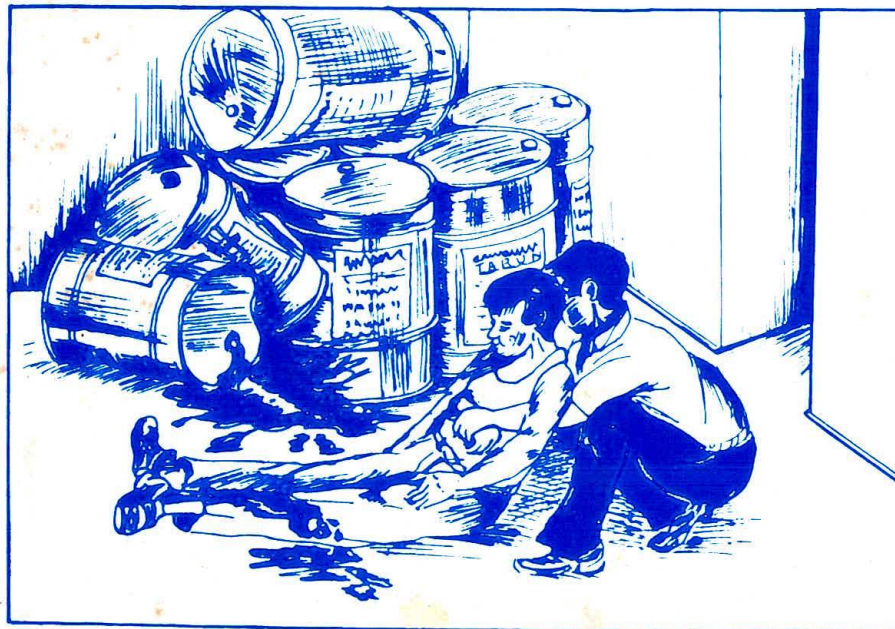


Manual for Trainers of Community Health Workers on Diagnosis and Treatment of Pesticide Poisoning



UNDP/WHO SEARO Project on Safety and Control of Toxic Chemicals
and Pollutants in Collaboration with Malaria Research Centre

**MANUAL FOR TRAINERS OF
COMMUNITY HEALTH WORKERS ON
DIAGNOSIS AND TREATMENT OF
PESTICIDE POISONING**

CONTENTS

Preface	1
SECTION I: General	3
SECTION II : Signs, Symptoms & Treatment	15
A. Routes of entry	15
B. Signs and symptoms - emergency treatment	20
C. Emergency treatment - (general)	31
D. Local treatment (general)	36
SECTION III : Medical Treatment	38
SECTION IV : Surveillance	46
SECTION V : Application of Pesticides	50
A. Application by task	51
B. Application by equipment	56
SECTION VI : Chemistry and Biochemistry	64
A. Chemical types of pesticide	64
B. Mode of action	68

SECTION VII : Protection for Poisoning

71

A. Protection by hygiene

71

B. Protection according to job

76

C. Protection of parts of body

80

D. Protection by technique

83

E. Protection of others

88

SECTION VIII : Environment Protection

92

APPENDIX : Incidents of Human Poisoning

100

PREFACE

Pesticide poisoning cases are reported sporadically from almost all over the country. Acute or chronic poisoning may occur by any of the pesticides used in the protection of crops, storage of grains, control of household pests, the vectors of human and animal diseases and the nuisance insects. The environment may be contaminated by improper disposal of insecticides or their containers or attempt to commit suicide or accident in the transportation or application of insecticides etc. Large scale poisoning cases have been reported by inadvertent which have opened up for cash crop cultivation excessive use and at times misuse of pesticides and very often careless handling of the pesticide has been observed. By and large pesticide poisoning is due to accidents or negligent handling. Cases of poisoning may become serious or fatal due to lack of recognition and non-availability of emergency treatment. Fortunately, it is possible to completely avoid poisoning by preventive methods, and if there is a case of poisoning early recognition of the symptoms of poisoning and prompt emergency treatment can save the patient.

This course is therefore designed for the training of trainers who are medical officers on the diagnosis and treatment of pesticide poisoning with the objective to (i) organize similar courses for medical officers and (ii) impart training to community health workers for which a separate manual has been provided.

At the end of the course medical officers attending the course are expected to acquire adequate knowledge on various pesticides used in the country, their toxicology and mode of action, method of application, possible ways of pesticide contamination and poisoning, methods of safe use of pesticides, signs and symptoms for emergency treatment and follow up action so that participants would be able to treat cases of poisoning in their areas and impart training to community health workers. The community workers after training should in turn become proficient in recognition and emergency treatment of poisoning cases. A community health worker should be able to acquire basic knowledge on various types of pesticides used in public health, agriculture and protection from household pests; likely hazards associated with each pesticide; do's and don't's in the use and safe storage of pesticides; recognition of early symptoms, administer first aid treatment and arrange immediate medical help with full details of the source of poisoning and about the chemical and history of the patient for correct treatment by the doctor.

The course is meant to be given over a 4 day period in conjunction with the following supplementary materials:

1. Recognition and Management of Pesticide Poisonings, D.P. Morgan
2. "The WHO Recommended Classification of Pesticides by Hazard"
3. "International Code of Conduct on the Distribution and Use of Pesticides" FAO
4. "WHO Recommended Drinking Water Standards for Pesticides"
5. "Pesticide Act"
6. Manual for training of community health workers on treatment and diagnosis of pesticide poisoning.

For further information, please contact Chief, Promotion of Environmental Health, South East Asia Regional Office, WHO, New Delhi.

SECTION - I GENERAL

CHEMICAL PESTICIDES IN LIQUID OR SOLID STATE

Definitions : 'PEST AND PESTICIDE'

PEST : A PEST IS AN ORGANISM WHICH IS TROUBLESOME, DESTRUCTIVE OR CARRIES DISEASE TO PLANTS OR ANIMALS

PESTICIDE : ANYTHING WHICH KILLS A PEST IS A PESTICIDE

Commonly used pesticides are toxic chemical substances which should be handled carefully. There are other kinds of pesticides such as biological agents, but these are not in common use. The rules for the safe use of these are similar in most respects to those for chemical pesticides.

Some biological agents are:

Bacteria : *Bacillus thuringiensis, Bacillus sphaericus*
Fungi : *Lagenidium gigantum, Coelomomyces species*
Culicinomyces species, Leptolegnia
Nematodes : *Romanomermis species*
Protozoa : *Nosemo algerae*
Viruses : Nuclear - polyhedrosis viruses

PESTICIDES ARE NAMED AFTER THE PEST THEY KILL

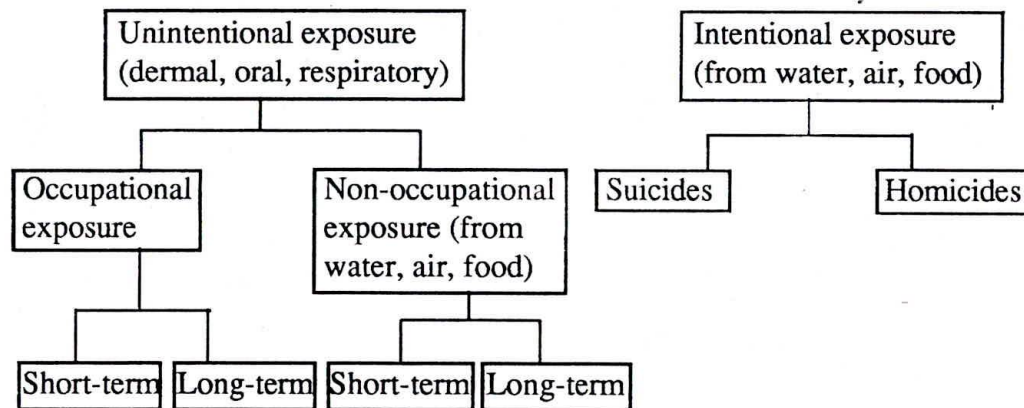
Examples:

INSECTICIDES	kill insect
LARVICIDES	kill insect larvae
FUNGICIDES	kill fungi (moulds)
RODENTICIDES	kill rats and other rodents
MITICIDES (Acaricides)	kill mites
MOLLUSCICIDES	kill snails
OVICIDES	kill insect eggs
NEMATOCIDES	kill nematodes

All the above groups of pesticides are used in India.

This course does not cover fumigants which are chemical pesticides used as gases.

Types of exposure to pesticides*



*Source WHO

FORMULATIONS

The pesticide itself is known as the active ingredient (ai)

Usually it has to be diluted for use because:

- i) physical properties of the active ingredients are unsuitable for field use
- ii) pesticides are highly toxic in the pure form (ai), and
- iii) required doses are difficult to disperse due to high concentration.

To make dilution easy, the pesticide is made into a FORMULATION

Some formulations are:

- | | |
|------------------------|---|
| Mixture with water/oil | <ul style="list-style-type: none">i) Wettable powders (WP) also called water dispersible powders (WDP)ii) Emulsifiable concentrates (EC) |
| Dry applications | <ul style="list-style-type: none">i) Dusts (D)ii) Granules (G)iii) Encapsulated granules |
| Gas or vapour | <ul style="list-style-type: none">i) Fumigantsii) Smoke generators or tablets which vaporiseiii) Aerosols and pressurised sprays, |
| Others | <ul style="list-style-type: none">i) Seed protectants (dry or liquid)ii) Baits for rodents, slugs, cockroaches etc.iii) Ultra low volume concentrates (ULV) |

1. WETTABLE POWDER

Also known as a water dispersible powder (WDP). It is added to water and mixed.

Inert dusts (such as Silicon oxides and Calcium silicates) are impregnated with pesticide and a wetting agent (detergent) is added. Resultant powder on mixing with water forms suspension.

Examples - DDT as 50% and 75% WDP

BHC as 50% WDP

Synthetic pyrethroids -

Deltamethrin 2.5% WP

Cyfluthrin 4.0% WP

2. EMULSIFIABLE CONCENTRATE

Pesticide is mixed with emulsifier to help the concentrate mix readily with water. The emulsifier causes oil to disperse uniformly throughout the carrier (i.e., water). Emulsifying agents used in the formulations are sodium naphthyl sulphonate and cetyl pyridium bromide.

Some preparations are :

Cypermethrin	25% EC
Malathion	50% EC
Abate	50% EC

For discussion

If a container is damaged, which formulation will cause more contamination:

wettable powder?

emulsifiable concentrate?

An emulsifiable concentrate will cause more contamination and toxicity, as it is liquid based and penetrates through surface layer. It cannot be collected back unlike WDP which contaminates only upper layer of area of contact and the powder can be scraped.

3. GRANULES

Granules may be floating, semi-floating or settling granules.

Usually, the active ingredient in the granule formulation is dispersed throughout the granule.

Pesticide is contained in small granules of inert material either as coating or as impregnated toxicant in the build up of the granules. Active ingredient content varies 3% to 10% in India. Since formulation is applied in soil, granules are less harmful to beneficial insects such as bees. Temephos granules, used for control of mosquito breeding are made with China clay, Kaolin and attapulgate as formulation materials.

Examples: Thimet 10-G (Organophosphate)
Furadan 3-G (Carbamate)
Baygon bait - granules 2% propoxur (carbamate)
Fenthion (2% granules)

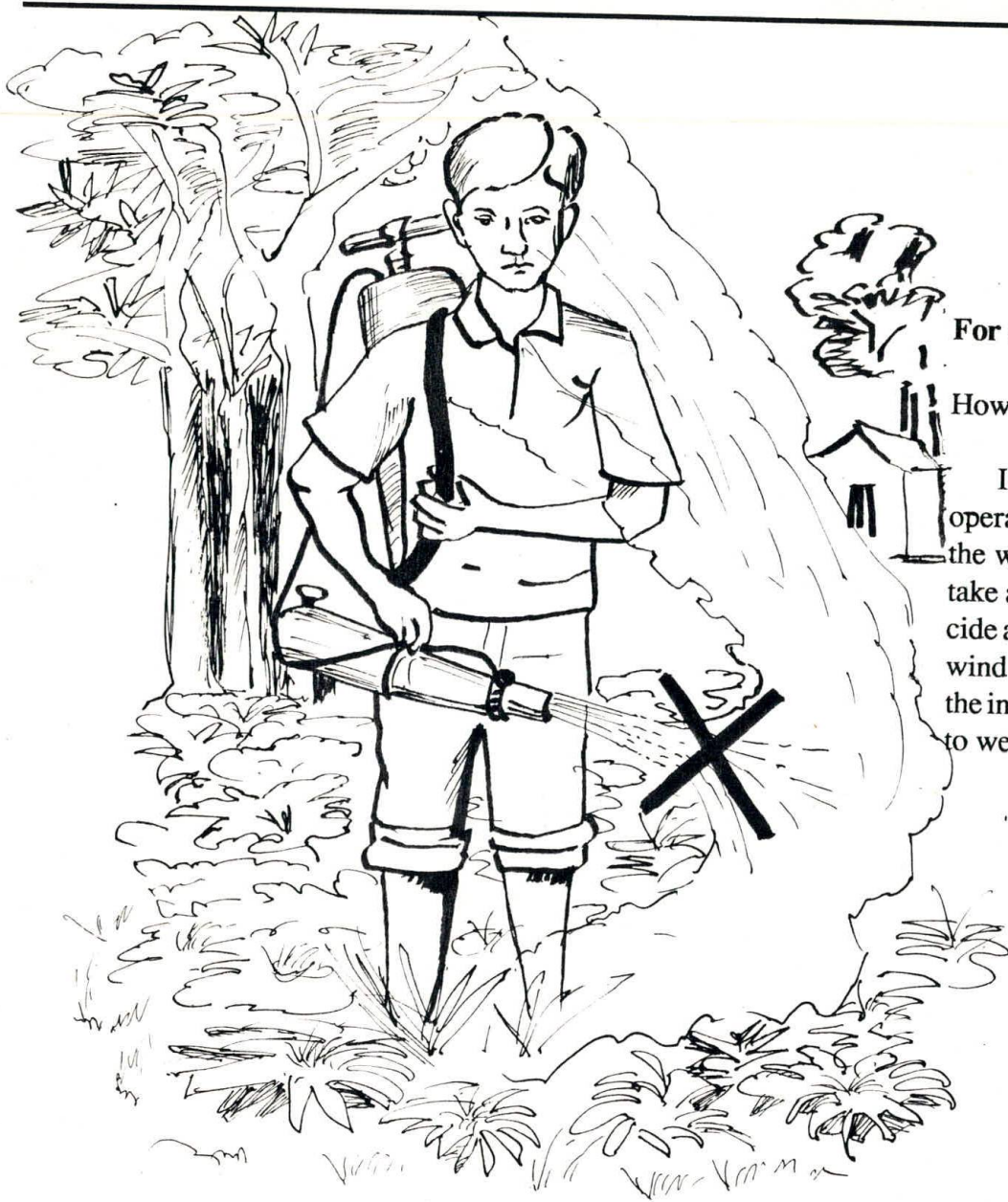
4. DUSTS

Dusts can be used in undiluted form or can be mixed with inert diluent.

