This Sprayer Operator Pocket Book has been designed for use by farmers and those who advise them, to improve the protection of crops in safe and effective ways. It has been adapted from a publication entitled 'Pesticide Safety and Application Equipment - an Instructor's Handbook' prepared by the same authors.

It is an output from a collaborative project involving the Food and Agriculture Organization of the United Nations (FAO), the Ministry of Agriculture in Cameroon (MINAGRI), the Inter-African Phytosanitary Council of the African Union (IAPSC/AU), T L Wiles and Associates Ltd, the Natural Resources Institute (NRI) and the International Pesticide Application Research Centre (IPARC) of Imperial College London.

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PESTICIDE SAFETY AND APPLICATION EQUIPMENT

Sprayer Operator Pocket Book

Notes:

PESTICIDE SAFETY AND APPLICATION EQUIPMENT

Sprayer Operator Pocket Book

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Notes:

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INTRODUCTION

This Sprayer Operator Pocket Book has been designed for use by farmers and those who advise them, to improve the protection of crops in safe and effective ways. It has been adapted from a publication entitled 'Pesticide Safety and Application Equipment - an Instructor's Handbook' prepared by the same authors.

Three posters are also available, which can be used together with this pocket book:

- Hints on pesticide use
- Hints on spraying
- Calibration of lever operated knapsack sprayers

All of these publications have been prepared by the authors on behalf of the Food and Agriculture Organization of the United Nations (FAO), in collaboration with the Ministry of Agriculture in Cameroon (MINAGRI), the Interafrican Phytosanitary Council of the African Union (IAPSC/AU), T L Wiles and Associates Ltd, the Natural Resources Institute (NRI) and the International Pesticide Application Research Centre (IPARC) of Imperial College London.

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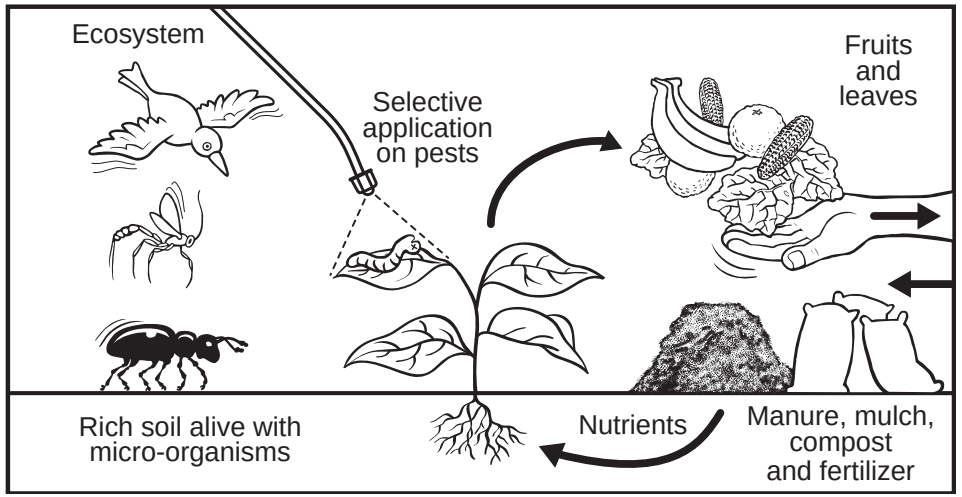
Glossary 6

Volume rate (VR)	The volume of diluted spray applied per crop area, usually expressed as litres/hectare. Farmers often unknowingly apply a VAR which is far too high, resulting in heavy overdosing and unnecessary run off on to the soil.
Weed	Wild plant which competes with the crop for water, nutrients and/or light. Also a type of pest.
Wettable granule (WG)	A granular pesticide formulation that breaks up on contact with water and disperses the pesticide as a suspension
Withholding period	The period of time a farmer should wait after spraying before allowing people or livestock to enter the field.

Glossary 5

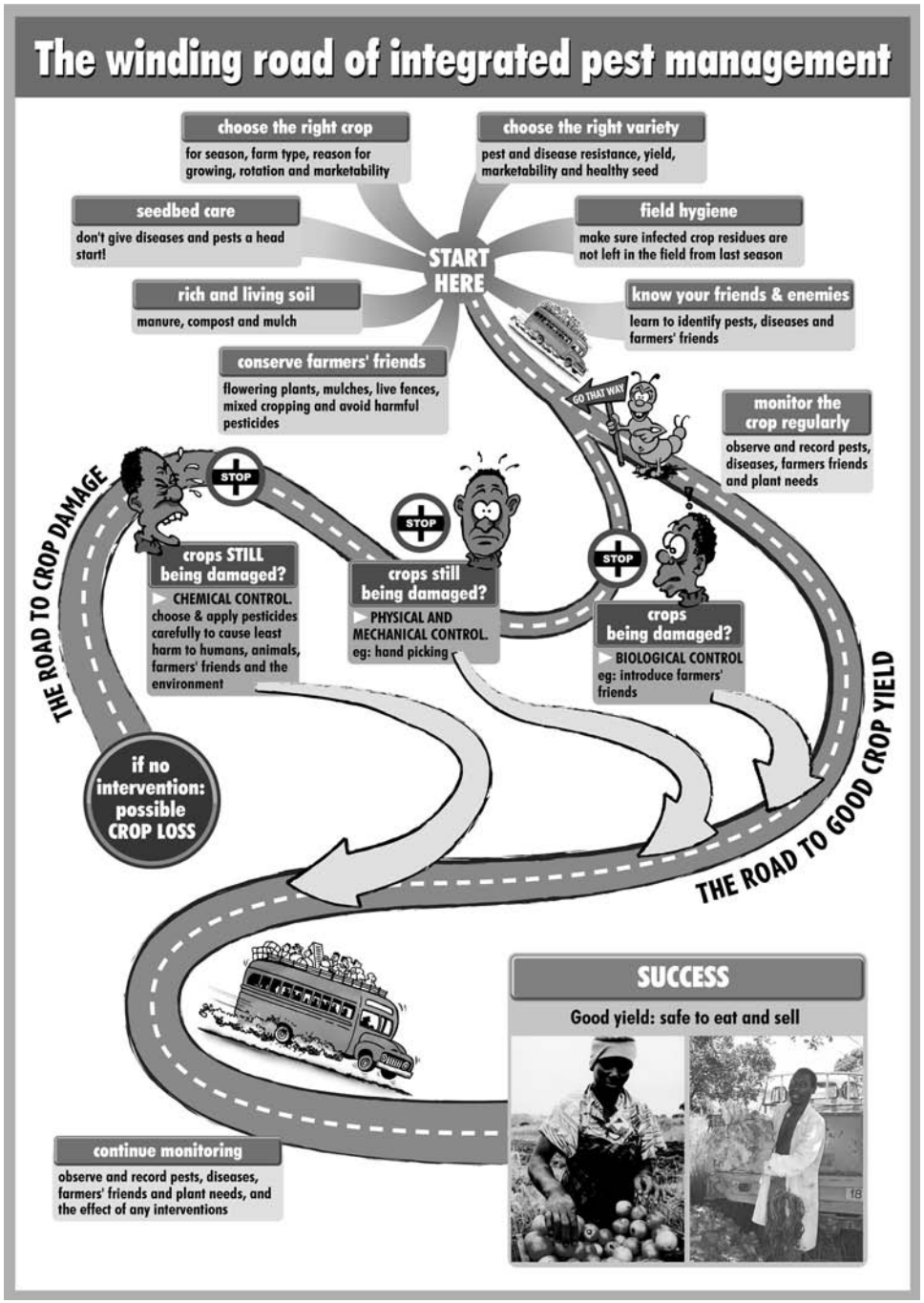
Rotary atomizer (RA)	A device which is rotated so that evenly sized droplets of pesticide form at the edge. Droplet size is mostly determined by rotation speed.
Selective	A word relating to pesticides which only kill organisms in a narrow range. For example, diflubenzuron only affects pests which have a cuticle because it disrupts formation of the chitin - it cannot affect fish, birds or people. Selective pesticides are also sometimes known as specific pesticides. Selective herbicides kill only one type of plant.
Systemic pesticide	A pesticide which can pass through the plant cuticle and be carried around in the plant sap (usually only upwards). Very useful for controlling sucking pests. May be applied as a seed treatment to protect young seedlings.
Tank dose	The quantity of concentrated pesticide product to be added to the sprayer tank (and then mixed with water) each time it is filled.
Toxicity	A measure of how poisonous a pesticide is either to mammals or to pests or natural enemies.
Trade name	The name a manufacturer gives to a particular formulation of a pesticide in order to market and sell it. There may be many different formulations and trade names of one active ingredient.
Translaminar	Capacity of a pesticide to pass through the plant cuticle, but unlike systemic pesticides, not to be carried around in the plant sap. Very useful for controlling pests inside the leaf such as leaf miners.
Translocated	Capacity of a pesticide to travel down in the plant to the roots or rhizomes.
Trigger valve	A device fitted to a sprayer lance to control the flow of liquid to a nozzle.

SUSTAINABLE AGRICULTURE



Sustainable agriculture replaces nutrients that have been taken during harvest and also targets pesticides only on the pests so that the ecosystem is affected as little as possible.

Good sprayers and careful pesticide application are important components of integrated pest management (IPM), which is an essential part of sustainable agriculture.



Glossary 4

Natural enemy (Farmers' Friend)	Organisms which feed on and kill crop pests. Examples are ladybird beetles which feed on aphids, and wasps which lay their eggs in moth larvae. See also Farmers' Friend.
Non-selective herbicide	A herbicide that kills all types of plant.
Nozzle	Device with a small hole fitted at the end of a spray lance to break up the liquid into spray droplets.
Pest	Living organism which feeds on or otherwise damages crop plants. Usually used to describe animal pests such as insects, mites and rats, but sometimes also used for diseases and weeds.
Pesticide	Product designed to kill pests (including diseases and weeds). Pesticides may be synthetic (man-made), biological (containing a living organism) or botanical (made from plant extracts).
Pictogram	Simple diagram or drawing which is designed to convey a message without the use of words
Pre-harvest interval (PHI)	Period of time after spraying before the crop becomes safe to harvest and eat. This can vary from a day to several weeks. Read the pesticide label carefully to find out how long the PHI is.
Product Rate	The quantity of the concentrated pesticide product which should be applied per hectare.
Protective clothing	Clothing worn to protect a sprayer operator's body from contact with pesticide. Also called Personal Protective Equipment (PPE).
Resistant (resistance)	Able to withstand something. For example, a plant may be resistant to a disease or pest, meaning it cannot be affected by it, or an insect may be resistant to a pesticide, and not be killed by it.
Respiratory Protective Equipment (RPE)	Equipment worn over the nose and mouth to filter out fine droplets (and vapours) from pesticide sprays.

