest(s) treated
- Location and number of acres or animals treated
- Time of day, date and year of application
- Type of equipment used
- Pesticide used, including the name and per cent of active ingredient, type of formulation, trade name, manufacturer and lot number, date made
- Amount used/acre or /100 gallons of water
- Stage of crop or animal development
- Pest situation, ie severity of infestation and presence of beneficial species
- Weather conditions - temperature, wind, rainfall
- Harvest date
- Results of application

GROWER'S PERMANENT RECORD OF CHEMICAL PESTICIDE APPLICATIONS
INCLUDE ALL TREATMENTS: SOIL, DORMANT
PRE-PLANT, GROWING SEASON AND POST-HARVEST

CROP / VARIETY	← GROWER'S NAME AND FIELD IDENTIFICATION						TOTAL ACRES IN FIELD OR ORCHARD	
IDENTITY OF TREATED AREA	DATES OF TREATMENT: START	DATES OF TREATMENT: FINISH	NUMBER ACRES TREATED	AIR OR GRND	- COPY THIS INFORMATION FROM THE PESTICIDE LABEL - PESTICIDE COMMON NAME OR TRADE NAME	LIQUID WET. PWDR. DUST GRANULES	ACTIVE INGREDIENT % OR LB/GAL	SPRAYS ONLY: AMOUNT OF MATERIAL PER 100 GALS.	OR PER ACRE	GALLONS OF MIXED SPRAY, LBS DUST OR LBS GRANULES PER ACRE	PEST TO BE CONTROLLED

GRND Ground

PWDR - Powder

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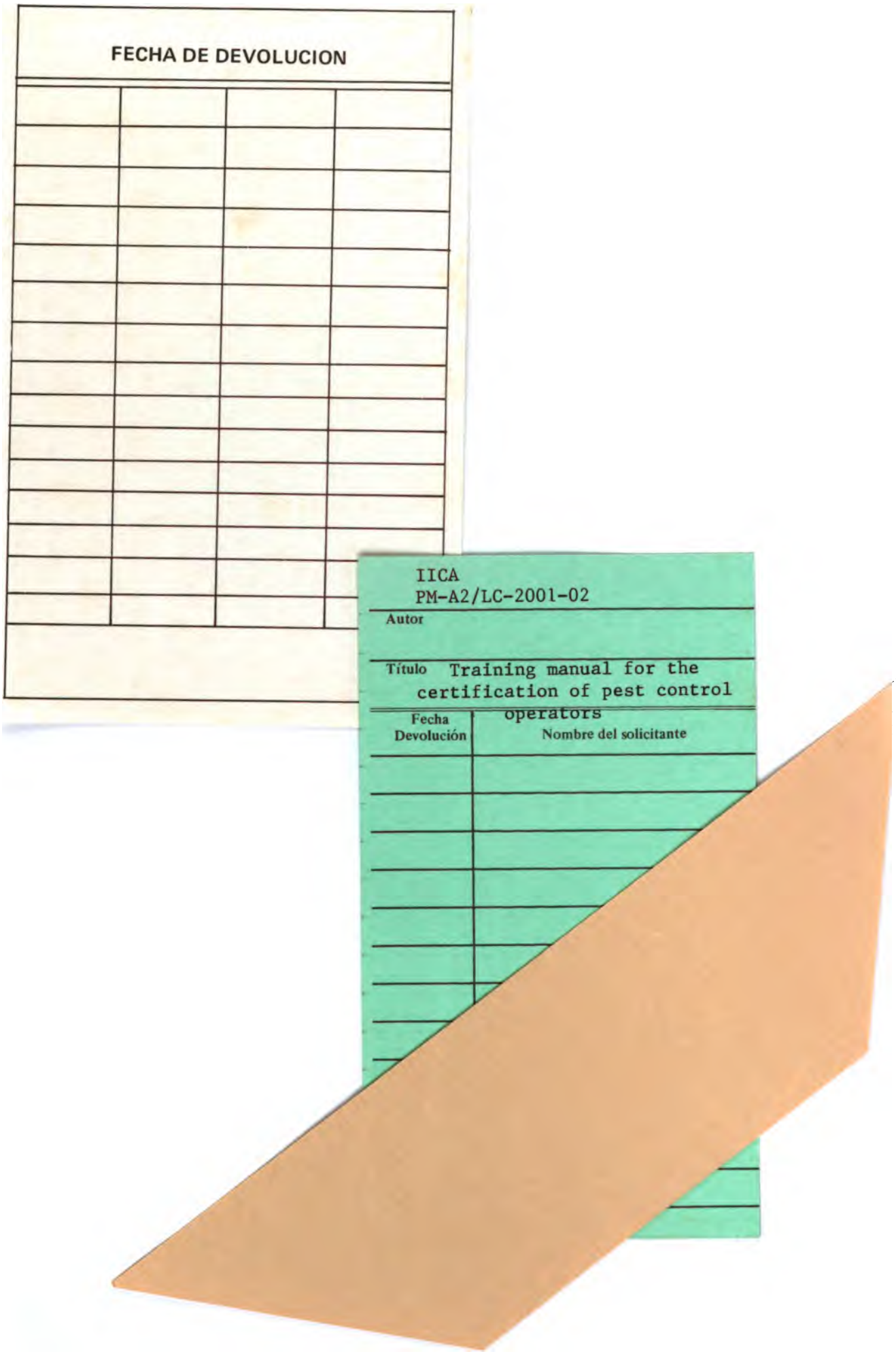
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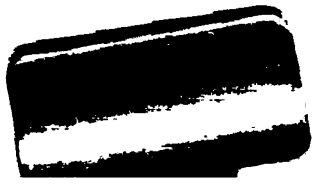

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