Granules and dusts are not usually diluted but are used in the form shown. The pesticide (active ingredient) is often present in low concentration.

Some common materials used as diluents in the dusts are

Talc
Prophyllite
Kaolin



For discussion:

How would dusts be affected by wind?

Insecticidal dusts can be applied by hand operated or powder driven dust blowers from the windward side of the site of application to take advantage of the wind to carry the insecticide across the site. A change in the direction of wind or blow-back can envelop the operator in the insecticidal dust. Thus it is desirable for him to wear a face mask during treatment.

Do not spray or dust into the wind

TOXICITY

Toxicity is the ability of a pesticide to cause harmful effect or it is the property of a substance which causes adverse effects in an organism. The term can be further split into

Acute	:	adverse effect in single short term use.
Chronic	:	adverse effect through repeated exposure.
Oral	:	adverse effect on swallowing.
Dermal	:	adverse effect through intact skin.
Inhalation	:	adverse effect due to absorption during respiration.

Toxicity varies with

1. The SPECIES

Obviously, a pesticide must be highly toxic to the target pest, if it is to be efficient, it may be less toxic for man.

2. The CONCENTRATION of the toxic part (the active ingredient) in the formulation as it is handled.

For discussion

Which is more toxic:

Emulsifiable concentrate?

OR

Dust?

Emulsifiable concentrate is more toxic than dust because it is more quickly absorbed through skin or mucous membrane. But when inhaled during application by dust blower, dusts may be as toxic as emulsifiable concentrates.

HAZARD

Hazard is the probability of adverse effects occurring.

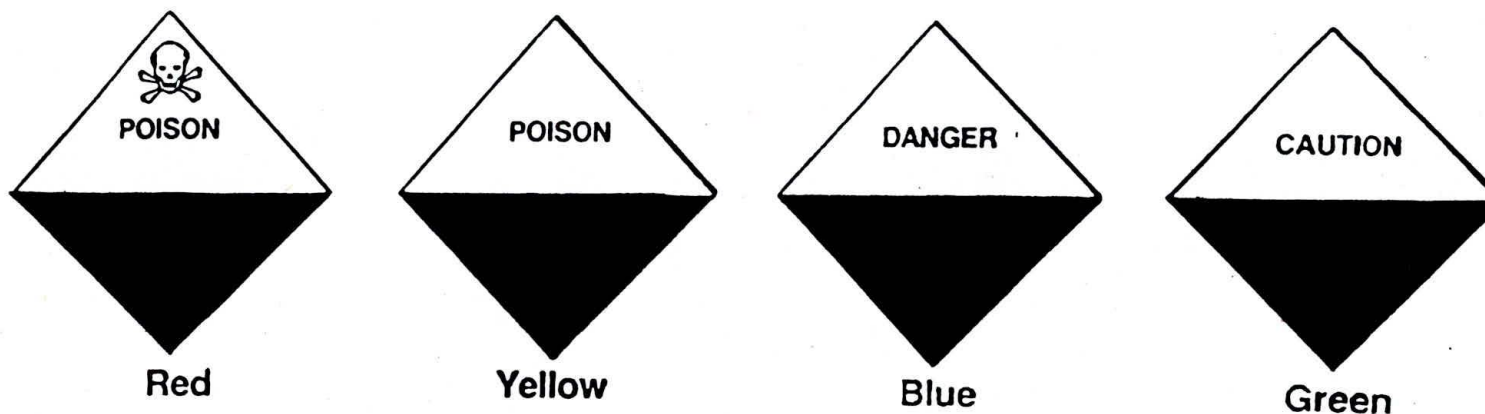
$$\text{Hazard} = \text{Toxicity} \times \text{Exposure}$$

Hazard and toxicity are different:

If exposure is nil, hazard is nil.

Hazard can be reduced by reducing exposure. The real concern is the risk or hazard associated with use of chemical, not whether it is toxic or safe. Depending on use and disposition a very toxic compound may ultimately be less harmful than a relatively non-toxic one.

How to reduce exposure is dealt with in subsequent sections.



Labels convey information on hazard and toxicity

LABELS

National labels according to hazard class.

Pesticide are labelled according to their hazard class. Labels also give instructions according to the toxicity of the pesticides.

In India, Rule 19 of the Insecticide Act calls for warning symbols which are diamond shaped. The lower triangle is coloured to indicate degree of toxicity of contents. Upper triangle contains signal words for cautioning.

Category	LD50 (oral) mg/kg	Warning word	Instructions
1. Extremely toxic	1 to 50	POISON	Keep out of reach of children if swallowed or if symptoms of poisoning occur, call physician immediately
2. Highly toxic	51-500	POISON	Keep out of reach of children.
3. Moderately toxic	501-5000	DANGER	Keep out of reach of children.
4. Slightly toxic	5000	CAUTION	-

ADDITIONAL INFORMATION ON LABEL AND LEAFLET*

Every pesticide container has a label affixed on it. The word label includes not only the printed paper label stuck on the container, but also the printing or stencilling on the container. The label on the container provides the most important facts about the pesticide in the container.

The leaflet is a paper found inside the container or otherwise attached to it. The leaflet also contains very important information. Both are statutorily required under the Insecticides Act, 1968 (section 18 and 19). Both the label and leaflet and the instructions on them must be thoroughly read by the user. The information contained on the label and in the leaflet is not only important but has been termed as the most expensive literature in the world. This is because of the expenditure on research and development, not only on the pesticide but also on its use, bioefficacy, toxicology and safety. Considering the effort and money spent in gathering and documenting the label information, it is important that the user appreciates the value of the information.

As stated earlier both the label and the leaflet are statutorily required. Before a pesticide is registered for use the label and leaflet are submitted to the Central Insecticides Board for their approval. The Central Insecticides Board examines thoroughly on all aspects, especially usage and safety, before according their approval. Good manufacturing practice calls for the label and leaflet to be read by the user, and the instructions thereon to be strictly obeyed.

LABEL

1. **Name of the insecticide including:**
 - a) brand name
 - b) trademark
 - c) common name

*Source: Manual for pesticide users published by Pesticide Association of India.

-
2. **Name of the manufacturer:** The full name and address of the manufacturer is given. In case the manufacturer is different from the person in whose name the insecticide is registered, the relationship between the manufacturer and the person who has registration is normally given.
 3. **Registration Number of the Insecticide:** This is a number given by the Central Insecticide Board to the manufacturer for a particular insecticide. It is exclusive for a manufacturer and insecticide.
 4. **Ingredient Statement:** This gives the names of the active ingredients, inert ingredient etc. with a percentage composition of each. Generally, the common name of the active ingredient is given if a common name is not approved, the correct chemical name is mentioned sometimes both are mentioned
 5. **Type of formulation:** This describes the type of formulation such as an emulsion concentrate, wettable powder, dust, granules etc. This also states the percentage content of the active ingredient in the formulation.
 6. **Net contents of the package:** This indicates the quantity of the formulation in the container. This is generally expressed in kgs., gms., litres or millilitres. the quantity given is the net weight of the package.
 7. **Batch number:** This indicates the quality control batch number assigned by the manufacturer. Different manufacturers have their own standards of assigning the batch number.
 8. **Date of manufacture:** This is normally mentioned on each package and indicates the date on which the material was manufactured.
 9. **Expiry date:** This is a date subsequent to the date of manufacture indicating the period within which the pesticide retains its efficacy and safety. This is an indication of the shelf life of the product.
 10. **Antidote statement:** The antidote statement describes the specific antidote (s) applicable to the pesticide. This is given to assist treatment in case of poisoning.
 11. **Warning symbols and signal words:** As mentioned earlier.

The label is affixed on the container in such a manner that it cannot be ordinarily removed. Further, most labels contain all the information in more than two languages; Hindi and English are commonly used and other regional languages are also used on the label. Alteration, obliteration or defacement of the label in whole or in part, other than by a manufacturer is an offence under the Insecticide Act.

LEAFLET: For each unit pack one leaflet is provided by the manufacturer. The leaflet contains very useful information. Limitation on the use of the pesticide is given on the leaflet. The following information is normally available on the leaflet.

1. **Particular application of the pesticide:** This includes names of insects, weeds, diseases etc. for particular crops against which the pesticide may be used.
2. **Directions for use:** This indicates the dosage to be applied, the manner of spraying, the time of application and other useful information related to the method of use of the insecticide.
3. **Warning and cautionary statement:** This includes symptoms of poisoning, safety measures required, emergency first aid treatment and antidotes. This also provides information about the flammability, irritation and other hazards.
4. **Container disposal:** This includes instructions concerning the decontamination of the empty containers and their method of disposal.
5. **Storage information:** This includes information on the method of storage.

SECTION II

Signs, symptoms and treatment on an emergency basis

Pesticides are poisonous chemicals that kill insects, weeds or other pests, but they can also poison people. People may be poisoned by getting pesticide on their skin, or by breathing in vapour, spray droplets or dust, or by swallowing.

Given below are some of the ways people may be poisoned:

- if they use pesticides in a wrong way. For example, children may be poisoned if pesticides are sprayed on their bed clothes.
- if they do not use protective equipment.
- if they eat, drink or smoke after working with pesticides.
- if empty pesticide containers are used to store food or drink.

ROUTES OF ENTRY

ORAL

There are four routes by which pesticides can enter the body.

The first route is through the MOUTH

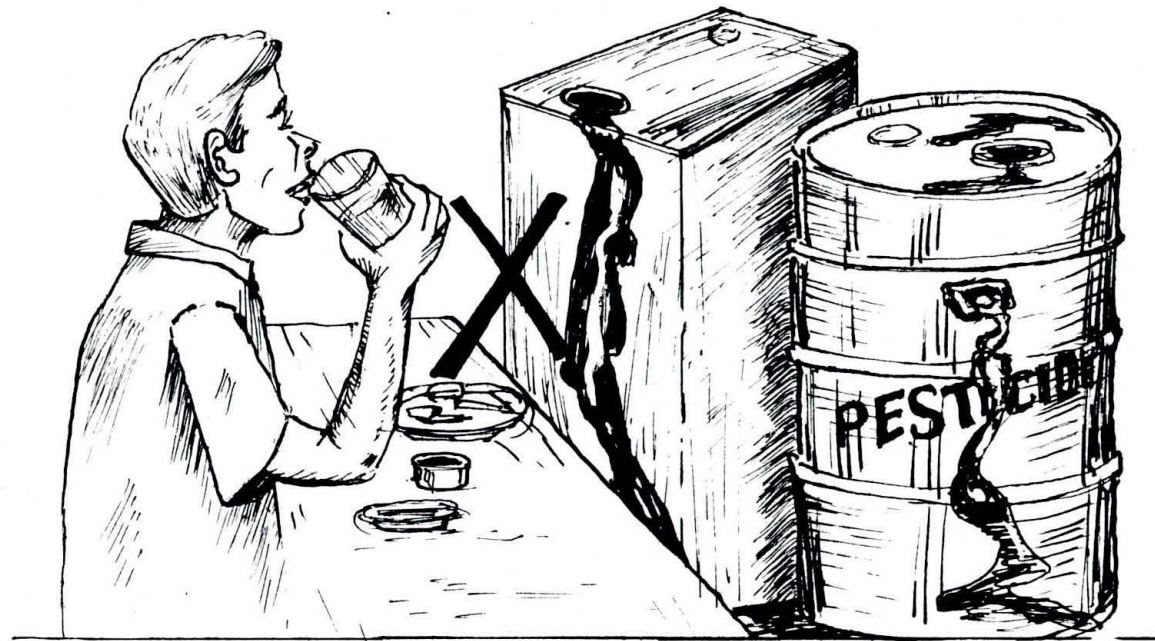
At work:

- by eating and drinking while handling pesticides e.g. contaminated food, vegetables, fruits & drinking water.
- by smoking while handling pesticides

At any time:

- by taking a drink from something containing pesticide in mistake for some other liquid.
- by leaving anything contaminated or containing pesticides in the way of young children.