Glossary 3

Funnel	Device to help pour liquid through a small hole without spilling.
Herbicide	Pesticide which kills weeds.
Hollow cone nozzle	The type of sprayer nozzle which produces a cone-shaped spray cloud (recommended for knapsack sprayers used for application of insecticides and fungicides).
Hot fogger (HF)	Equipment that produces a high temperature to vaporize the spray droplets and then allows the pesticide to condense into a dense fog of extremely small droplets
Insecticide	Type of pesticide designed to kill insects.
Integrated pest management (IPM)	An ecologically based pest control strategy that relies heavily on resistant crops, hygiene and natural predators and parasitoids, and tries to disrupt these factors as little as possible by using appropriate chemical pesticides only when necessary.
Knapsack sprayer	Type of sprayer carried on the operator's back. These are usually lever-operated, but may be powered by an engine as in motorised knapsack sprayers and mistblowers.
Lance	A device to which the nozzle(s) is fitted to help the operator direct the spray into the crop and keep it away from his/her body.
Mechanical control	Method of pest control which relies on force to kill or expose the pest or disease, for example, disc ploughing a field to kill the cutworms.
Mistblower (MB)	A sprayer incorporating a fan (blower) to provide an airstream that produces the spray droplets and projects them some distance up into trees or over several rows of crop.
Mode of action	The way in which the pesticide kills the pest.

INTEGRATED PEST MANAGEMENT (IPM)

IPM uses many different methods together to control pests (insects, weeds, diseases of crops).

Cultural Control Methods

Pests are controlled by farming practices such as crop rotation, field hygiene and using crop varieties that have some pest resistance.

Biological control methods

Pests are controlled by methods involving living organisms, such as bringing in and conserving Farmers' Friends (natural enemies) that attack pests.

Chemical control methods

Pests are controlled by chemicals. These may be botanical extracts from plants such as neem and pyrethrin, or synthetic pesticides. Most of these chemicals are applied to the crops as sprays.

Pesticide types according to target pest

Pesticide type	*Target pest*
Acaricide	Mites, spiders, ticks
Fungicide*	Fungi
Herbicide*	Weeds
Insecticide*	Insects (may also control ticks & mites)
Nematicide	Nematodes
Rodenticide	Rodents

* The most common pesticide types

Glossary 2

Cone nozzle	Type of nozzle where the spray comes out in a cone shape. Can produce fine/medium sized droplets which are good for insecticides and fungicide application from portable sprayers
Constant Flow Valve (CFV)	A valve fitted to a lance to ensure uniform pressure and flow rate at the nozzle
Contact herbicide	Herbicide which kills the parts of the plant it touches.
Cultural control	Controlling pests and diseases by changing the way the crop is grown, or its habitat. Examples are crop rotation and field hygiene.
Deflector nozzle	Type of nozzle where the spray liquid comes out of a hole and hits a flat surface then spreads out in a fan shape. Produces large droplets which are good for herbicide spraying.
Diluted	Mixed with water (or other solvent).
Disease	Plant sickness caused by a pathogen or physical and chemical factors such as low temperatures or shortage of particular nutrients.
Ear defenders	Device to cover a sprayer operators' ears to protect them from loud engine noise.
Farmers' friends (natural enemies)	Organisms which feed on and kill pests. Examples are ladybird beetles which feed on aphids, and parasitoid wasps which lay their eggs in moth larvae. See also Natural Enemy.
Flat fan nozzle	The type of sprayer nozzle which projects spray liquid in a flat fan pattern. More appropriate for tractors than for knapsack sprayers since coverage of bushy plants is not so good.
Foliar	Something which is applied to the leaves.
Formulation	The mixture of ingredients, including the active ingredient, which makes up a commercial pesticide.
Fungicide	A pesticide designed to control fungal diseases such as tomato late blight or powdery mildew.

GLOSSARY OF TERMS

Glossary 1

These may not be universal definitions, but they explain the intended meaning in this Sprayer Operator Pocket Book

Technical term	Definition or explanation
Active ingredient (a.i.)	The part or ingredient (often poisonous) of a pesticide which controls the pest.
Artificial respiration (resuscitation)	The emergency first aid technique to establish and maintain breathing and circulation by breathing into someone's mouth when their own breathing has stopped, and applying chest compressions.
Beneficial insects	Insects which are helpful to farmers by killing pests or pollinating plants.
Biological control (or biocontrol)	Use of living organisms to control pests and diseases.
Botanical	A product made from plant extracts.
Calibration	Calibration is the adjustment of the sprayer and operating technique in order to apply the correct quantity of pesticide to the target.
Chemical control	Using chemical products (pesticides) to kill pests.
Cold fogger (CF)	Equipment that produces extremely small droplets without heat.
Common name	The name of the active ingredient of a pesticide.
Compression sprayer (CS)	A sprayer with a tank which is pressurised by pumping before spraying starts, and at intervals afterwards. Usually slung over one shoulder.
Concave	Dipping down into a hollow, instead of sticking out (convex).
Concentration	The quantity of active ingredient per litre of pesticide - in other words how strong the pesticide solution is.

PESTICIDES

Types

There are many different types of pesticide to kill different types of pests. The table to the left shows the most common ones.

NOTE: There are very few pesticides that control bacterial diseases and none that control virus diseases.

Names

Pesticides have a Trade Name, which you will see written in large letters on the pesticide label. The active ingredient (the poisonous part) has a Common Name, which usually appears in much smaller print on the label.

There may be several products with different Trade Names, which all contain the same pesticide Active Ingredient.

Class	Description
I a	Extremely hazardous, **DO NOT USE**
I b	Highly hazardous, **DO NOT USE**
II	Moderately hazardous, **take great care**
III	Slighty hazardous, **take care**
Unclassified	Unlikely to cause hazard, **but still take care**

Calibration of portable sprayers (LK, CS, MB, RA)

If the pesticide label recommends an amount of product (a Product Rate) to apply per hectare (instead of an amount to add to each 15 litre tank - a Tank Dose), follow the steps below:

1- Measure and adjust the Volume Rate (volume of sprayer liquid applied to each hectare) – see pages 69 & 70.

2- Divide this Volume Rate by the volume of your sprayer tank to give the number of times it must be refilled to spray one hectare. For example if the Volume Rate is 300 l/ha and the sprayer tank volume is 15 litres, the sprayer must be refilled 300/15 = 20 times.

3- Divide the recommended amount of product per hectare by the number of times the sprayer must be refilled to give the amount of product to add to the sprayer each time it is filled. For example, if the recommended Product Rate per hectare is 2 litres, the amount of product to add to each sprayer tank is 2 litres/20 = 1/10litre = 100 ml.

Volume of liquid product to add to the sprayer tank for some different volume rates and product rates.

Volume per hectare (l/ha)	Number of knapsack loads of 15 litres	Approximate amount in mls per knapsack for different product rates			
		0.5 l/ha	1 l/ha	1.5 l/ha	2 l/ha
150	**10**	50	100	150	200
210	**14**	36	71	107	143
255	**17**	30	59	88	118
300	**20**	25	50	75	100

Note on foggers: Calibration and use of hot foggers should only be carried out by trained fogger operators because this type of equipment can be dangerous if badly calibrated and badly operated.

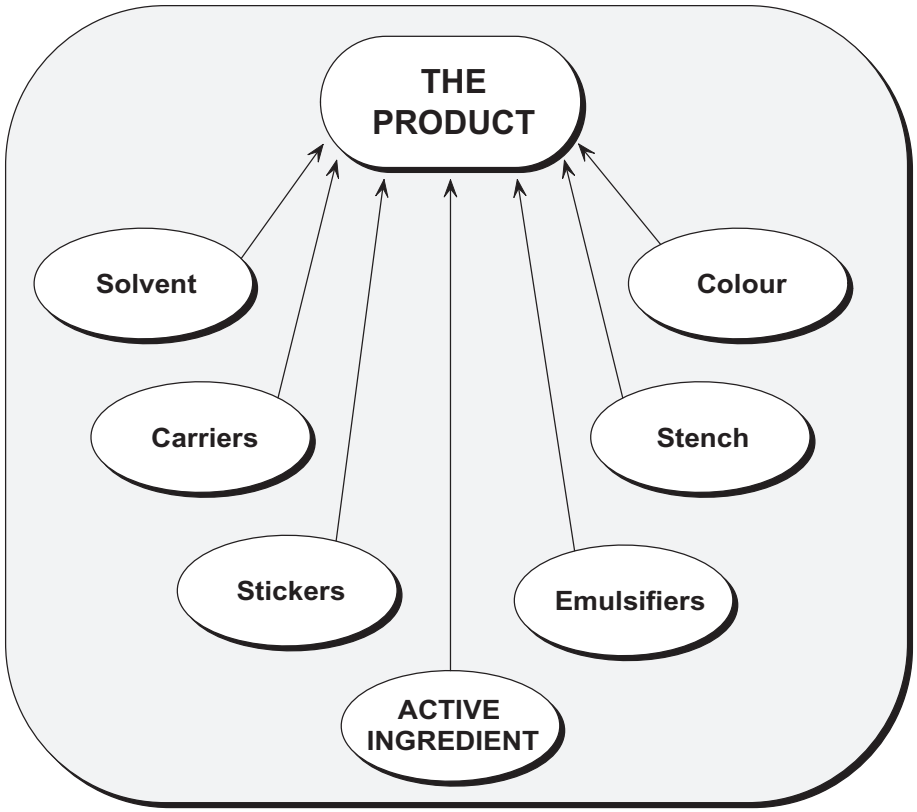
Pesticide toxicity

All pesticides can be dangerous. Some are very dangerous while others are less dangerous. The level of danger is usually marked on the pesticide lable as a hazard classification in the World Health Organization system. The categories are Ia, Ib, II, III or unclassified. Some countries indicate these hazards by a colour code.

DO NOT USE class Ia & Ib pesticides since even a very small quantity on the skin can poison you.

For all other pesticides, use appropriate protective clothing (see pages 30 - 32) and take great care.

Examples of components of a pesticide product



Measuring and adjusting volume of spray per hectare

1. Mark out a square of crop measuring 10 large paces by 10 large paces. This will be about 100m^2
2. Put the sprayer on level ground and fill with clean water to a clearly marked level, e.g. to the filter
3. Spray the square of crop with water as if you were spraying pesticide
4. Put the sprayer back on level ground and measure the number of litres of water required to refill the sprayer to the clearly marked level
5. This gives the volume of water applied to one hundredth of a hectare, so multiply this figure by 100 to give the volume of spray applied to one hectare
6. If this volume is very different from the table on the left, either change the nozzle for a different size, or move at a different speed
7. Keep checking the volume rate until it is right.

Note: Volume rates per hectare are not really relevant for spraying cocoa pods with fungicide.

Volume rates for different target types

Target type	Volume rate (litres/ha)
Bare soil and small plants, e.g. herbicide application to soil or small weeds, or insecticide/ fungicide application to young crops	150 – 200 l/ha
Medium sized targets, e.g. herbicide application to medium sized weeds or insecticide/fungicide application to tomatoes, Irish potatoes, groundnuts	200 – 250 l/ha
Large targets such as dense coffee	300 l/ha

Note 1: The pesticide label may give a recommendation for the volume rate to use.

Note 2: Rotary atomizer sprayers apply much lower volumes - between 20 l/ha for herbicides and 10 l/ha for insecticides/ fungicides.