The most common route of entry through oral route is by eating and drinking while handling pesticides and also smoking while handling.



Most common mode of entry of pesticides through oral route

INHALATION

The second route of entry is through the **LUNGS** by breathing in the pesticide.

This can be done by breathing in:

- vapour
- light spray
- light dust

Only minute particles reach the lungs but larger particles can be absorbed through mucous membranes or coughed up and swallowed.



The lungs are a primary route of entry for vapours, fumes and dusts.

DERMAL

The third important route of entry is dermal. The human body is covered by skin, also known as epidermis. Even where skin is intact, pesticides are capable of diffusing and crossing this barrier. In other words it is possible for pesticides to enter the human body even through intact skin.

All areas of skin permit pesticide absorption. However, research has shown that different parts of body permit different rates of absorption.



Some pesticides can be absorbed directly through the skin

Pesticide Absorption Rate in various parts of human skin

Body Area	Relative absorption rate per minute
Forearm	1.0
Palm of hand	1.3
Ball of foot	1.6
Abdomen	2.1
Skull	3.7
Forehead	7.0
Scrotum	11.8

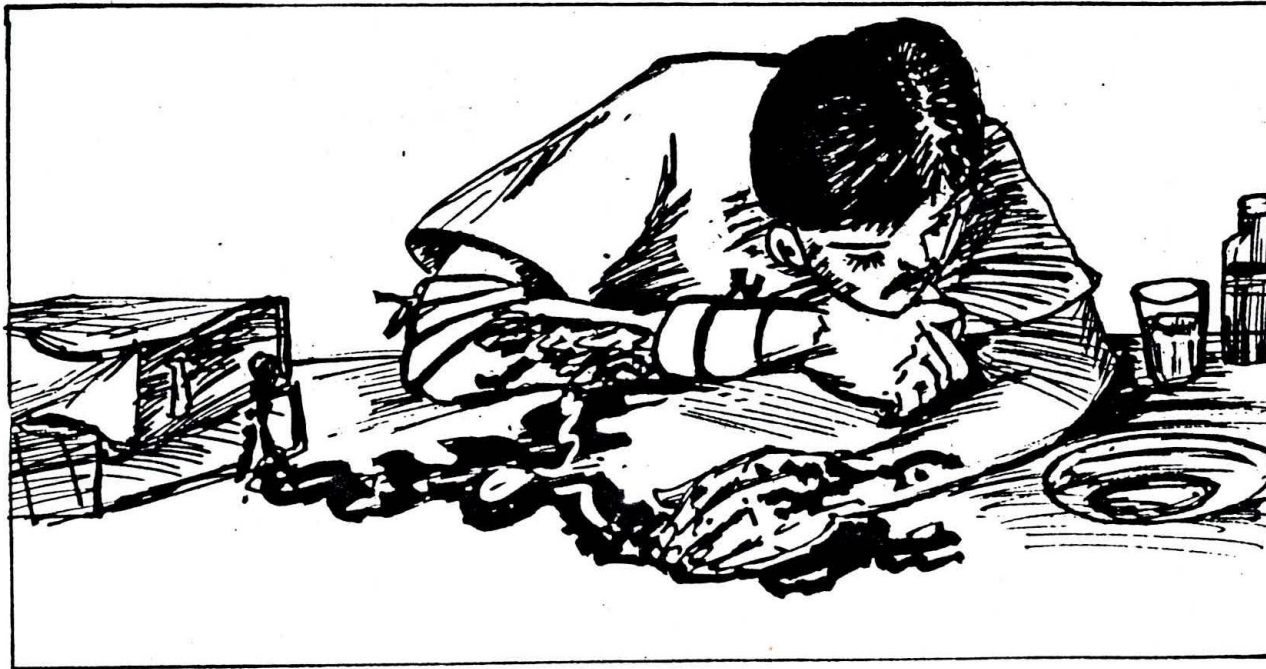
Other factors influencing absorption of pesticides from dermal route are:

Skin characteristics: sores and abrasions, wetness of skin, location on the body (absorption occurs readily through eyes & lips)

Environmental Factors: temperature, humidity

Pesticide characterization: acidity (pH), vehicle, physical, state (solid, liquid, gas), concentration of active ingredient

When the skin is broken either due to injury or other diseases, it is much easier for the pesticide to enter the body.



Never allow pesticides to come in contact with cuts or wounds

Subject A signs and symptoms of intoxication : emergency treatment

1. ORGANOCHLORINES

Signs and symptoms

Poisoning by organochlorine compounds causes -

at first: irritation
headache
malaise (feeling of tiredness)

then: giddiness
nausea
vomiting
muscle twitching
convulsions
respiratory depression

In acute poisoning onset is within 1-72 hrs. and death within 24 hours of the onset.

The above signs and symptoms are usually seen with the more toxic organochlorines only e.g., aldrin, dieldrin, DDT does not cause these acute symptoms in ordinary exposure but it is stored indefinitely in human tissues

DDT in dry powder and aqueous suspension forms is poorly absorbed from GIT and respiratory tract and does not penetrate the skin appreciably. Oils, fats and lipid solvents, however, enhance the absorption of DDT from all sites including intact skin.

No simple confirmatory laboratory test is available.

The clinical presentation also includes the following systemic effects.

a. Central Nervous System

Organochlorines are CNS stimulators that produce apprehension, excitability, parasthesias, dizziness and tremors progressing to stupor, coma and convulsions in severe cases. They may enhance myocardial irritability leading to cardiac dysrhythmias after heavy exposures. Serious complications involve seizures with resultant hypoxemia, metabolic acidosis and death.

b. Lungs

The solvent vehicle or organochlorine insecticides is capable of producing hydrocarbon pneumonitis after aspiration.

c. Blood

Lindane has been reported to cause aplastic anaemia, agranulocytosis and bone marrow hypoplasia.

d. Muscle

Myoglobinuria, acute renal failure and a proximal myopathy may develop with lindane.

Emergency treatment

If a person seems to be suffering from organochlorine poisoning following steps should be taken.

a. if a person is not breathing

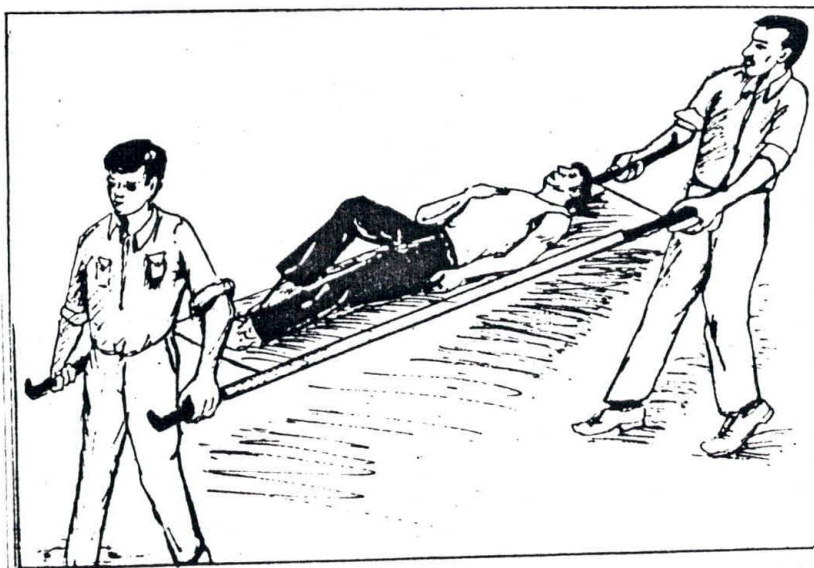
- give artificial respiration

b. if person is breathing but is not conscious

- turn on to face with head to one side
- watch breathing
- send for, or transport to medical aid
- in case of convulsions (fits) gently restrain person to avoid injury.

c. if person is breathing and is conscious

- send for, or transport to medical aid
- if person has drunk poison, induce vomiting

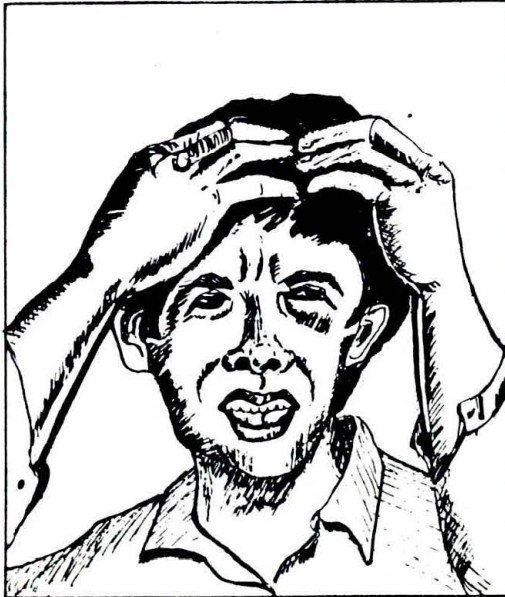


2. ORGANOPHOSPHATES

Signs and symptoms

Poisoning by organophosphorus compounds causes -

at first : sweating	then: pin-point pupils
salivation	brachycardia
lacrimation	diarrhoea
weakness and tremor	vomiting
abdominal cramps	respiratory difficulty
blurred or double vision	convulsions
	coma
	cardiac arrhythmias and arrest



Headache and vomiting are common symptoms of pesticide poisoning

In acute poisoning: onset within $\frac{1}{2}$ - 12 hrs, death within 48 hours recovery is complete if the dose is not fatal.

Confirmatory laboratory test:

Plasma cholinesterase activity estimation is diagnostic if plasma cholinesterase activity is less than 20% of normal or whole blood cholinesterase is less than 60% of normal.

The poisoning due to organophosphates is due to deactivation of acetylcholinesterase enzyme. This causes accumulation of large amounts of acetylcholinesterase enzyme. This causes accumulation of large amounts of acetylcholine. The clinical effects can be categorized as:

a. **Muscarinic effects**

- Tightness in chest, wheezing, rhinitis, dyspnoea, increased bronchial secretion, cough, pulmonary oedema, cyanosis.
- nausea, vomiting, abdominal tightness & cramps, diarrhoea, tenesmus, fecal and urinary incontinence,
- sweating, salivation, lacrimation
- brachycardia, fall in blood pressure,
- miosis, blurring of vision

b. **Nicotinic effects**

- muscular twitching, fasciculation, weakness, cramps.
- pallor, tachycardia, elevation of blood pressure.

c. **Central nervous system effects**

- initial stimulation followed by depression

Emergency treatment

If a person seems to be suffering from organophosphorus poisoning treatment is urgent.

1. If atropine is available give 2 mg I/V and repeat after 10-15 minutes if symptoms not improved.
2. **if person is not breathing:**
 - give artificial respiration
3. **if person is breathing but is not conscious**
 - wash contaminated skin
 - turn the face head to one side
 - watch breathing
 - in case of convulsions (fits) gently restrain person to avoid injury.
4. **if person is breathing and is conscious**
 - if person has drunk poison, induce vomiting
 - wash contaminated skin
 - watch carefully and do not leave alone for half a day even if the person seems to have recovered.

In all cases send for, or transport to medical aid if possible.

<p>REMEMBER</p> <ul style="list-style-type: none">- Prevention is better than cure- Determine priorities quickly- Act promptly, delay can be fatal



Wash the patient thoroughly with clean water.



Spills should be wiped off when water is not available.

3. CARBAMATES

Signs and symptoms

Poisoning by carbamate compounds causes:

at first: sweating
dizziness
weakness
tightness in chest
abdominal cramps
vomiting
blurred vision
tachycardia
muscle fasciculation

Note: Onset is sudden. Symptoms usually start to improve in 1-2 hours and complete recovery can occur in 12 hrs. Fatalities are uncommon except after massive oral dosage.

The above symptoms are due to muscarinic & nicotinic effects like organophosphates.

Confirmatory laboratory test: Cholinesterase activity can be measured in severe cases but it is not usually helpful due to rapid spontaneous reactivation of enzyme.

Emergency treatment: Keep quiet and transport to medical aid if person does not seem to be recovering.

4. CHLORONITROPHENOLS

Signs and symptoms

Poisoning by chloronitrophenols and cresols causes:

- Dyspnoea
- hyperpyrexia
- weakness
- hyperglycaemia and glycosuria
- coma

Onset in acute poisoning may be delayed due to slow cumulative absorption. Death is due to irreversible hyperpyrexia, early appearance of rigor mortis.

Chronic poisoning causes:

- yellow staining of skin and hair (but not sclera)
(this colour does not wash off)
- peripheral neuritis
- agranulocytosis
- generalised weakness
- cataract

Confirmatory laboratory tests:

Compound in blood (4 mg/100 ml)

- Emergency treatment: - artificial respiration if required
- wash the contaminated skin

5. BIPYRIDYLS

Signs and symptoms

Bipyridyls (paraquat, diquat) cause serious poisoning when taken by mouth.

At first: malaise
 weakness
 ulceration of mucous membranes

After 48 hours: renal and hepatic dysfunction

After 14 days: dyspnoea
 progressive pulmonary fibrosis
 death due to respiratory failure

Condition is usually irreversible after 48 hours.

Laboratory confirmation: in urine or gastric aspirate:

to 5 ml add 0.1 g sodium bicarbonate
 0.1 g sodium dithionite

Mix, blue colour positive for paraquat, yellow-green for diquat.

Splashes in eye are severely irritating to conjunctiva and cornea. Exposure of hands causes discoloration and shedding of nails. Inhalation causes epistaxis due to ulceration of mucous membrane. Inoculation into scratches etc. causes skin vesiculation.

Emergency treatment: In case of bipyridyl poisoning take the following measures whether or not symptoms are apparent:

- Induce vomiting
- Wash out stomach with plenty of water and leave 7% bentonite or fuller's earth 70% in stomach.
- Send for further medical attention.

6. WARFARIN

Signs and symptoms

Warfarin, a coumarin derivative, is one of the most widely used rodenticides and has a good safety record. Rodents must eat the bait 3-10 days before fatal levels are achieved, which means a human toxicity can develop only after repeated doses. Multiple doses inhibit normal clotting and cause death by haemorrhage. A dose of 1-2 mg/kg wt daily over 1 week causes severe haemorrhage.

Acute effects depend on site of haemorrhage

and include: Haemoptysis, haematuria, gastrointestinal bleeding, abdominal or back pain, haemarthrosis, chymotic lesions.

Maximum depression of coagulation factors occurs 36-72 hours after warfarin ingestion.

Laboratory confirmation:

Depression of prothrombin time.

Estimation of warfarin in blood levels.

Emergency treatment: Give activated charcoal if large amounts have been ingested.

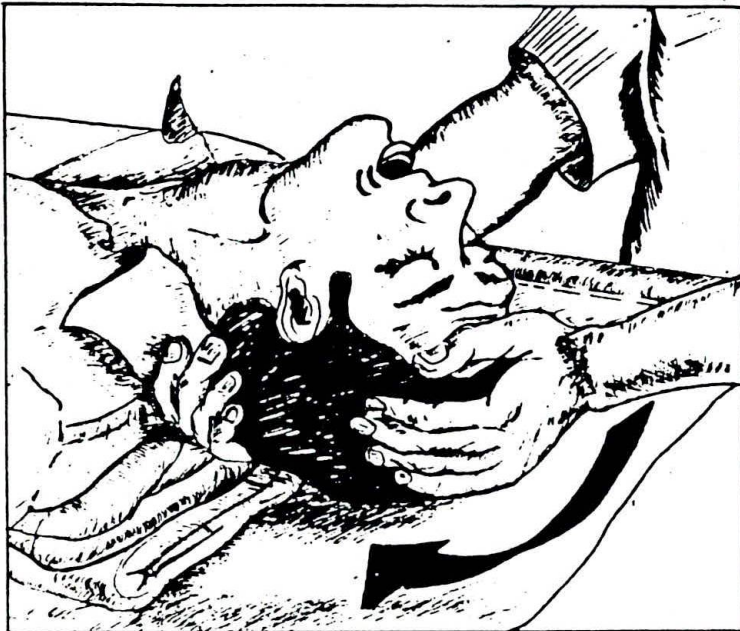
EMERGENCY TREATMENT (General)

1. ARTIFICIAL RESPIRATION

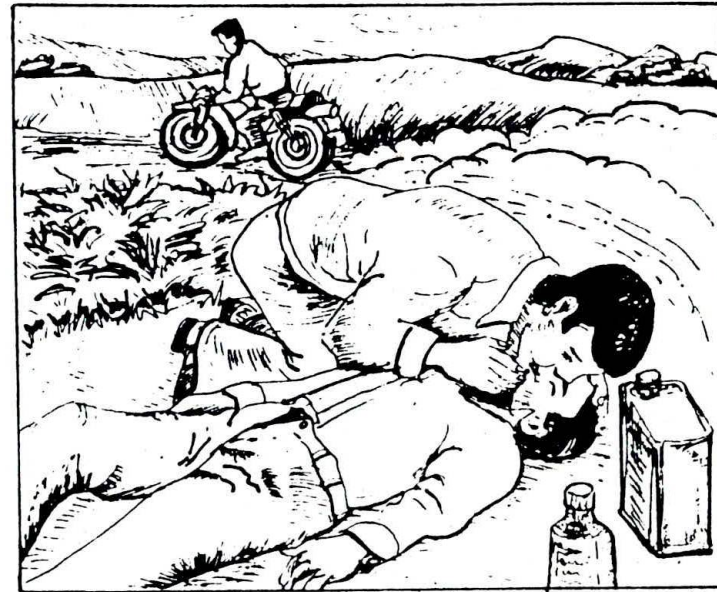
Artificial respiration is given when a person is not breathing on his own.

1. Make sure that airway is clear by pulling chin up and head back.
2. Use mouth to mouth method, through a cloth.
3. Fill the chest of the person with air 10 times per minute. Watch the chest rise to be sure airway is not blocked.

If medical aid is available, continue until the doctor says to stop. If medical aid is not available, and the pulse is beating continue as long as possible. If the pulse is not beating, stop after half-an-hour.

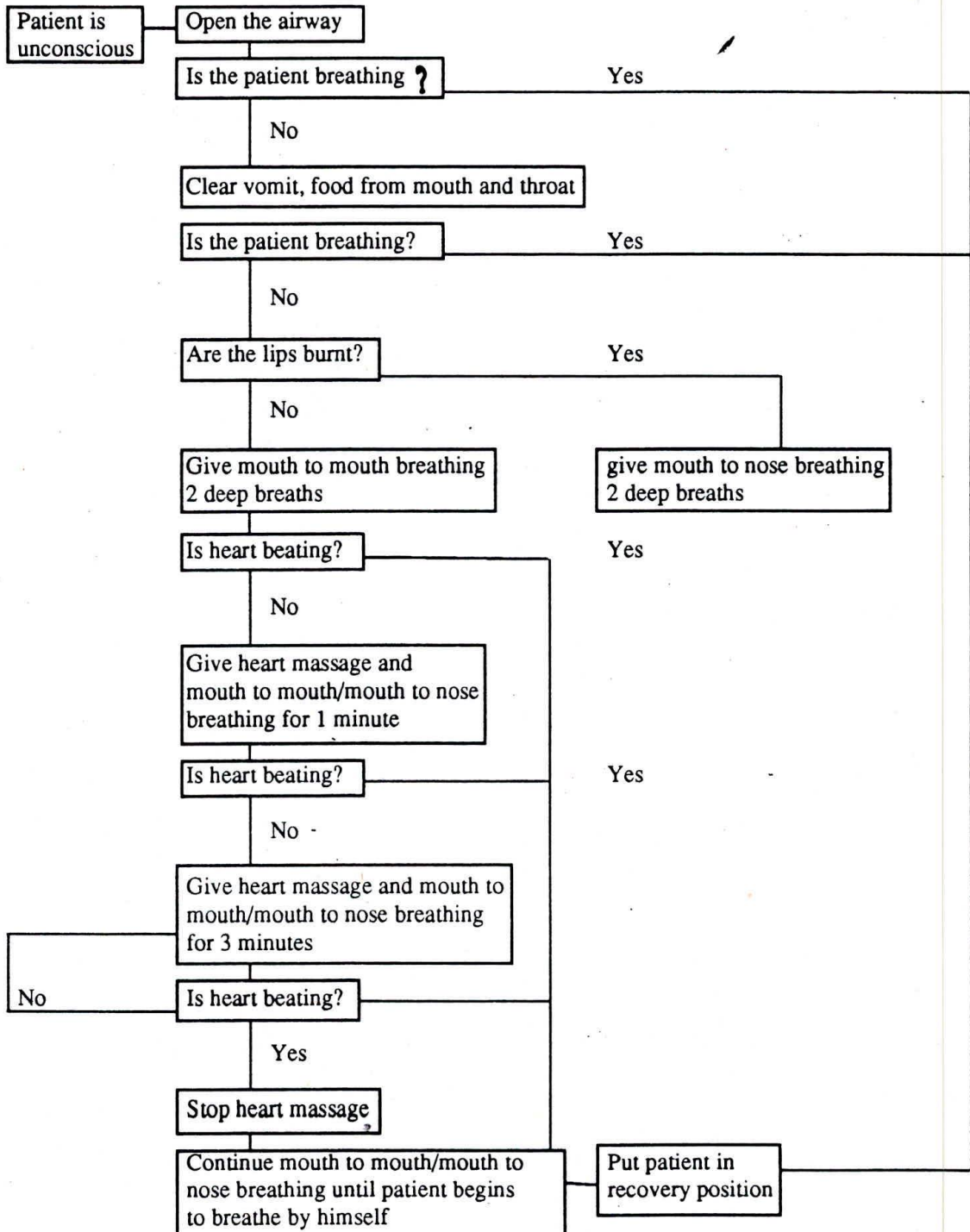


Tilt the unconscious patient's head backward to open his air passages.



Give the patient artificial respiration and send immediately for medical aid.

FIRST AID



2 VOMITING

A). When a person vomits it is important that none of the vomit should be breathed into the lungs.

If the person is unconscious, lie him front downwards, head downwards, head down and turned to one side. Transport the person in this way in case he vomits. Never give anything by mouth to an unconscious person.

B). To induce vomiting:

- place person head downwards
- put your fingers in person's mouth and lightly tickle the back of throat
- do not give slat mixtures to induce vomiting.

Do not try to induce vomiting if the person is unconscious.

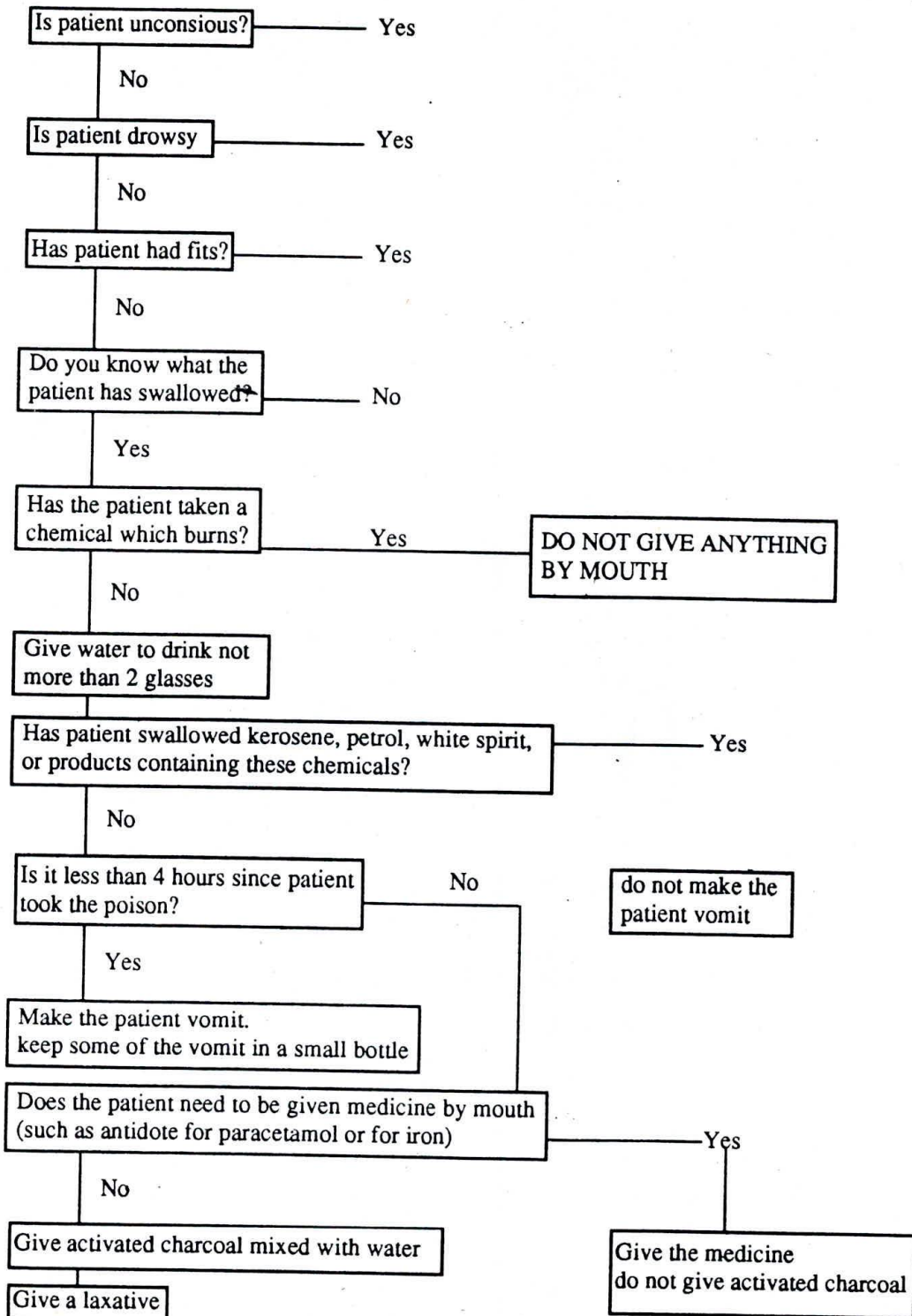
Contraindications for induction of vomiting

1. Unconciuous patient
2. Convulsing patient
3. If ingested poison is strong alkali, corrosive and or kerosene.



Induce vomiting in the conscious patient who has ingested highly toxic material

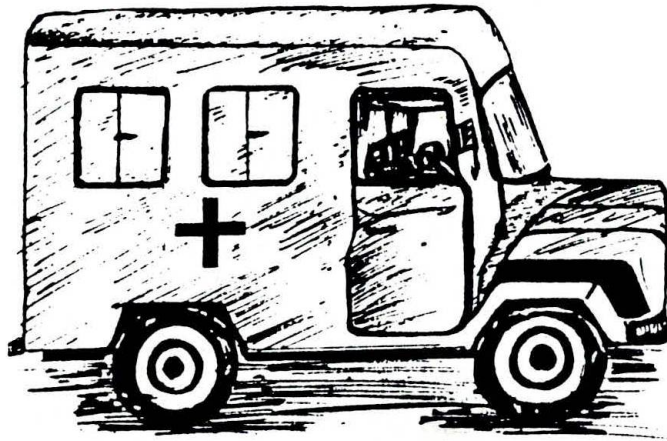
WHAT TO DO IF THE PATIENT HAS SWALLOWED POISON?