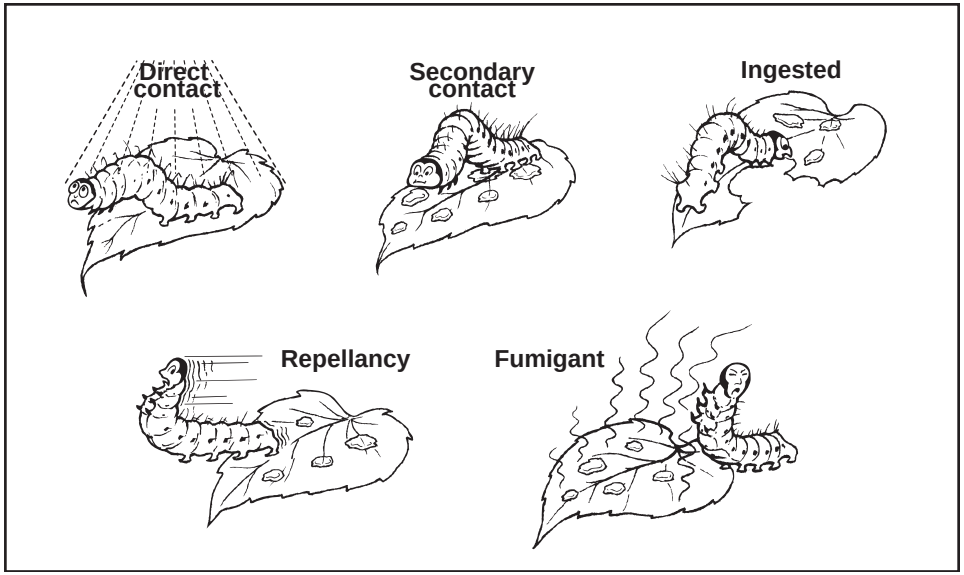
Pesticide Formulations

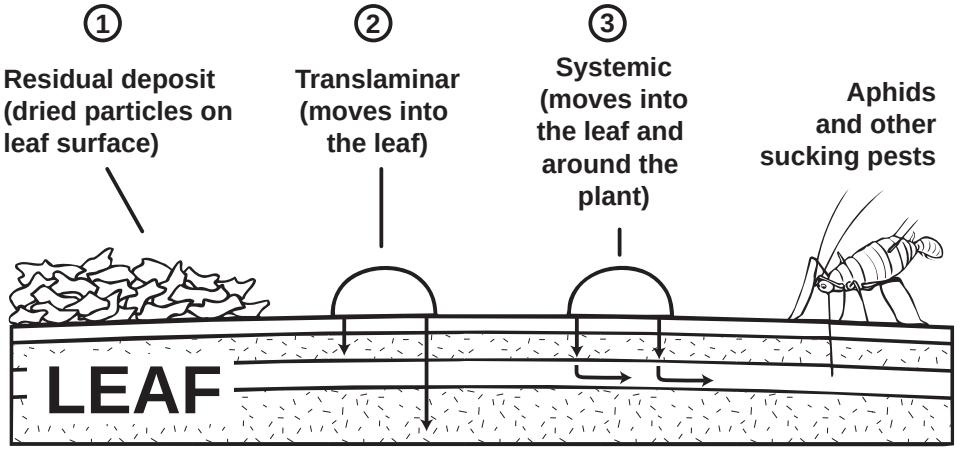
The poisonous part of the pesticide (active ingredient) is usually mixed with other substances such as solvents, carriers, emulsifiers and sometimes colours, to make the pesticide formulation - see diagram on the left.

There are different types of formulation such as emulsifiable concentrates (EC) and wettable granules (WG).

Dry formulations such as powders and granules are less easily absorbed through the skin. They are usually mixed with water and sprayed, except for some dust formulations that are sprinkled dry onto the crop or pest.

Granule formulations are safer than powders because the larger particles cannot ‘puff up’ and be breathed in when getting them out of their packaging. They are usually mixed with water, where they break up into smaller particles so that the liquid can be sprayed.





Calibration of portable sprayers (LK, CS, MB, RA)

Introduction

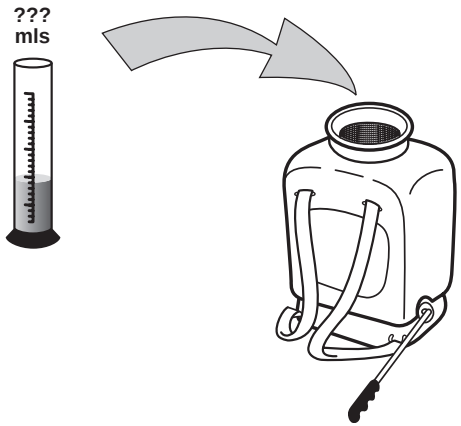
Calibration is the setting up of the sprayer and application techniques to apply the correct dose to the target.

1. In most cases, the pesticide label will state how many milliliters or grammes of pesticide product should be added to a 15 litre sprayer (the Tank Dose). Always have a measuring cup or some other method of measuring this exact quantity.

2. In some cases the pesticide label does not state how much product to add per 15 litres sprayer, but states how much product should be applied per hectare (the Product Rate).

3. Whichever is the type of calibration advice on the pesticide label, it is first necessary to measure (and adjust if necessary) the volume of mixed spray liquid to apply per hectare (the Volume Rate).

1.



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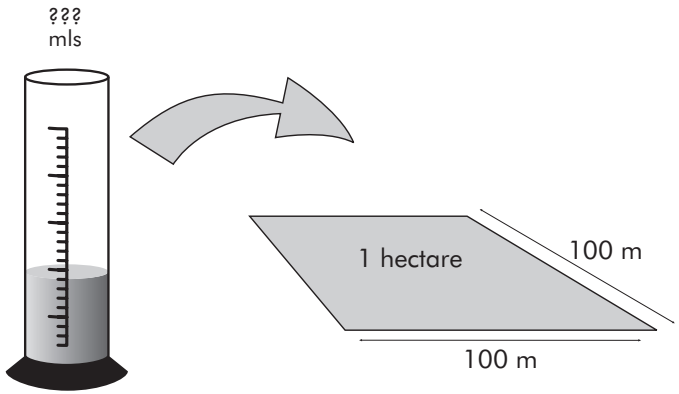

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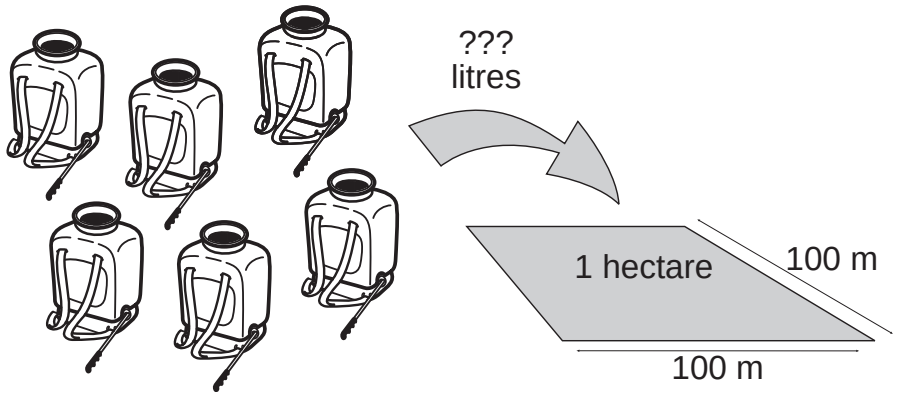


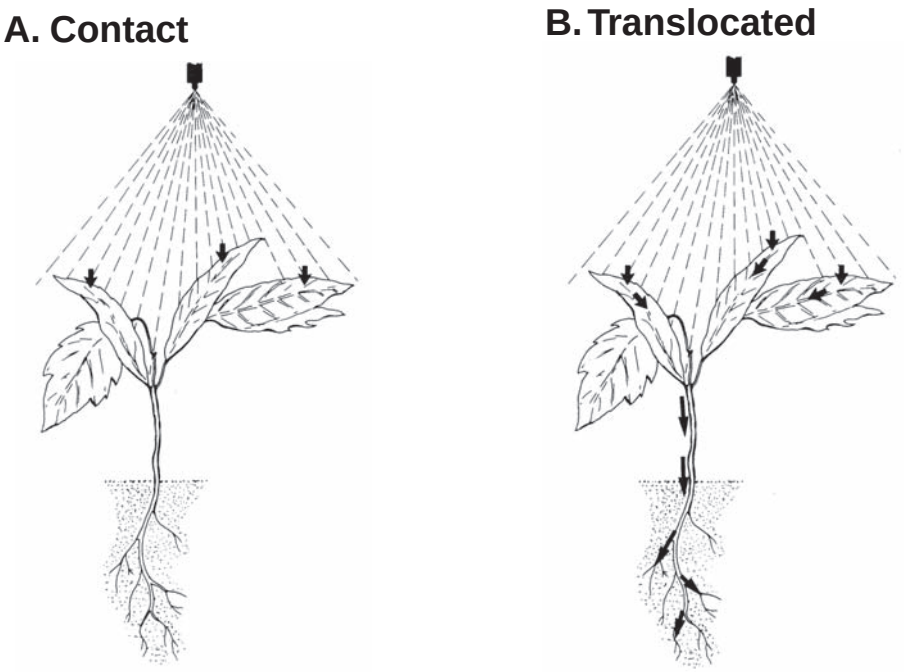
How pesticides work

Insecticides

An insecticide may affect insects by:

- direct contact (falling directly on them)
- secondary contact (the insects touch it on the leaf as they move about)
- ingestion (insects eat the sprayed leaf or suck liquid from the sprayed plant)
- repellence (insects runs away from the smell or taste)
- fumigant action (the insects breathe in the pesticide vapour)

Some types of insecticide fall on the plant and stay on the leaf surface (residual deposit). Other types may pass through the leaf surface into the tissues (translaminar) or pass into the plants ‘veins’ (systemic) and are carried around the plant in the sap. Systemic insecticides are very good for control of sucking pests such as aphids, scale insects and whitefly.



Herbicide classification summary table

Site of application	Mode of action	Selectivity	Examples
Foliar Applied	Contact	Selective	ioxynil
		Non-selective	paraquat
	Translocated	Selective	2,4-D
		Non-selective	glyphosate
Soil Applied Residual	Pre-plant incorporated	Selective	trifluralin
	Pre-emergence	Selective	atrazine

Choosing nozzles for LK and CS sprayers

The table on the left shows the suitability of different nozzle types for different jobs.

Herbicide application

Use a deflector nozzle (or if that is not available, a fan nozzle) with a flow rate of around
0.5 - 1 litres/minute.

Insecticide and fungicide application

Use a cone nozzle (or if that is not available, a fan nozzle) with a flow rate of around
0.2 - 0.5 litres/minute.

In both cases, use nozzles with slightly higher flow rates if the weeds or crops are large.

Summary nozzle table

Type of nozzle	Herbicide (1 bar)	Insecticide (3 bar)	Fungicide (3 bar)
Cone	*	***	***
Fan	**	**	**
Deflector	***	*	*

* = unsuitable
** = acceptable
*** = most suitable

NB: There are exceptions to this table depending on factors such as size of spray target, leaf structure, intercropping system etc.