3. TRANSPORTATION

If the person seems to be poisoned, transport to hospital/medical centre as soon as possible, but -

- A) First:
- induce vomiting if pesticide taken by mouth
 - remove contaminated clothing and quickly wash skin.
 - give any other other treatment recommended.
- B) Disturb person as little as possible, i.e., do not drive very fast over bumpy roads.
- C) Take a pack of pesticide with you or a copy of label. This is particularly important to identify exactly the pesticide used.
- D) Take a sample of vomit if available. This is for later laboratory analysis if required.
- E) Be prepared to tell the medical attendant how much and what sort of pesticide the person has handled in last few days



C LOCAL TREATMENT (general)

1. WASHING OUT OF EYE

Pesticides splashed into the eye are rapidly absorbed and may also irritate the eye.

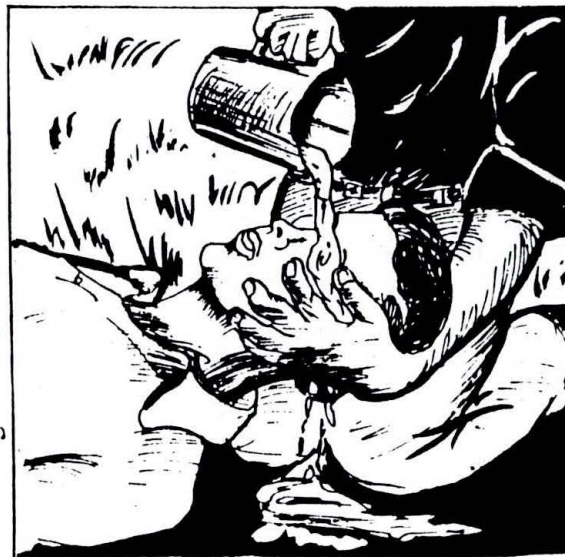
A splash in the eye must be washed out at once with a lot of clean water.

Water may be poured from cup or tea pot.

It is easier if a third Person holds eye open.

Continue washing for at least ten minutes.

Organophosphorus compounds splashed in the eye can cause marked blurring of vision: this is a temporary effect which may last several hours.



Contamination in the eye must be washed immediately with clean water.

2. WASHING SPLASHES OFF SKIN

If a man gets a drop of pesticide on his skin, or if he has a spill which soaks part of his clothing, it is important to remember that most pesticides can be absorbed into the body through the skin.

Therefore, IMMEDIATELY

- Remove any soaked clothing
- Wash skin with lots of clean water and soap if available.
- Watch out for any symptoms of poisoning.
- If a large area of skin was splashed or was contaminated by soaked clothing, the man should stop work, at least for the day.

How may major soakages of clothing occur and how may they be dealt with in local circumstances?

Major soakages of clothing occur due to

1. Entry without protective clothing where aerial spraying is being done.
2. Spraying on crops or trees of higher elevation with high volume sprayers.
3. Spraying in densely grown crops or bushes
4. Accidental spillages due to leaks on spray tanks
5. Spraying against wind current

Local level measures to major soakages of clothing with pesticides.

1. Prior notice to all the public of the area aerial spraying is going to be done and precautions to be taken during that period should be strictly adhered to.
2. A longer spray boom or lance should be used. Protective clothing should also be worn.
3. Protective clothing should be worn & care should be taken that crops & bushes should have proper alley ways for moving in between for various agriculture operations including spraying of pesticides.
4. Sprayer tanks should be checked for leakages before use and protective clothing should also be worn.
5. Spraying should never be done against the wind.

SECTION III: MEDICAL TREATMENT

1. HISTORY OF EXPOSURE

The diagnosis of pesticide poisoning is not always easy.
Pesticide poisoning of some types may mimic many other conditions.

Therefore some emphasis must be laid on:

History of Exposure

To what?

For how long?

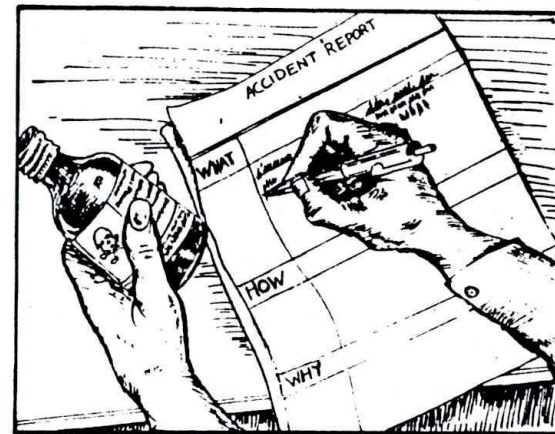
When exactly was last exposure?

What was time relationship between exposure and onset?

As soon as pesticide poisoning is suspected, it is important to think - is patient still exposed? (Is clothing contaminated or stomach full?)



The doctor should be informed immediately
he should be shown the container and label.



Cases of poisoning should be notified
to prevent recurrence.

2 GENERAL PRINCIPLES

- A. Pesticide poisoning does not differ from poisoning by other chemical substances, in so far as supportive treatment is concerned.
- B. Most pesticide poisonings (except for the bipyridyls) do not have delayed effects, and recovery is usually complete unless there has been a prolonged period of anoxia.

Basic approach to the poisoned patient

- I **Stabilization:** Prevent further deterioration
- II **Complete evaluation:** Survey directed towards identifying the toxin, evaluation of severity, associated complications & trauma.
- III **Appropriate treatment to reduce absorption:** Skin decontamination, administration of syrup of ipecac or gastric lavages and administration of oral activated charcoal and cathartics.
- IV **Appropriate measures to improve elimination of toxin:** Urine pH alteration, diuresis, haemodialysis, haemoperfusion, peritoneal dialysis.
- V **Consideration of use of specific antidotes:** Specific antidotes are not available for all poisonings but naloxone and glucose can be administered to all patients exhibiting CNS depression.
- VI **Continuing care and disposition:** Adequate observation period should be established.

3. ORGANOCHLORINES

For patients suffering from organochlorine poisoning:

Treatment is symptomatic

SYMPTOMS/SIGNS

TREATMENT

- | | | |
|------------------------------|---|--|
| - if apnoeic or cyanosed | : | artificial respiration |
| - if poison ingested | : | gastric lavage followed by saline purgative
(Sodium sulphate 30 g in 250 ml water) |
| - elimination enhancement | : | Use of cholestyramine (3-8 g four times a day) can
increase faecal excretion. In compounds that have
enterohepatic recirculation, activated charcoal may
also reduce half life. |
| - if skin contaminated | : | bathe with water and soap |
| - if convulsing | : | diazepam 5-10 mg slowly I.V.
(adults)
0.2 mg/kg I.V.
(children)
or barbiturates: both repeated as often as necessary |
| - other supportive treatment | : | 10% calcium gluconate 10 ml orally 4 hourly
Vitamin B Complex
High carbohydrate, low fat diet.
correction of acidosis. |

Contraindicated are: adrenaline, epinephrine or related drugs, all CNS stimulants, oily purgatives and fat in diet .

4. ORGANOPHOSPHATES

For patients suffering from organophosphorus poisoning:

Use **antidotes:** atropine and pralidoxime

Atropine : 2 mg I.V. every 10 minutes as necessary: full atropinization shown by dilation of pupil, flushing of face, pulse 140+.

Repeat as necessary for 48-72 hours. (Dose for children is 0.015 - 0.05 mg/kg).

Pralidoxime : Given at same time as atropine: 1 gm in 20 ml saline by slow I.V. injections, repeated hourly. Most effective if given within 12 hours of onset. (Dose for children 20 to 50 mg/kg diluted in saline)

Precaution : Give the injection very slowly.

Convulsions may be controlled with

diazepam

5 mg I.V. (adults)

0.2 mg/kg I.V. (children)

or Phenytoin

- 150-250 mg I.V.

slowly (adults)

- 15 mg/kg I.V.

(children)

Contraindicated are: morphine, barbiturates, phenothiazine tranquillizers, antihistamines, parasympathomimetic agents.

Other supportive treatment as necessary

Artificial respiration

Gastric lavage if patient presents within 4-6 hours

Washing of contaminated skin

Observe at least 48 hours after the last dose of atropine

Administer fluid to replace losses

5. CARBAMATES

For patients suffering from carbamate poisoning:

Usually supportive treatment is enough.

Atropine may be given to control symptoms if these are severe: if the patient is conscious, atropine by mouth may be sufficient. Tincture of belladonna can be used if oral atropine not available.

Contraindicated are oximes (pralidoxime, Toxigonin) of any kind.

The oximes are not effective in antagonizing the toxicity of the more rapidly hydrolyzing carbamyl ester inhibitors, and since pralidoxime itself has weak anti ChE activity, they are not recommended for the treatment of overdose with neostigmine or physostigmine and are contraindicated in poisoning with carbaryl.

6. CHLORONITROPHENOLS

For patients suffering from poisoning by chloronitrophenols and cresols no specific antidote is available.

The reduction of pyrexia by tepid sponging or bathing and by antipyretics is of prime importance.

Convulsions may be controlled with diazepam 5 mg IV.

Contraindicated is
atropine

Other supportive treatment as necessary

artificial respiration
Oxygen
gastric lavage
washing of contaminated skin
correct fluid acidosis and electrolyte imbalance;

Note: - Watch for evidence of hepatic or renal damage
- Avoid aspirin because it enhances the uncoupling of oxidative phosphorylation.

7. BIPYRIDYLS

For patients with bipyridyl poisoning speed of treatment is essential.

Wash out stomach
Leave in stomach
Bentonite 7%
or fuller's earth 30%

If given within 2 hours, adsorption of compound in stomach may be effective.

Administer mild cathartics
Forced diuresis to eliminate compound in circulation may be helpful.
Otherwise only supportive treatment can be given and observation is required for at least 14 days.

Watch fluid and electrolyte balance. Watch for the development of septicemia 7-10 days post ingestion.

Local lesions are treated by cessation of contact and local palliative treatment.

Once proliferative changes occur in lungs and other organs, no specific treatment has been found to be effective - hence the ingestion of the compound is highly hazardous.

8. WARFARIN

Warfarin causes depression of prothrombin time, beginning in 24 hrs. and peaking between 36 and 72 hrs. The complete blood count provides a baseline to measure blood loss prospectively.

Treatment

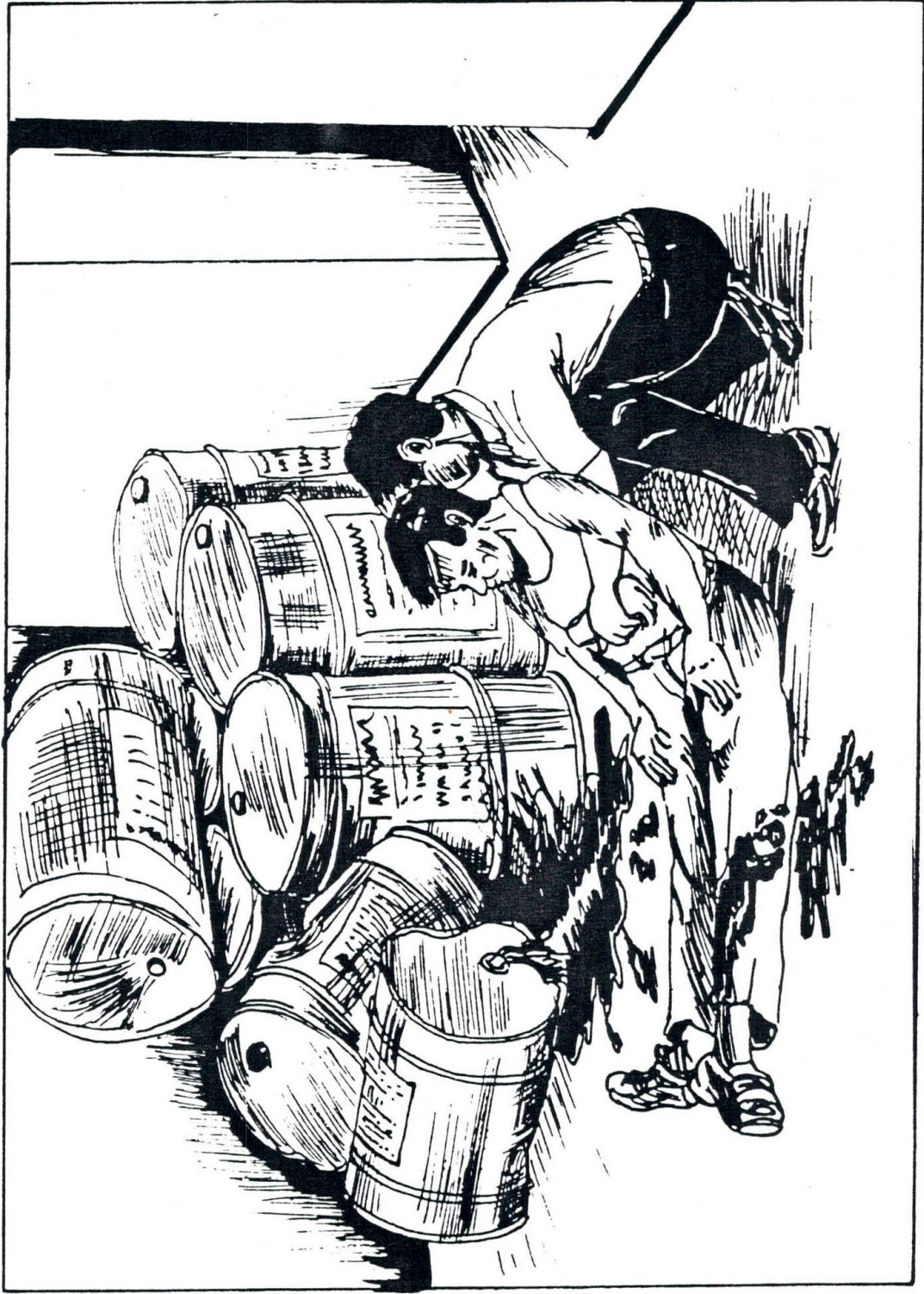
Activated charcoal and cathartics are usually all that is needed unless a large intentional dose is ingested.

Antidotes are -

Vitamin K 10-25 mg orally (adults)
 5-10 mg orally (children)

Constant monitoring is required until prothrombin time returns to normal after cessation of vitamin K thereby.

Other measures : fresh - frozen plasma and fresh blood for acute bleeding.



The patient should be removed from contaminated site immediately.

SECTION IV: SURVEILLANCE

NOTE: The surveillance methods are not presented in detail. More information about the actual tests is available from the manufacturers.

1. REPORTING

Under section 26 of the Insecticides Act, 1968, the States Governments have been empowered to notify a person or class of persons for notifying all occurrences of poisoning due to pesticides coming within the cognizance to the authorities as notified in the said notification. For this, a proforma has been devised for sending half yearly report to the Plant Protection Adviser to the Government of India.

The object of reporting is to prevent a recurrence of the case. The questions to be answered are:

1. Why did the case become poisoned?
2. Are others subject to the same hazard?
3. How may the hazard be abolished or reduced?

PROFORMA

Half yearly return regarding poisoning cases due to pesticide under
Section 26 of the Insecticides Act, 1968

Name of the States/UTs _____ Period of return from _____ to _____

S.No.	Nature of poisoning			No. of deaths	No. of poisoning	Whether postmortem is done in case of death and its report	Analysis of viscera and its report	Name of insecticides	Name of manufacturers, Batch No.	Remark
	Accidental -	Non Accidental	Homicidal + Suicidal							
1	2	3	4	5	6	7	8	9	10	

2. RECORDS OF EXPOSURE

When men are using moderately or highly toxic pesticides, brief records of exposure should be kept, on the lines suggested below.

These records will be needed if a man becomes intoxicated and may be compared with the records of men who were not intoxicated.

Week beginning:

Pesticide:

Name	Day	1	2	3	4	5	6	7
		HP	HP	HP	HP	HP	HP	HP

H - hours worked in spraying

P - pumps charges sprayed

3. TINTOMETER FIELD KIT

A tintometer field kit is used for measuring cholinesterase. Whole blood taken from a finger prick is used. Approximately 19 tests can be done in 1 1/2 hours total time by a trained technician. The kit is independent except that 1 litre of freshly distilled water is required for 38 tests.

Tintometric test: Fingerstick whole blood, samples from exposed subjects and from a control (non-exposed) person are allowed to incubate with acetylcholine and the indicator bromothymol blue. Change in colour is compared with standard.

This kit is used chiefly to follow cholinesterase levels over a period of time in men exposed to organophosphorus insecticides.

An initial test before exposure is essential to give a baseline. This is expressed as a per cent of "normal" in 12.5% steps. Later tests are compared with this level.

4. ACHOLEST TEST KIT

This kit is more suitable for diagnosis of poisoning than for routine following of cholinesterase levels. The test uses plasma and therefore centrifugation of blood is necessary. The result is expressed as a percentage of "normal" in 25% steps.

5. CHOLINESTERASE ROUTINE

The baseline test is preexposure preferably the average of 2 or 3 separate tests 1 day apart.

If a man is working with organophosphorus compounds and a routine (weekly) test is 50% of the pre-exposure value, or less, he should be suspended from any contact with organophosphorus or carbamate pesticides.

He can be allowed to resume work when a tintometer test gives a result 12.5% below his pre-exposure value or the Acholest test is under 20 minutes, corrected for temperature.

Population groups at risk of exposure to pesticides*

Suicides and mass poisoning; pesticides
formulators, mixers, applicators,
and pickers

Single
and short-term
very high level
exposure

Pesticide manufacturers,
formulators, mixers,
applicators, and pickers

Long-term,
high level exposure

All population groups

Long-term, low level exposure

The width of the triangle indicates the approximate size of the exposed groups

*Source WHO

SECTION V

THE APPLICATION OF PESTICIDES

Objective (s)

1. To understand the common uses of pesticides.
2. To recognise the equipment used to apply them.

Examples:

i. *Agriculture*

Insecticide : CYMBUSH 25% EC

It is used in Agriculture against pests of cotton, brinjal & Lady's finger (Bhindi)
Equipment used for application is the knapsack sprayer fitted with fine mist nozzle.

ii. *Public Health*

Insecticide : DDT (50% WP)

It is used in the control of Anopheline vectors of malaria equipment used for application is the stirrup pump.

iii. *Household Pests*

Propoxur spray (1%)

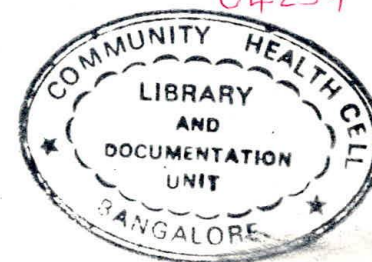
Used to control cockroaches & other household insects.
Equipment used - Intermittent or continuous hand sprayer

A APPLICATION BY TASK

Number : 1 Agriculture; hand spray, low crop

Pesticides are applied in many different ways using a variety of application equipments. But these equipments are designed to apply insecticide under certain situations. Given below are some examples of equipment and the main purpose of application.

Equipment/technique	Purpose
1. Spraying with stirrup pumps	- indoor residual spraying in malaria control - outdoor for crops
2. Spraying with hand compression pump	- spraying insecticides on crops, residual insecticides on walls and spraying larvicides.
3. Knapsack sprayer	- larviciding in public health.
4. Dust blower	- Paris green larviciding - agriculture crop dusting.
5. Thermal fogging	- As adulticide space application & ULV application
6. Aerial	- ULV or dust application
7. Space spray	- hand operated - motorised mist blower. Public health



Hand spraying



It is probably the most common method of application of insecticides and herbicides.

For discussion

What kind of formulations are likely to be used?

The formulations used are -

In Public Health

WP and occasionally EC

In Agriculture

WDP

EC

Dusts

Granules

House hold pests

EC

Baits

Pellets

Equipment used for application:

Stirrup pumps are used for WDP

Hand compression pumps for WDP/EC

Knapsack sprayer for WDP/EC

Dust blower for dust & powder formulations.

2. PUBLIC HEALTH; INDOOR RESIDUAL SPRAY



Most applications are outdoor but for the control of pests carrying disease, INDOOR RESIDUAL APPLICATION is used.

'Residual' means that the pesticide will remain effective for weeks or months.

For discussion

Indoor residual application is used for the control of

1.	Pests	Diseases
	Mosquito	Malaria Filaria Dengue JE
	Bed bugs	Relapsing fever
	Sandfly	Kala azar

3. PUBLIC HEALTH, LARVICIDING

Pesticides can be sprayed on water to kill insect larvae that grow and feed in water. This is LARVICIDING.

1. Larvicides are used to control the following mosquito larvae

Anopheles

Culex

Aedes

2. Other methods of controlling insect larvae are:

Bioenvironmental control measures

- a) Larvivorous fishes

Application of biocides

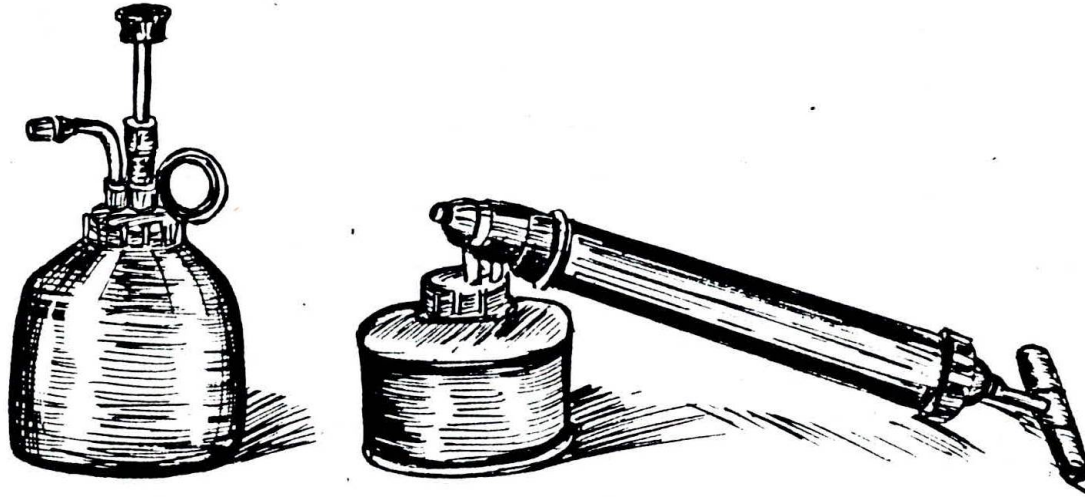
- b) Minor engineering methods

- filling of pits, ditches
- trimming of margins of ponds etc.
- drainage of low-lying areas.
- mosquito proofing of overhead tanks & wells.
- use of siphons

- c) Other methods - use of EPS beads in wells, overhead tanks etc.



4. SPRAYING IN HOUSEHOLD



This is a HOUSEHOLD SPRAY; and is usually used to control nuisance-causing insects. The pesticide usually is of low toxicity and short action.

In India however, householders may obtain more toxic pesticides and use them unwisely.

B. APPLICATION BY EQUIPMENT

1. EXTERIOR HAND SPRAY



This is frequently used on low crops.

The tank may be pressurized by hand or motorized.

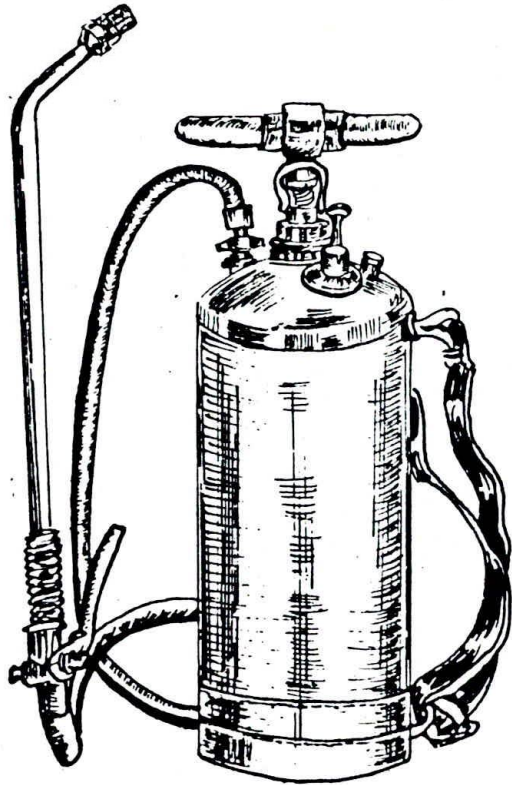
Regular maintenance of pumps is important for both efficiency and safety.

Supervisors should know how hand sprayers can be safely used and should pass on this information to their men.

What hazards unconnected with pesticide exposure occur with motorized pumps?

- Hazards - Fire hazard
- Blasting due to high pressure

2. INTERIOR HAND SPRAYER



Hand compression sprayer

This is used for indoor residual application

The tank is usually pressurized by hand.