Herbicides

Herbicides control weeds in different ways. They may be:

- non selective herbicides that kill all plants, so have to be applied only on the weeds
- selective herbicides that kill only some plants, i.e. the weed not the crop

They can be:

- contact herbicides - kill only the leaves they touch - see A opposite
- translocated herbicides - travel down to the roots and kill them too - see B opposite

And they can be:

- foliar herbicides - applied to the leaves
- soil applied herbicides - applied to the soil to kill weeds as they come up (emerge)

Examples of different types of fungicide

Non-systemic organic fungicides	Non-systemic inorganic fungicides	Systemic fungicides
▪ Maneb ▪ Mancozeb ▪ Thiram ▪ Zineb ▪ Phenyl mercury acetate ▪ Fentin acetate ▪ Tecnazene ▪ Ceptafol ▪ Captan ▪ Chlorothalonil ▪ Dithianon	▪ Elemental sulphur ▪ Copper oxychloride ▪ Copper sulphate ▪ Cuprous oxide ▪ Cupric hydroxide	▪ Bupirimate ▪ Flutriafol ▪ Hexaconazole ▪ Metalaxyl ▪ Propiconazole ▪ Triadimefon

Types of nozzles for LK and CS sprayers

Cone nozzle

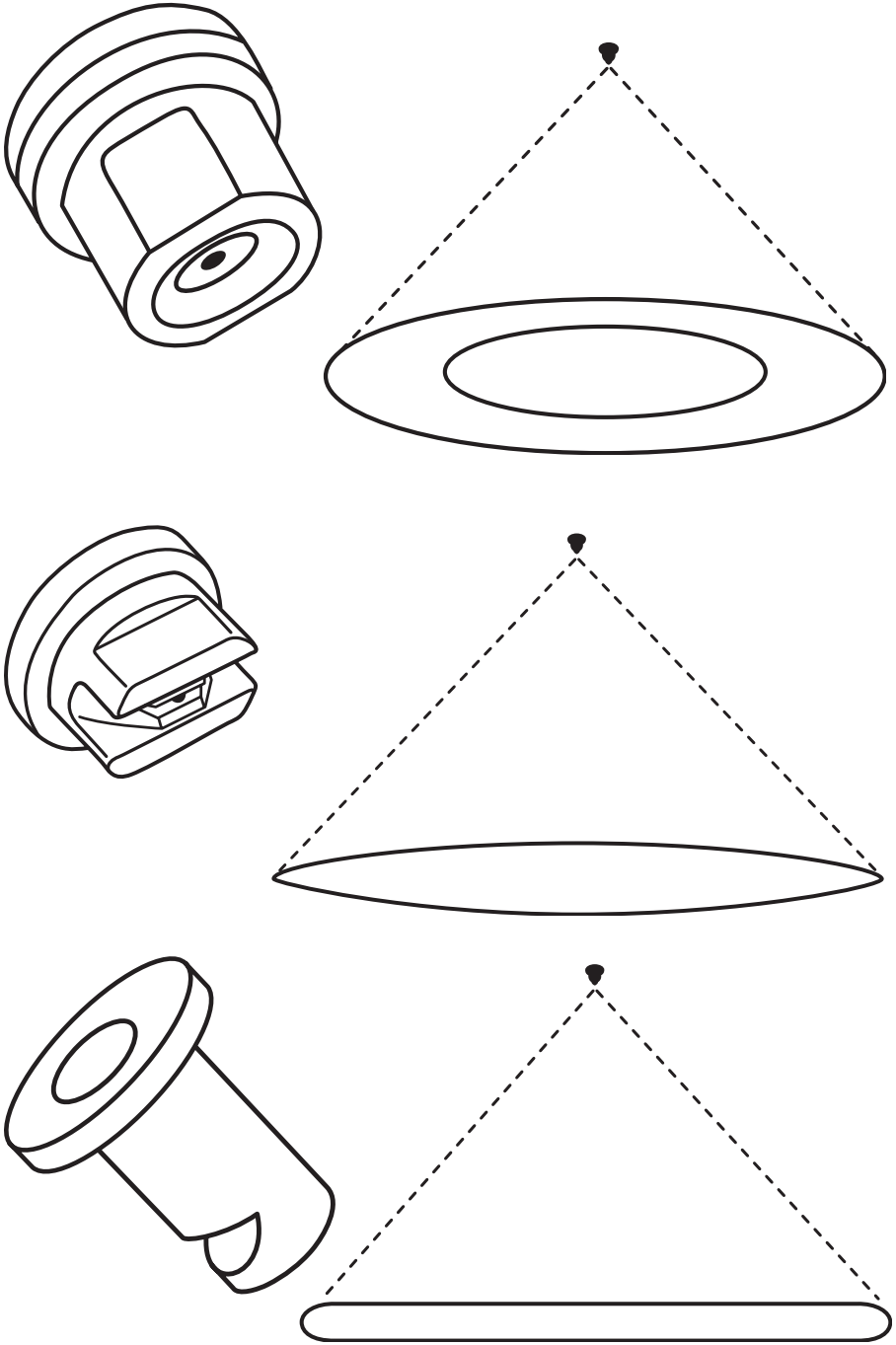
These give a cone shape of spray consisting of small to medium-sized droplets

Fan nozzle

These give a fan of spray consisting of medium-sized droplets

Deflector nozzle

These give a fan of spray consisting of larger droplets



Fungicides

Fungicides control fungal diseases in one of two ways. They may be:

- non-systemic fungicides - stay on the surface of leaves and kill fungus that is there and spores which land on the leaves soon after. These can PREVENT a fungal infection

- systemic fungicides - move inside the plants leaves and stems and can kill fungus inside the plant. These can CURE a fungal infection.

Summary of factors in choosing pesticides

- Efficacy of active ingredients
- Safer active ingredients
- Safer formulations
- Safer packaging
- Mode of action
- Resistance

Using HF sprayers safely

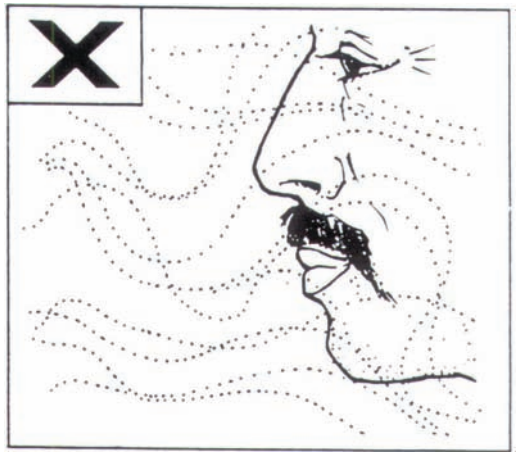
- Only TRAINED OPERATORS should use thermal foggers
- Full protective clothing including respirator should be worn
- Ensure that the correct flow restrictor is fitted (see manufacturer's handbook)
- Calibrate the sprayer
- Use a funnel with a filter to fill the tank
- Outdoors, always start fogging at the downwind edge of the spray block. However, fog is quickly dispersed by the wind so fogging is most effective when there is as little wind as possible
- Indoors, start fogging at the far end of the building and walk away from the fog towards the door. When finished, stop fogging and shut the doors to retain the fog in the building.

Choosing pesticides

- Identify the pest properly
- Choose the right type of pesticide for the pest e.g. insecticides for insects, fungicides for fungus, herbicides for weeds
- Choose safer products e.g. WHO class III
- Choose safer formulations e.g. wettable granules
- Choose safer packaging e.g. sachets mean that the pesticide does not have to be handled for measuring/weighing
- Think about the way it works e.g. a systemic insecticide is best for sucking pests; a translocated herbicide will kill the roots of grass weeds; and a systemic fungicide can cure fungal infections
- Change the type of pesticide active ingredient regularly to prevent pest resistance building up.

1.

2.



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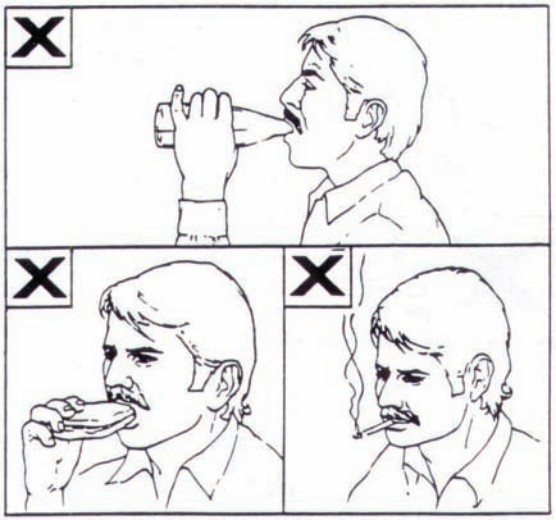
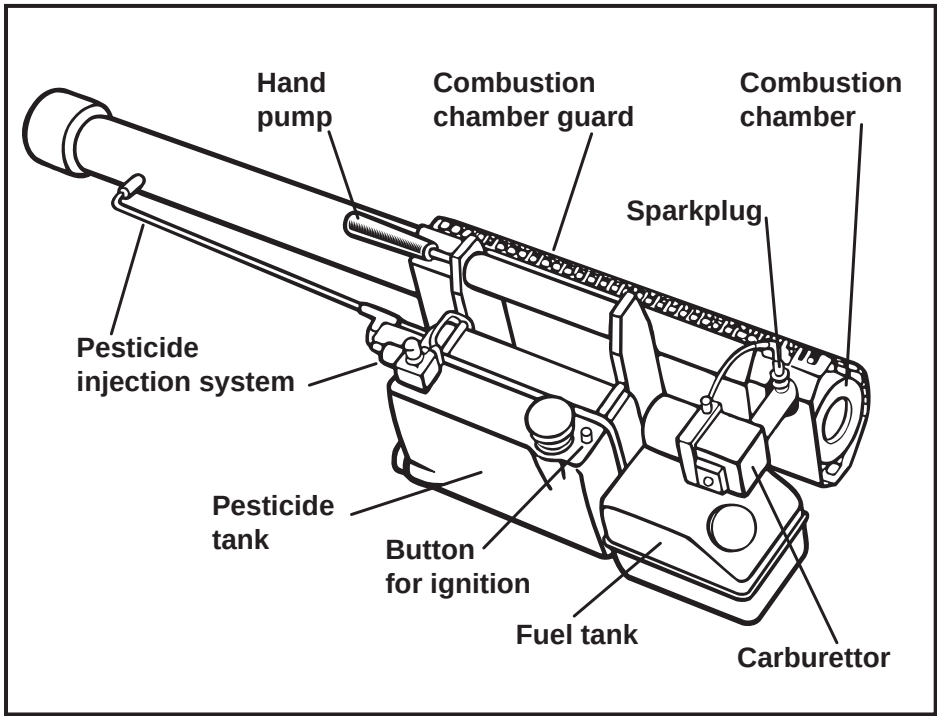


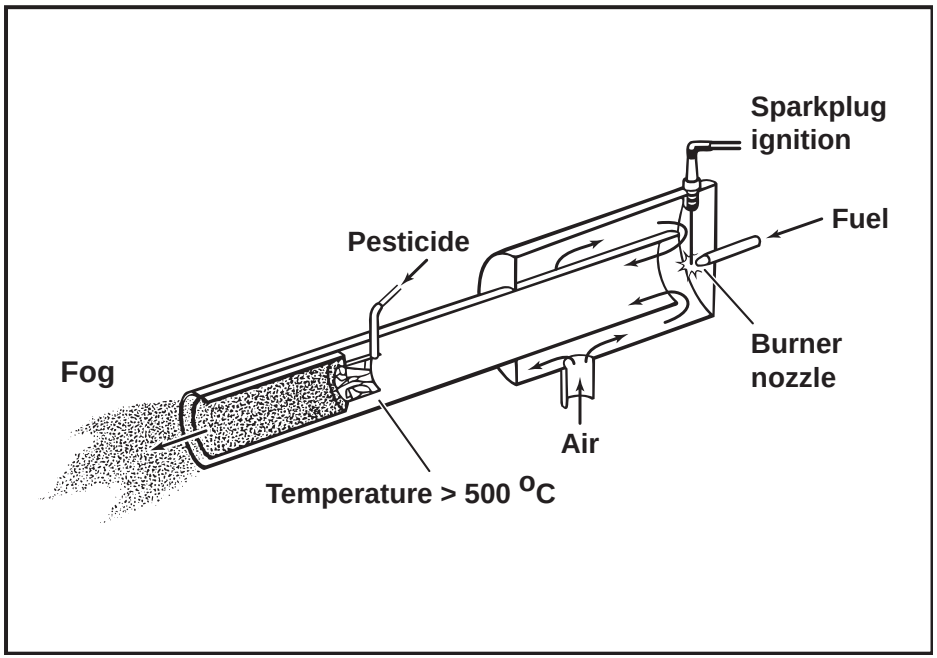
HF sprayers (hot fogger)

These use a petrol-driven pulse jet engine to produce very small droplets that hang in the air for a long time. They are useful for treating warehouses for stored product pests and for control of flying insects outdoors. Also used for capsid control in cocoa plantations.

Safe HF sprayers should have:

- no leaks
- a valve to prevent pesticide reaching the nozzle if the engine stops
- a wide strap
- guards to cover the hot combustion chamber.





SAFETY IN USING PESTICIDES

Pesticides can enter people's bodies:

1. through the skin (if it leaks on the skin)

2. through the lungs (if it is breathed in)

3. through the stomach (if it is swallowed)

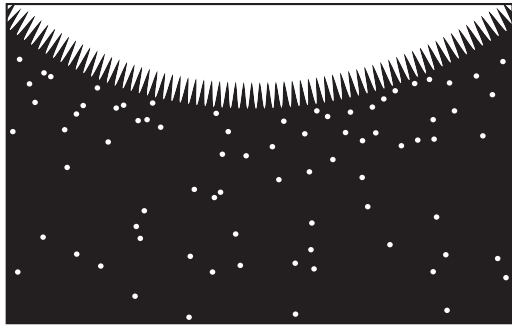
NOTE: sprayer operators are most at risk of exposure to pesticide when they are preparing spray solutions because they are handling the concentrated pesticide product. Sprayer operators should take special care to avoid contact with this concentrated product by using the right protective clothing (see page 30).

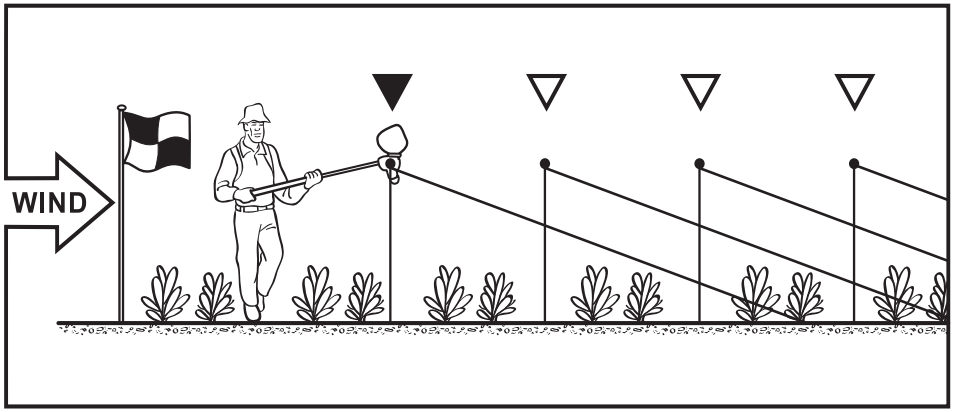
During spraying, the operator is applying diluted pesticide so the protective clothing requirements are slightly less (see page 32).

Example of a pesticide label

Using RA sprayers safely

- Always calibrate before spraying
- Always start the disc before turning over the bottle to let the spray liquid onto it
- Always start spraying at the downwind edge of the field
- Always keep the spray head downwind of your body
- Never blow a blocked restrictor, soak it in water and clean it with a soft brush (not a metal object)
- Spray when there is a light wind and it is not too hot. Mornings and late afternoons are best
- If the wind is stronger, hold the spray head lower so that it is nearer to the crop (this only applies to application of insecticides/ fungicides - do not apply herbicides in strong winds)
- Rinse out the sprayer after use and spray the washings over the crop. Do this three times
- Remove batteries after use, and replace batteries when the disc speed slows down.





Pesticide labels

Main label section

This contains basic information about the product such as:

- Trade Name e.g. Karate (the product name in large print on the label)
- Common Name e.g. lambdacyhalothrin (the active ingredient name). There may be many different products with different trade names containing the same active ingredient
- formulation e.g. wettable granule (WG) or emulsifiable concentrate (EC)
- concentration e.g. 2.5 % w/v, this is the concentration of active ingredient in the formulation (2.5 % = 25 g/litre)
- the quantity of product in the package.

Example of a pesticide label

HOW TO USE KARATE 2.5 EC
Use any conventional ground or aerial spraying equipment, but use the correct nozzle and pressure. (Ask **KARATE** distributor for advice).

Apply in the following volumes of clean water:

CROP	LITRES PER HECTARE OF SPRAY	
Cotton, maize and rice	10-240	Ground Application
Vegetables, Cowpeas and Groundnuts	120-300	Ground Application
Fruit crops	500-2000	Ground Application
All crops	25-50	Aerial Application

HOW MUCH KARATE 2.5 EC TO USE

CROP	PEST	RATE OF KARATE 2.5EC PER HECTARE	HARVEST INTERVALS
Cotton	Bollworms, Leaf Rollers, Stainers, Jassids	800 ml Apply at 10-14 day intervals at the first sign of pest attack	14 days
Vegetables Cowpeas and Groundnuts	Caterpillars, Sucking pests, Bollworms	400-800 ml Apply at 10-14 day intervals at the first sign of pest attack	vegetables 3 days cowpeas 9 days groundnuts 3 days
Maize and Rice	Caterpillars e.g. Stalkborers, headborers	400-800 ml Spray before larvae enter plants	maize 1 day rice 21 days
	Grasshoppers, Army worms	800 ml	

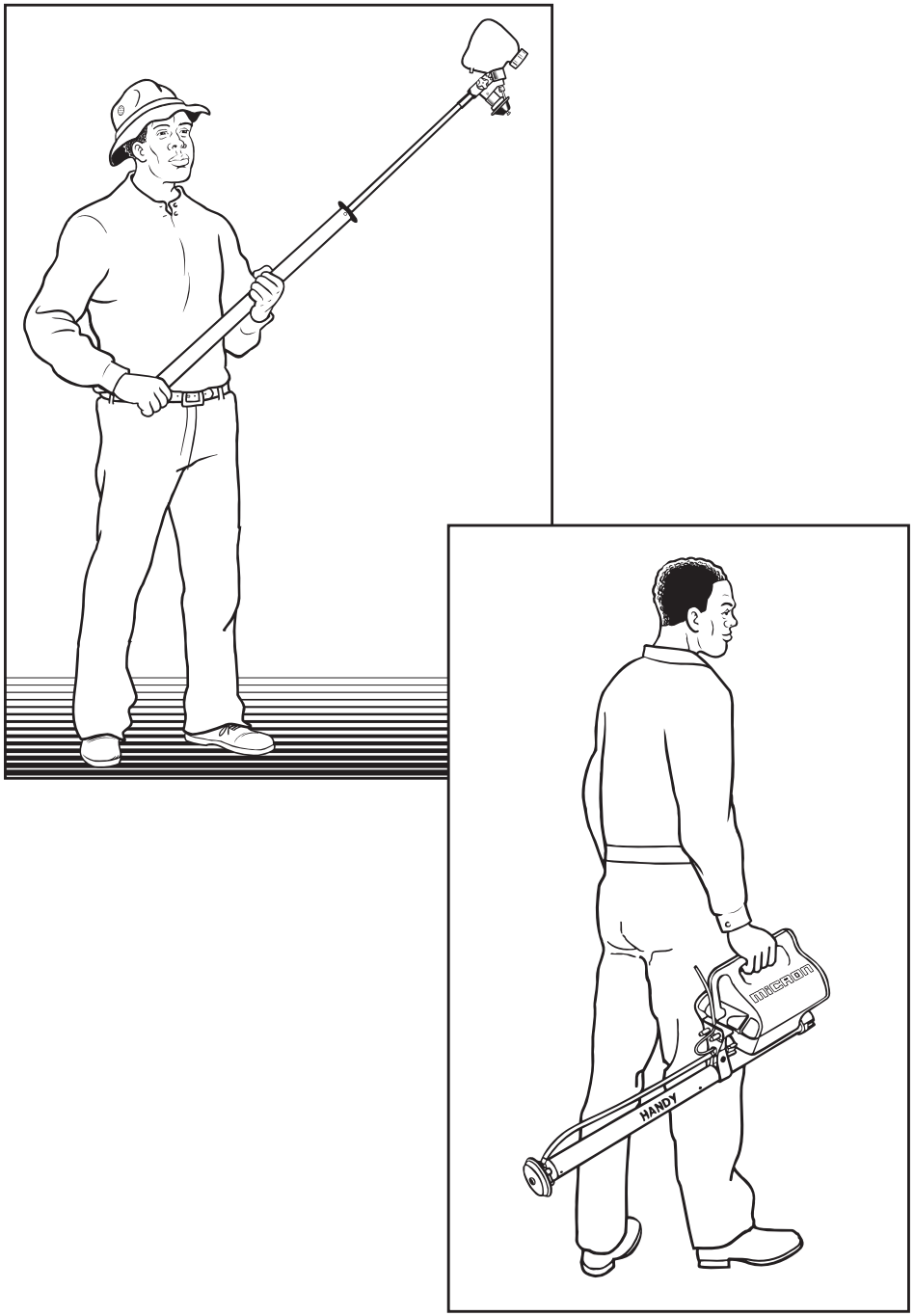
Use smaller amounts when pests first appear or for light infestations.
Use larger amounts for heavy infestations.
For vegetables with waxy leaves, add 30 mls of **AGRAL 90** per 100 litres of water.

RA sprayers (rotary atomiser)

RA sprayers are held in the hands and use batteries and an electric motor to spin a disc, which produces evenly-sized droplets. RA sprayers for insecticides and fungicides produce small droplets that are carried by the wind over several crop rows. RA sprayers for herbicides produce larger droplets that do not drift with the wind.

Safe RA sprayers should have:

- no leaks, and if an additional back pack tank is connected :
  - flat or convex lid
  - wide tank opening
  - deep tank strainer
- teeth on the disc
- facility for changing the number of batteries
- facility for changing the flow restrictor
- facility for changing the angle of the spray head on insecticide/fungicide RA sprayers.