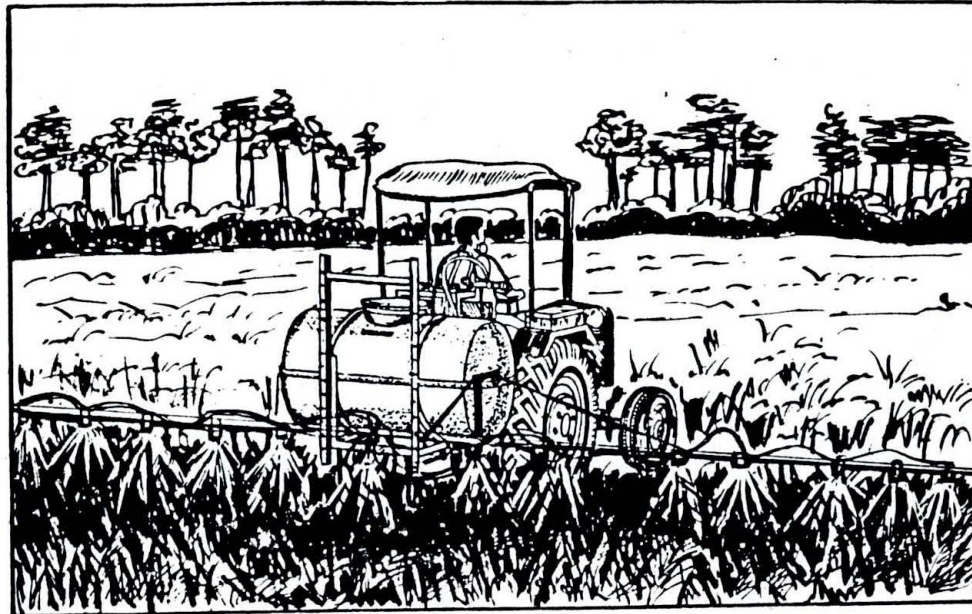
Regular maintenance of the pumps is important for both efficiency and safety.

The spraymen must know how to use it properly and safely and the supervisor must ensure that he does so.

Which parts of pump particularly require maintenance?

1. Rubber washers wear out easily as they have to be replaced frequently.
2. The leather cap of plunger also gets eroded frequently. It also needs replacement whenever it is worn out.
3. Nozzles get clogged up frequently and they have to be cleaned properly before use (in case of pumps with direct nozzle connection).

3. EXTERIOR MACHINE SPRAY

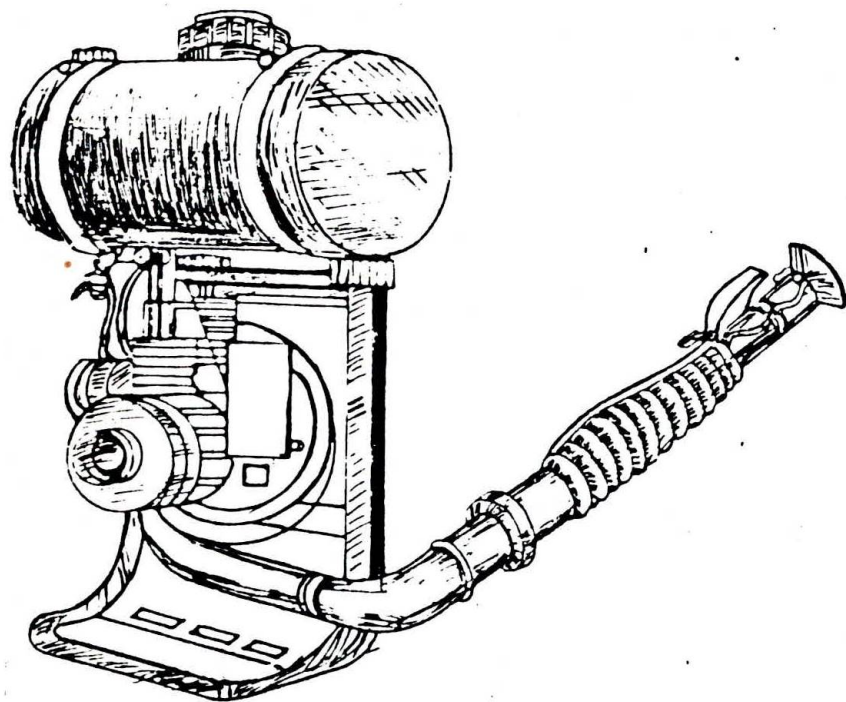


This is particularly used for spraying large areas of land or for trees.

It is usually drawn by a tractor

The operator must know how to use it safely.

4. ULV HAND APPLICATION, EXTERIOR



ULTRA-LOW VOLUME (ULV) is a type of application where only small quantities of highly concentrated active ingredients are dispersed in very small droplets.

This may be done as a fog or a spray-mist. Fogs can be seen but spray are very difficult to see.

A mist settles to the ground very slowly. The smallest droplets may take 1-2 hours.

The picture shows a type of hand held ULV sprayer. Some are motorized: others are electrically powered by batteries.

All those using ULV equipment must know how to use it safely.

5. LAYING RODENTICIDE BAIT

Rodents eat much of the food grown for man and are a serious pest in all country. For killing rodents, pesticides are incorporated into various kinds of attractive baits. This is RODENTICIDE APPLICATION.

1. For following rodents, rodenticides are used in our country.

This is RODENTICIDE APPLICATION

- Rattus rattus* - Indian house rat
- R. norvegicus* - Norwegian brown rat
- Bandicota bengalensis* - The mole rat
- Mus musculus* - House mouse
- Tatera indica* - The Indian gerbil
- Millardia meltada* - The grass rat
- Mus booduga* - Indian field mouse
- Funnabulis pennati* - Garden squirrel

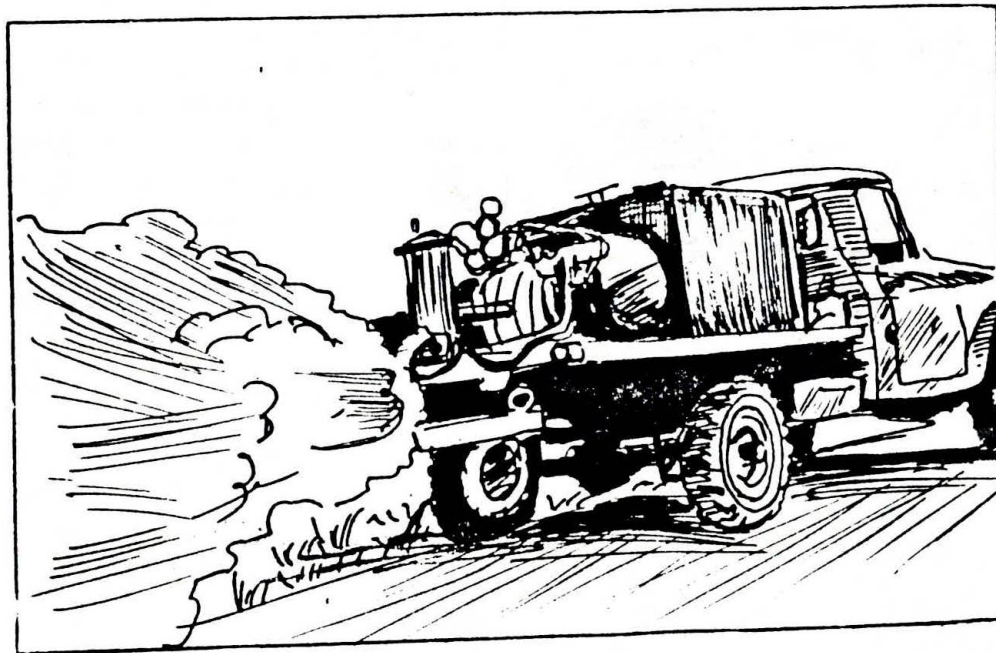
2. What are the usual baits used?

- Baits used usually**
- Acute poison baits with zinc phosphide,
 - chronic poison baits with warfarin.

6. ULV

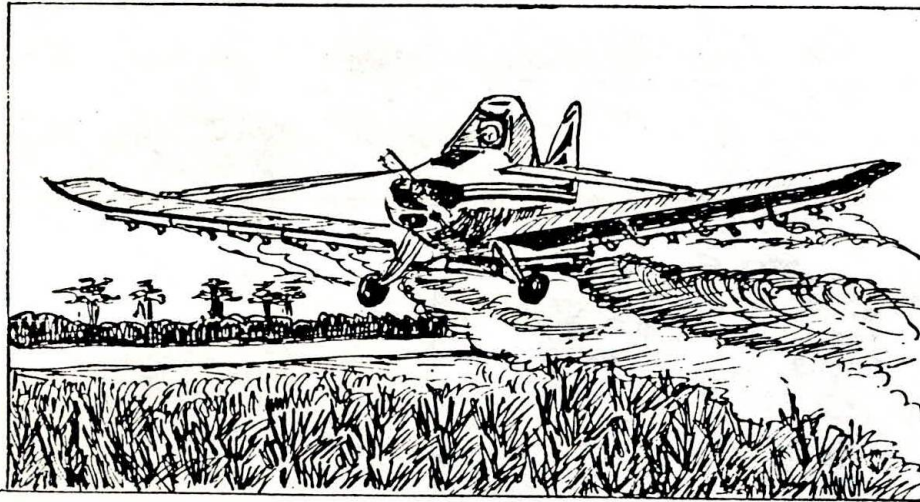
This shows a large ULV SPRAYER that has to be mounted on a vehicle. It is used mostly for the control of epidemics of dengue which is transmitted by mosquitoes.

This is a powerful machine and all those using it must be careful and use it safely.



7. AERIAL APPLICATION

AERIAL APPLICATION is an important means of application of pesticides, particularly covering large areas of land.



A pilot must know:

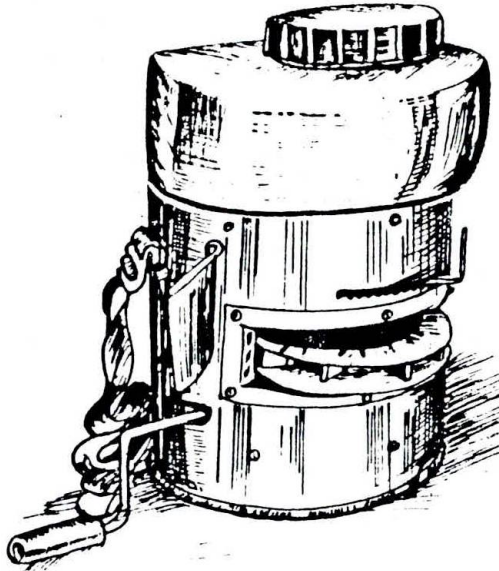
- what he is using
- how he must protect himself
- how his ground crew must protect themselves
- how he must protect the public
- and he should not forget his maintenance engineers they also need protection

Ground supervisors and loaders must know

- what they are using
- how to protect their men, including flagmen
- how to load the plane without overloading.

Note: Aerial application of pesticides can be very dangerous if proper precautions are not taken.

8. GRANULE OR DUST SPREADING



This applicator is used for spreading granules by hand.

They can also be distributed by machine in the same way as dusts.

Pesticide concentrations in granules are usually low but the operator should know what he is using.

Dusts require particular attention in use and operators must know how to avoid drift.

SECTION : VI
CHEMICAL TYPES OF PESTICIDES

1. ORGANOCHLORINES

1. Pesticides can be split into several chemical groups. Most pesticides applied in agriculture and public health are **INSECTICIDES**.
2. An important chemical group of the insecticides are the **ORGANOCHLORINE** compounds.
3. Given below are some organochlorine compounds:

Endrin	DDT	Dicofol
Aldrin	Methoxychlor	Fenazaflor
Dieldrin	Citicide	Heptachlor
HCH or BHC	Endosulfan	Isobenzan
Lindane (-HCH)	Toxaphene	chlordane

Some organochlorine compounds are stored in the body, usually without causing any apparent adverse effect. Most organochlorine compounds are **PERSISTENT** in the environment and may affect non-target wild-life. For these reasons use of these insecticides is being discouraged.

Human exposures occur through ingestion of contaminated food or water, inhalation of vapour, or absorption through skin. They are CNS stimulators. The presence of chlorine in their molecules has conferred on them chemical stability which has resulted in persistent residues in the environment. The facts that these products are stored indefinitely in human tissues has led to banning of several organochlorine pesticides. Lindane accumulates to a lesser extent than other organochlorines. Hepatic enzyme induction can also result from exposure to chlordane, methoxychlor, DDT, dieldrin and heptachlor.

2. ORGANOPHOSPHATES

1. The organochlorines have been partly replaced by **ORGANOPHOSPHORUS COMPOUNDS**. These are less persistent in the environment and are not stored in the body.

-
2. There are many organophosphorus compounds. The list given below is only of selected compounds in order of toxicity.

Demeton	Fenthion	Trichlorphon	Temephos (Abate)
Parathion	Diazinon	Dimethoate	Chlorppyrifos (Dursban)
Methyl parathion	Fenitrothion	Malathion	Phorate
			Dichlorvos

Other compounds used in this country are:

Please note that toxicity is not the same as hazard.

Of the two groups of insecticides: organochlorines and organophosphates, the latter are highly toxic but less hazardous because these are less persistent in the body/plants/environment.

List those compounds heard of by the group. Go through the list again and pick out those used.

Parathion
Malathion - Adulticide

Fenthion
Temephos - Larvicides

3. CARBAMATES

Another smaller group of insecticides used are the CARBAMATES such as - the order of toxicity being as before, the less toxic down the list.