Second label section

This section contains information on how and when to use the product, such as:

- how to mix the product
- how much to apply
- how often to apply
- the pre-harvest interval, i.e. the number of days before the sprayed crop can be harvested and eaten.

Example of a pesticide label

SAFETY PRECAUTIONS
- Do not smoke, drink or eat while using this product.

FOR SAFETY WHEN MIXING
- **Wear eye protection** (at least glasses). Undiluted **KARATE** can damage your eyes.
  If you get it in your eyes, wash it out at once. See First aid.
- **Wear synthetic rubber gloves.** Undiluted **KARATE** can irritate your skin.
  If you get it on your skin, wash it off at once.
  If you spill it on your clothes, change and wash them immediately.
- After emptying container [pressure rinse] or [rinse three times manually] adding washings to spray tank.

FOR SAFETY WHEN SPRAYING
- As with all chemicals, **avoid contact with the spray** as much as you can.
- When using mistblower, wear a mask covering nose and mouth.
- To avoid harming fish, do not spray over water.
- Dispose of unwanted spray solution by spraying off on waste ground. [or use other approved local disposal procedure]

FOR SAFETY AFTER SPRAYING
- Dispose of empty rinsed container by crushing, cutting, then burning or burying.
  Do not use it again. [or use other approved local disposal procedure]
- Do not dump unwanted **KARATE** in water.
- Keep unused **KARATE** in this container, tightly closed, **locked up out of reach of children** and away from food.
- **Wash yourself.** Change and wash your work clothes.

FIRST AID
Eye splashes: Hold eyelids apart and pour in a gentle stream of water for 10 to 15 minutes. Go to a doctor.
IF KARATE IS SWALLOWED do not make the person vomit.
Take person, and this container, to a doctor at once for medical treatment.
MEDICAL TREATMENT: If gastric lavage is performed, take care to prevent aspiration of gastric contents. Consider administration of activated charcoal and a laxative. Treat symptomatically.

Batch No.	
Date of Man.	
Date of Exp.	

Using MB sprayers safely

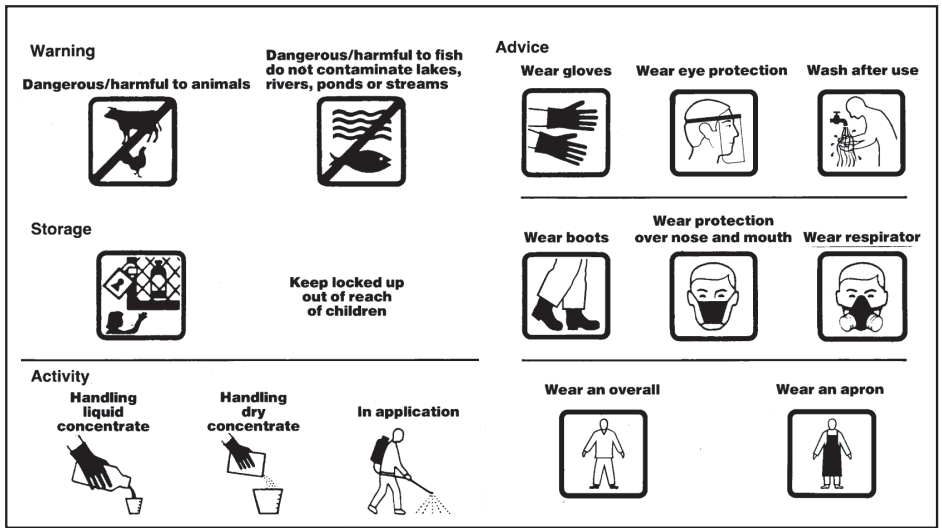
- Always calibrate before use – see pages 68 - 72
- Always use MB sprayer with the engine running at full speed so that small droplets are produced and carried away from the operator
- If pesticide is being mixed in the sprayer, always half fill the tank with water first, then add pesticide, shake, top up with water and shake again
- Spray when there is a light wind and it is not too hot. Mornings and late afternoons are best
- Always start spraying at the downwind edge of the field
- Always direct the airblast crosswind or downwind, never upwind. The airblast may be strong but the wind will still carry spray back onto the operator if it is directed upwind
- Clean the sprayer after use by rinsing with water and spraying the washings over the crop. Do this three times
- Stop the engine at the end of the day by shutting off the petrol supply to keep the spark plug clean.

Third label section

This contains safety precautions such as:

- protective clothing recommended for mixing and spraying
- how to apply, store and dispose of the product safety
- first aid and medical treatment if someone is poisoned

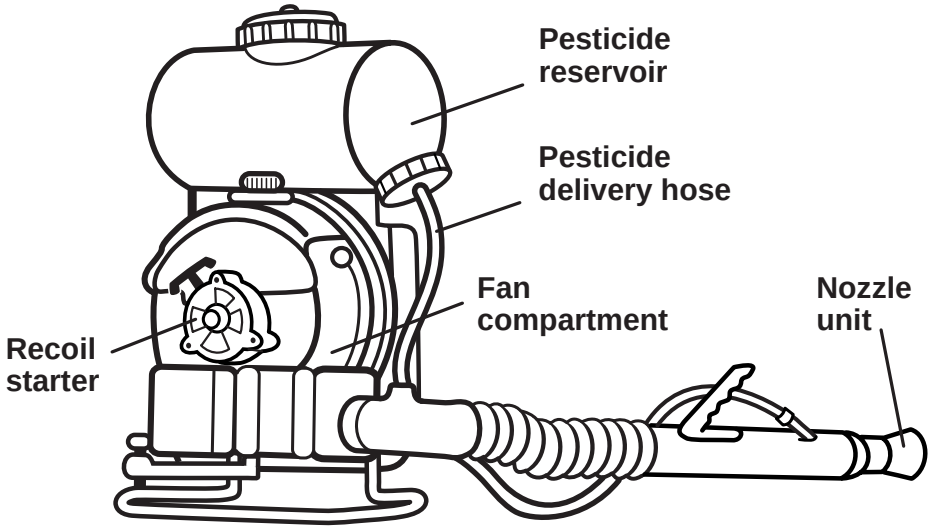
These safety precautions may be written instructions or in the form of pictograms - little pictures which have an easily understood meaning.

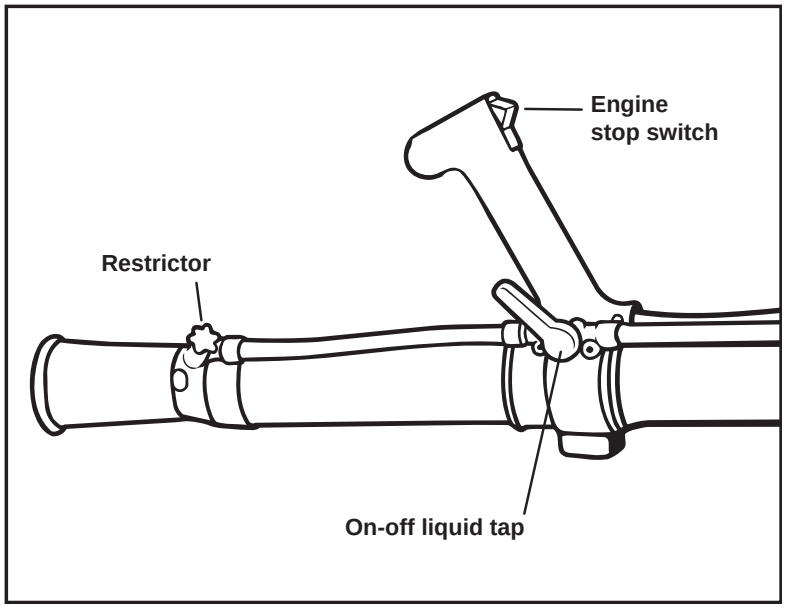


MB sprayers (mistblowers)

MB sprayers have a petrol engine and fan to produce an airblast. This makes the spray and carries it a few meters. Useful for treating several rows of field crops at once and for spraying upwards into tree crops. Safe MB sprayers have:

- no leaks
- wide tank opening
- flat or convex lid
- deep tank strainer
- wide, padded straps (but not absorbent)
- ignition cut out switch
- engine and flow controls on the handle (not on the engine frame)
- guards to cover hot exhaust
- guards to cover any fast-moving parts.



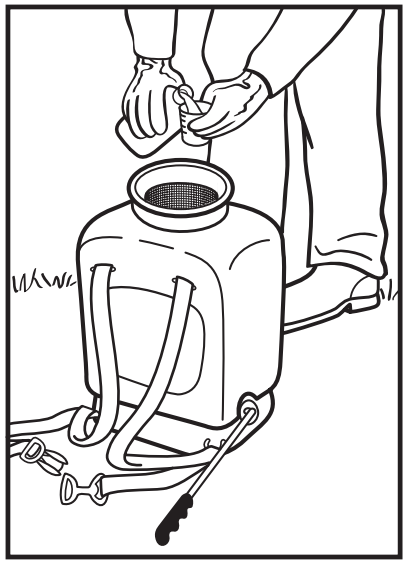


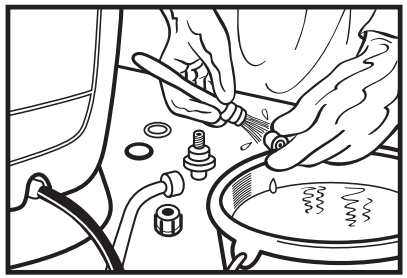
Packaging

Pesticides are sold in various types of package and farmers should choose packages that are:

- made of strong material
- an appropriate size for the job - only buy enough for the area of crop to be treated
- easily re-sealed (does not appy to sachets)
- easily disposable and not attractive for re-use or easily confused with food or drink containers
- displaying a clear label.

NOTE: never put pesticides into drinks bottles or food containers. Also, never put drinks or food into old pesticide containers.





CS sprayers (compression sprayers)

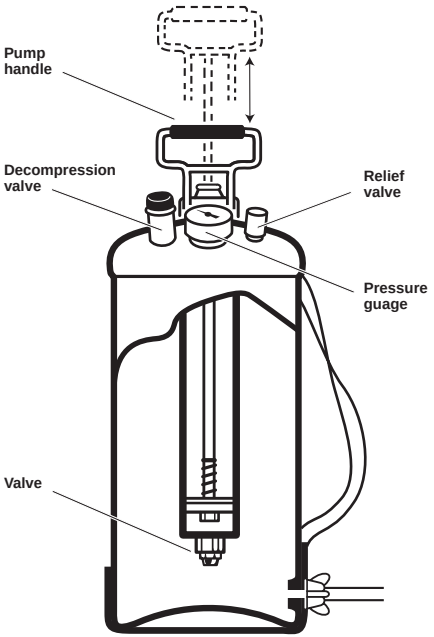
CS sprayers are pumped up to pressurise them before spraying (then regularly afterwards). Worn over the shoulder with a single strap. Useful for small crop areas, spraying walls of stores and houses. Safe CS sprayers should have:

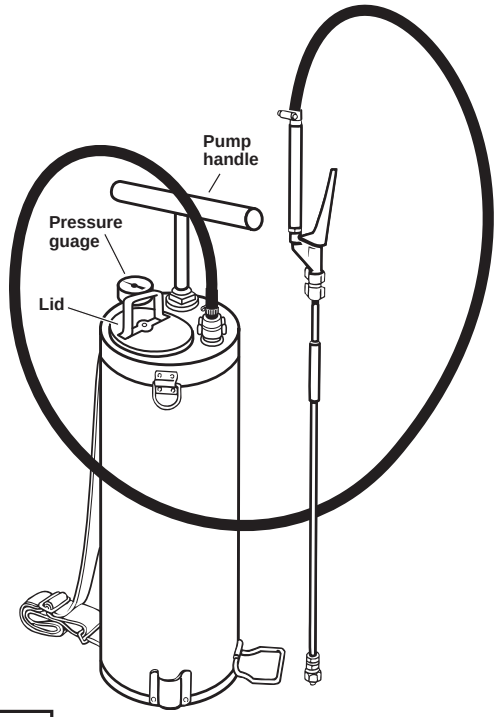
- no leaks
- a funnel with strainer to help filling through the small tank opening
- long lance
- nozzles that can be changed
- trigger valve with strainer
- wide strap
- parking place for lance

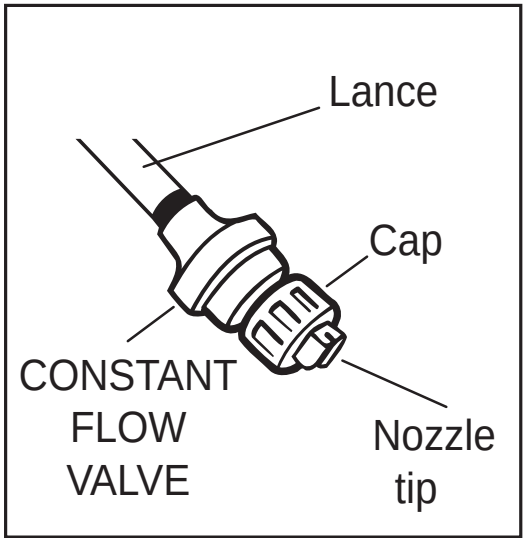
Using CS sprayers safely

Safe CS sprayer use is the same as for LK sprayers (page 48). Use a funnel with a strainer to fill the sprayer.

NOTE: pressure in the tank decreases during spraying, but a constant flow valve will maintain a constant pressure spray from a CS sprayer.







Operator protection

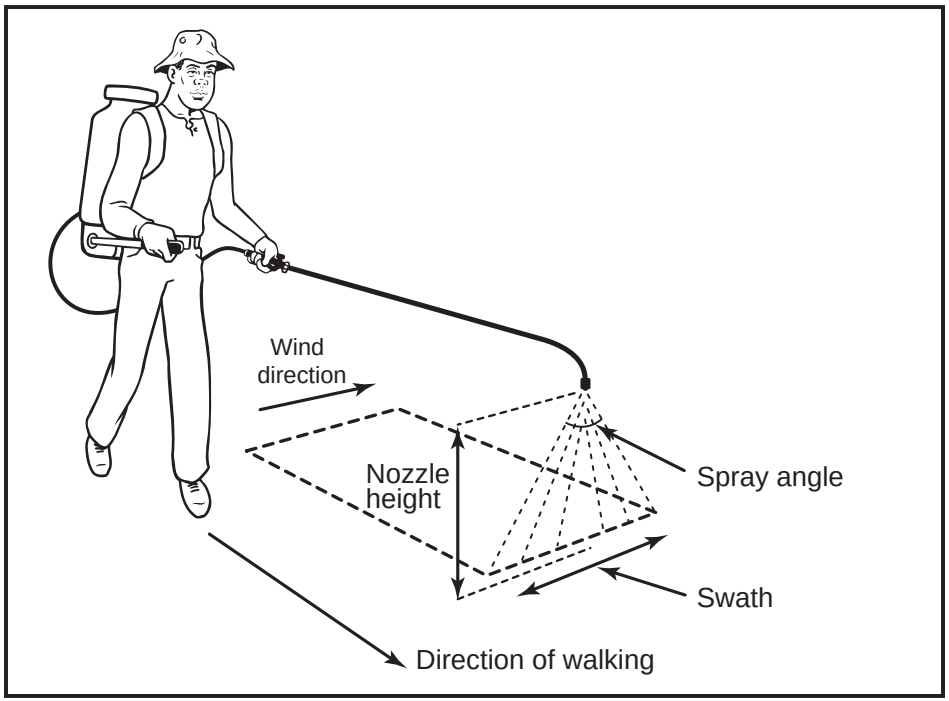
Mixing and filling (+ cleaning/maintaining sprayers)

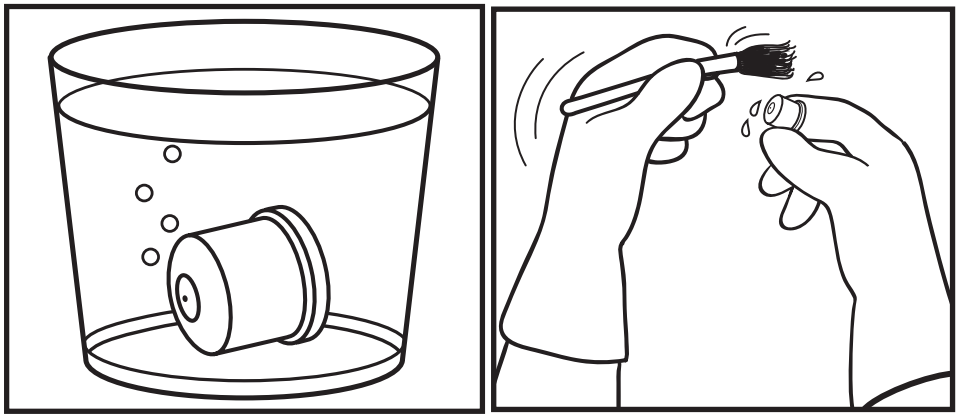
These are the most dangerous operations with pesticides since the operator is handling concentrated product. Operators should wear:

- gloves or plastic bags on hands
- eye protection – a visor will stop pesticide splashing onto the face. If a visor is not available, goggles or even glasses or sun glasses will protect the eyes
- cotton clothes to cover the body (long trouser legs worn outside the boots, and long sleeves)
- shoes or boots which cover the feet (NEVER sandals)
- a hat
- waterproof apron or large plastic bag to cover the front of the body
- always have soap and water available to clean spilled pesticides off the skin.

Using LK sprayers safely

- Always calibrate before spraying – see pages 68 - 72. If pesticide is being mixed in the sprayer, always half fill it with water first, then add pesticide, shake the sprayer, top up with water and shake again. Do not take the filter out and stir the spray liquid with a stick
- Spray when there is a light wind and it is not too hot. Mornings and late afternoons are best
- Always start spraying at the downwind edge of the field
- Always keep the spray lance downwind of your body
- NEVER blow a blocked nozzle, soak it in water and clean it with a soft brush (not a metal object)
- Clean the sprayer after use by rinsing with water and spraying the washings over the crop. Do this three times.





Operator protection (continued)

Safety in applying pesticides

During spraying, the operator is using diluted pesticide so less protective clothing is needed than when filling and mixing. He/she should wear:

- cotton clothes to cover the body (long trousers with legs worn outside the boots, and long sleeves)
- shoes or boots that cover the feet (NEVER sandals)
- a hat
- always have soap and water available to clean spilled pesticide off the skin.

Additional protection

Some special cases where additional protection is required are listed below:

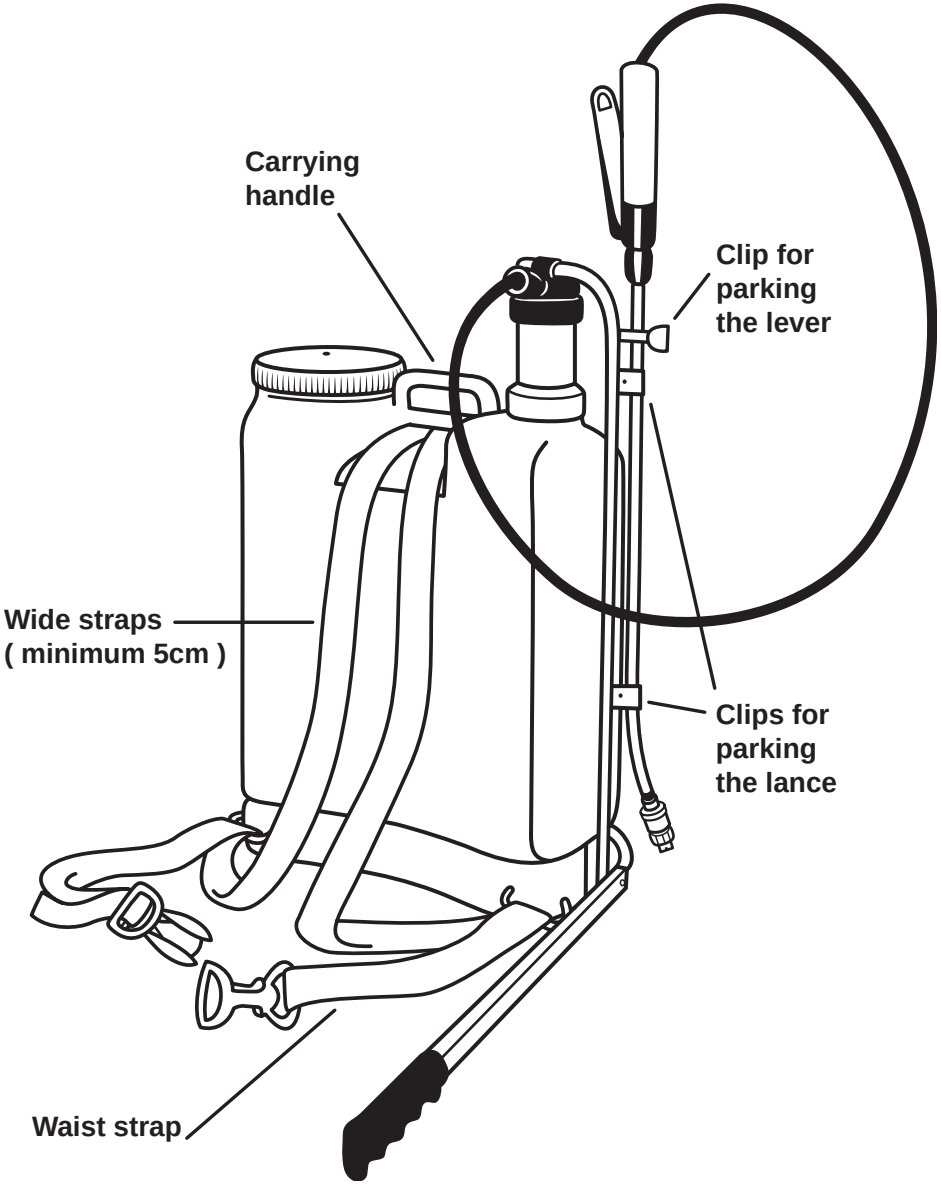
- a light disposable mask (or cloth tied around the face) should be worn when applying insecticide / fungicides with rotary atomizers
- respiratory protective equipment (respirator) should be used during fogging and dusting
- ear defenders should be used with loud motorized equipment such as foggers or mistblowers.

LK sprayers (lever operated knapsack)

LK sprayers are worn on the operator's back and pumped continuously. Useful for field crops, bushes and some tree crops. Safe LK sprayers should have:

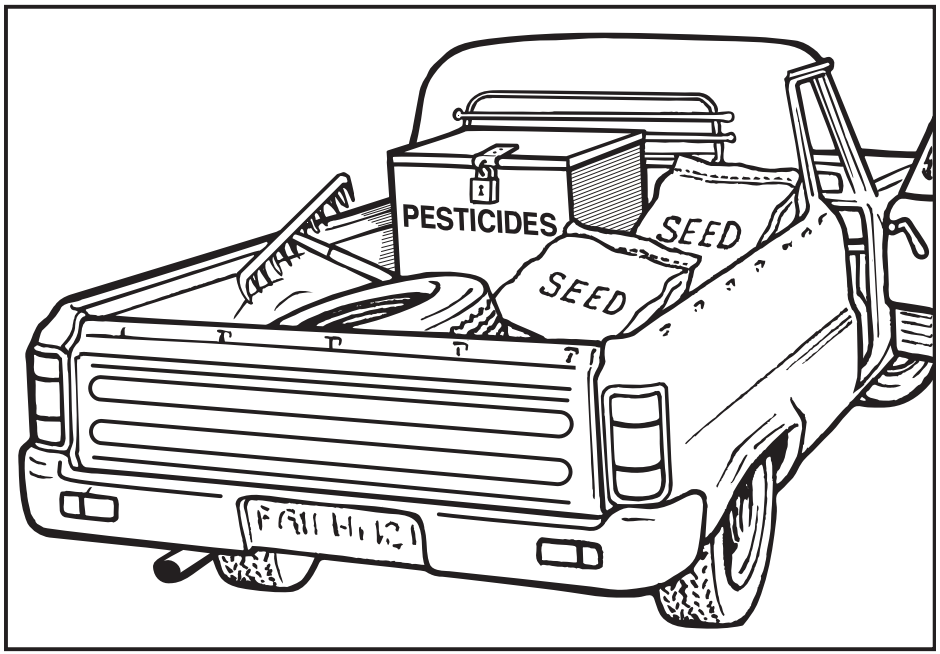
- no leaks
- wide tank opening
- deep tank strainer
- flat or convex lid
- long lance
- nozzles that can be changed
- trigger valve with strainer
- wide straps
- parking place for lever and lance.

NOTE: LK sprayers with piston pumps can produce higher pressures than diaphragm LK sprayers.



Safety in storage of pesticide

- Keep pesticides stored in a secure locked cupboard or storage box outside the house
- Never keep pesticides near beds or cooking areas or within reach of children
- Only buy sufficient pesticide for the area of crop you will treat
- Avoid storing pesticides for a long time because they may become ineffective or start leaking.



SPRAYERS

There are many types of portable sprayer available. Farmers and operators should choose good quality sprayers. This will save them money, protect their crops and health better and safeguard the environment.

Check for:

- strong materials
- no leaks
- correct nozzles
- easy and safe filling
- no places for pesticide to collect, e.g. concave lids.

Sprayer abbreviations

LK = lever operated knapsack

CS = compression sprayer

MB = motorised mistblower

RA = rotary atomiser

HF = hot (thermal) fogger

Safety when transporting pesticides

- Never transport pesticides with people, food or animal feed
- Transport pesticides in a locked box in the back of a pick-up truck, or in the boot of the car - never in the passenger compartment
- Always carry some absorbent material (such as toilet paper) and soap and water to clean up any spills.

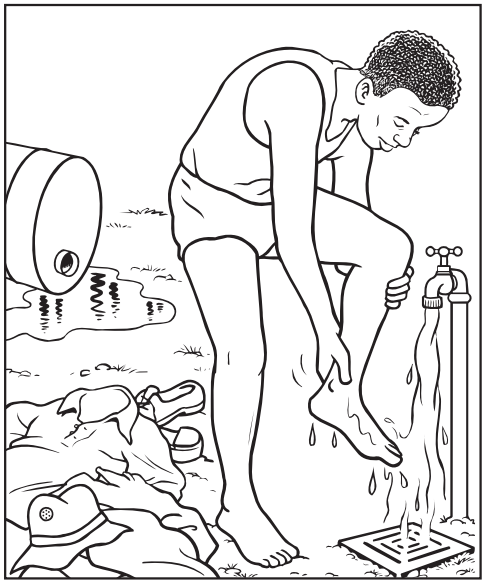
Pesticide poisoning and First Aid

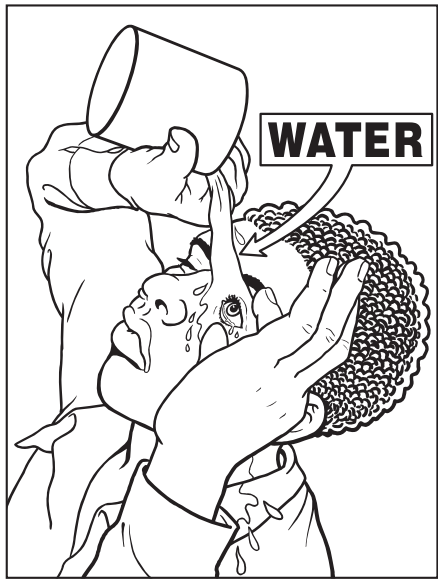
Symptoms/signs of poisoning

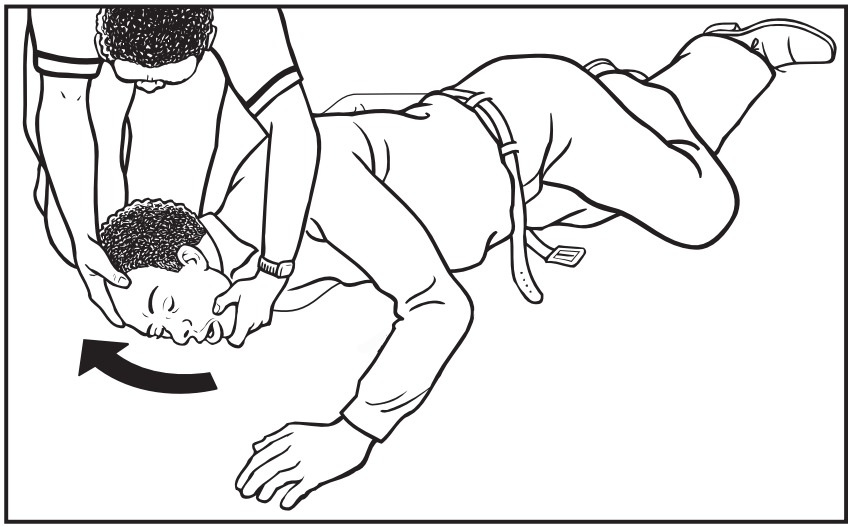
- Dizziness, feeling sick, tiredness, worry, excitedness, sweating, salivation, shaking hands, stomach cramps, blurred vision, pupils of the eyes become very small, unconsciousness.

First aid

- Act quickly - speed is essential
- Check breathing and give artificial respiration if necessary
- Wash contaminated skin or eyes with plenty of water
- Remove contaminated clothing
- If the patient is unconscious, lie them down on their side
- Call for transport to a medical centre
- Continue First Aid during transport to medical help
- Take the pesticide container or label with you so that medical staff can identify the best treatment.





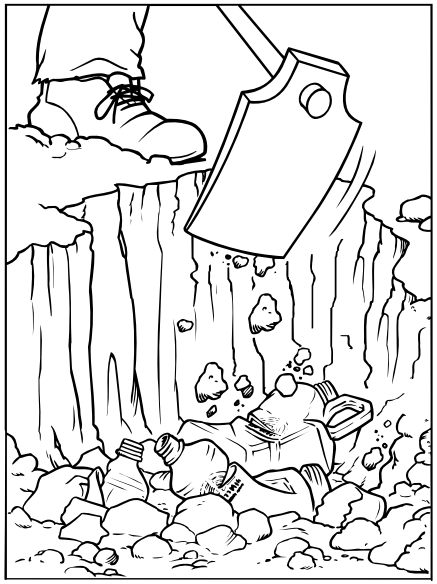


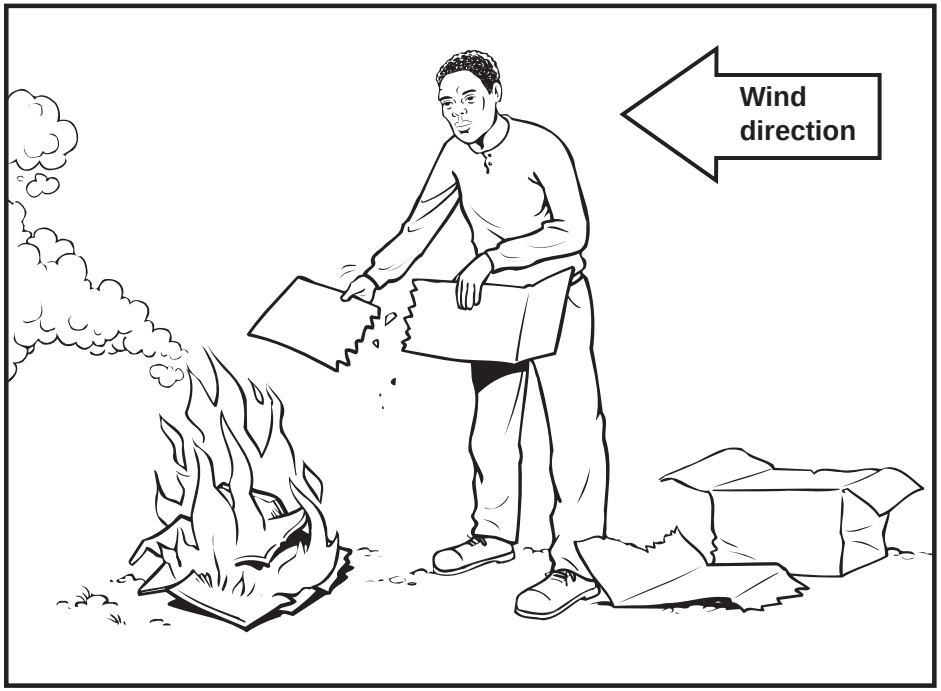
Safety after spraying

- Make sure people do not enter sprayed fields after treatment – put up a clear sign

- Take down signs when the **withholding period** is over. This is usually 24 hours, but for very toxic products may be over a week. Check the pesticide label for instructions

- Do not harvest before the **pre-harvest interval** (PHI) has elapsed. This is the interval after spraying before produce can safely be harvested and eaten. It is usually longer than the withholding period. Check the pesticide label for instructions.





Safe disposal of pesticides and packaging

Concentrated product

- Try to return it to the retailer if possible
- Never try to burn concentrated product

Diluted spray mix

- Try not to mix so much that there is spray mix to be disposed of
- Dilute it ten times with water and spray onto the crop or waste ground away from water or houses
- Wash sprayers three times with water and spray onto crop or waste ground as above.
- NEVER pour washings in rivers/streams

Pesticide containers

- Wear protective clothing as for mixing/filling
- Rinse containers three times and use the washings to dilute the spray mix
- Puncture and bury metal and plastic containers
- Burn cardboard packs - note wind direction and always stand UPWIND of the fire.