METHOMYL (LANDRIN, NUDRIN)

PROPOXUR (BAYGON)

CARBARYL (SEVIN): Decarbofuran, Mipsin, Carbofuran, Aldicarb, Bendiocarb

Carbaryl, the most commonly used insecticide in agriculture, is safe as mammalian toxicity is low and it does not leave residues in the environment. Propoxur (Baygon) is most commonly used for household pests. It is highly toxic to insects and moderately toxic to mammals.

4. NITROCHLOROPHENOLS

The NITROCHLOROPHENOLS belong to an entirely different group of pesticides and are used to prevent fungal (mould) attack on timber and as herbicides.

the best known is:

SODIUM PENTA - CHLOROPHENATE (SPCP)

Other compounds used in this country are:

PCNB - soil fungicide

(penta chloronitrobenzene)

5. BIPYRIDYLS

the BIPYRIDYL COMPOUNDS are chiefly herbicides.

PARAQUAT - Gramoxone

DIQUAT - Reglone

These are unusual compounds as they are of very low hazard in proper use, and are not stored in the body. However, they are HIGHLY TOXIC IF TAKEN BY MOUTH in any way.

Paraquat has low chronic toxicity because of its rapid deactivation upon soil contact, but on ingestion it can produce multisystem organ failure and pulmonary fibrosis.

6. RODENTICIDES

Many chemicals of different chemical classes are used as RODENTICIDES. These include (in descending order of toxicity for humans).

THALLIUM SULPHATE	SODIUM CYANIDE
SODIUM FLUORACETATE (1080)	ALUMINIUM PHOSPHIDE
ZINC PHOSPHIDE	OTHER COMPOUNDS USED IN THIS COUNTRY ARE
BARIUM SALTS ESP. CARBONATE	COUMATETRALY
WARFARIN	COUMACHLO

Thallium is so hazardous that its use is not recommended. Sodium fluoracetate should only be used by specially trained personnel.

Warfarin is the most commonly used rodenticide and is an anticoagulant of blood i.e., it stop blood clotting.

Warfarin: Rodents eat the bait for 3-10 days before fatal levels are achieved. Due to development of resistance super warfarin compounds like difenacoum have been developed. Restrictions have now been imposed on use of these compounds due to reported toxicity among mammals.

Zinc phosphide is also highly toxic. Serious adverse effects include pulmonary oedema, hypertension, dysrhythmias and convulsions.

7. OTHER PESTICIDES AND MIXTURES

The following mixtures are commonly used in this country:

- 1) By mixing diazinon with DDT the bed bug problem is tackled in areas where bed bugs have developed resistance to organochlorines.

-
- 2) Methylparathion + DDT (1:3)
 - 3) Toxaphene + DDT (2:1)
 - 4) Carbaryl + r BHC (1:1)
 - 5) Methyl parathion + Carbaryl (1:4)
 - 6) Piperonyl butoxide + pyrethrum (10:1)
 - 7) Phosalone + DDT (1:2)

Chemicals in mixtures may exert an additive effect (the most common) or a synergistic effect where the effect is greater than the additive effect, or an antagonistic effect where the effect is less than the additive effect.

Subject: B Mode of action

1. ORGANOCHLORINES

They cause: STIMULATION OF NERVOUS SYSTEM
INDUCTION IN LIVER ENZYMES IN HIGH DOSAGES
STORED IN FAT IN PROPORTION TO INTAKE

ACUTE INTOXICATION by organochlorines results in stimulation of the central nervous system.

Very high levels of exposure may be associated with induction of liver enzymes but no other effects have been described in humans.

STORAGE

Most organochlorine compounds or their metabolites are stored in fatty tissues. The level of storage is directly related to exposure. The level of storage has no influence on acute intoxication as far as it concerns the likelihood of its occurrence or its severity. Acute toxic dose: Aldrin 3-7g; Chlordane 6g; Dieldrin 1.5 - 5g; Lindane 10-30 g.

2. ORGANOPHOSPHATES

ORGANOPHOSPHORUS COMPOUNDS: INHIBITION OF CHOLINESTERASE IN RED CELLS, PLASMA AND OTHER ORGANS.

NOT STORED IN BODY

POSSIBLE CUMULATION OF EFFECT

1. Organophosphorus compounds inhibit the enzyme cholinesterase, causing potentiation of the effects of acetylcholine at cholinergic junctions.
2. The enzyme is inhibited in red cells, plasma, the brain and other organs. Its level has to fall well below its preexposure level (70% in plasma, 30% in red cells for a single acute exposure) before symptoms appear.
3. Organophosphorus compounds are not stored to any extent on repeated exposure but the effects on cholinesterase may be cumulative in a series of repeated daily exposures.

Organophosphorus compounds act as anticholinesterases (anti chE) and cause acetylcholine to accumulate at cholinergic receptor sites and thus are potentially capable of producing effects equivalent to excessive stimulation of cholinergic receptors throughout the central and peripheral nervous system. Certain fluorine - containing anti ChE agents e.g. DFP can cause delayed neurotoxicity due to inhibition of neurotoxic esterase.

Chronic exposure to low levels can cause non-specific CNS symptoms, but there is no correlation between symptoms & cholinesterase inhibition.

3. CARBAMATES

Carbamate compounds act similarly to organophosphorus compounds, that is they inhibit cholinesterase. However, the action of the carbamates is both QUICKER AND READILY REVERSIBLE.

- There is no storage in the body
- There is no cumulation of their effect on cholinesterase because of the rapid reversibility.
- Carbamates produce symptoms of cholinergic excess like organophosphates but *in vivo* spontaneous hydrolysis of the carbamylated acetylcholinesterase enzyme leads to less severe and shorter duration symptoms.

4. NITROCHLOROPHENOLS

CHLORO/NITRO COMPOUNDS act by strongly stimulating metabolism causing an increase in metabolic rate and hyperthermia which may become irreversible.

- They are not stored in the body but their effect on repeated exposure can be cumulative.

5. BIPYRIDYLS

The **BIPYRIDYL COMPOUNDS** are highly toxic if taken by mouth accidentally or deliberately. Isolated cases of poisoning have been reported by dermal exposure. After initial irritative action on mucous membranes and a latent period of 7-14 days, there are irreversible proliferative changes in epithelium, especially in the lungs and kidney. These changes continue to cause respiratory and renal failure even after all the compound ingested has apparently been excreted.

Any oral exposure to commercial 20% concentrate should be considered potentially fatal, inhalation of paraquat spray is unlikely to produce toxic effects because of size of spray droplets. Diquat is less toxic than paraquat. Mechanism - reduction in NADPH renders the cells more susceptible to attack by lipid hydroperoxides. This peroxidation converts molecular oxygen to superoxide radicals which disrupt cell structure and function.

6. RODENTICIDES

The mode of action of rodenticides can be summarized briefly.

1. Thallium is a cellular poison.
2. Sodium fluoroacetate (1080) is an inhibitor of enzymes concerned with tissue respiration. Monofluoroacetate metabolite fluoroacetate inhibits both Krebs's cycle enzyme, aconitase, which catalyzes citrate metabolism and succinate dehydrogenase which catalyzes succinate metabolism. Thus blockage of kreb's cycle leading to decreased glucose metabolism.
3. Zinc phosphide has a CNS effect similar to the anticholinesterases, and is haemolytic. Zinc phosphide produces pulmonary oedema, hypertension, dysrhythmias and convulsions.
4. Warfarin inhibits prothrombin formation. Multiple doses are usually needed to reach a stage of symptomatic inhibition. Usual mode of death is gastrointestinal haemorrhage. These compounds depress hepatic synthesis of vitamin K dependent clotting factors.

SECTION: VII

PROTECTION FROM POISONING

1. EATING

No one should eat or drink while handling pesticides without first washing hands and face in clean water (with soap).

If food is taken to the field, it should be carried in a tin with a tight fitting lid.

If a man eats or drinks without washing, by what route is he taking pesticides into his body?

The route of entry of insecticides in this case will be oral and it is called the oral exposure.



Always wash hands and face before meals

2. SMOKING

Those handling pesticide should never (be allowed to) smoke without first washing hands and face in clean water (and soap.)

Cigarettes should be kept in a tightly closed tin if carried in overalls.

If a man smokes without washing, by what route is he taking pesticides into his body?

A person who smokes with pesticide contaminated hand will take pesticides into lungs through inhalation.



Never smoke with soiled hands

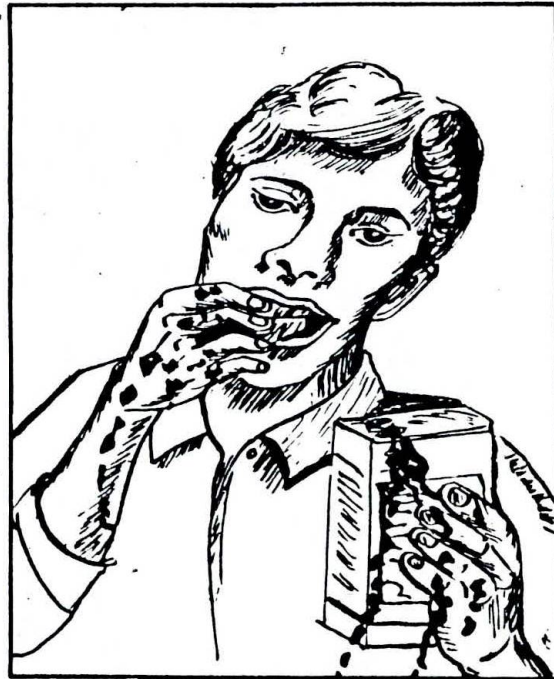
3. CHEWING

No one should chew (or prepare things to chew) while handling pesticides without first washing hands and face in clean water (with soap).

Never carry things to chew in overalls without using a tin with a tight fitting lid.

If a man chews without washing, by what route is he taking pesticide into his body?

A man who chew with pesticide contaminated hands, will take pesticides into the body through oral route.



4. BLOWING OUT NOZZLE

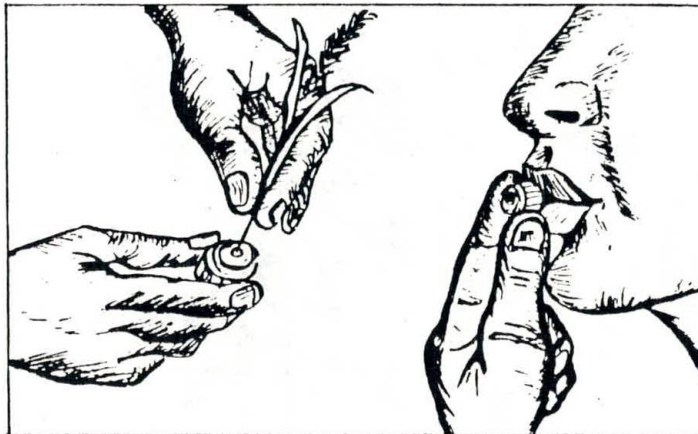
If a nozzle is blocked, no one should ever blow it down to clear it.

Instead remove the nozzle and press it against the pressure release valve of the pump.

Blocked nozzle should be cleaned using either a thin grass stem or stick or with soap and water.

If a man clears a nozzle by mouth, by what route is he taking pesticide into his body?

Pesticides will enter the body through oral route when spray nozzle is cleaned by mouth.



Blocked nozzles should be cleaned with a pin or stick;
never blow out a clogged nozzle

5. WASHING HANDS AND FACE

Wash hands and face in clean water, use soap if available.

Always wash before eating, drinking, smoking and at the end of the day's work before returning to base.

If possible wash hands each time the pump is refilled.

At the end of the day, take a shower.

If there is no or little water available at the application site, it should be taken to the field in a clean drum (with a tap).

How does washing stop absorption of pesticides?

User may become contaminated accidentally by a splash or spill of pesticides. Washing will remove the chemical from skin.

What else should be washed, other than skin?

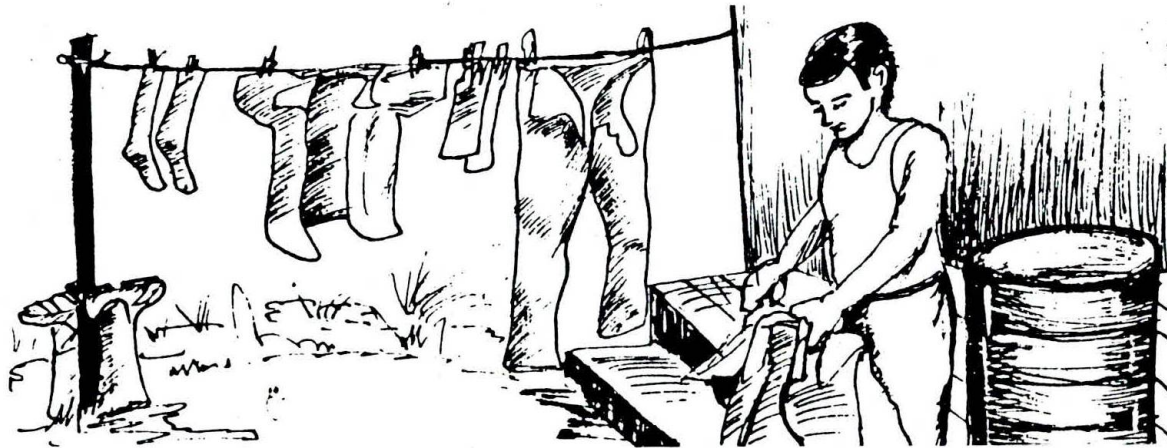
Apart from the body, eyes and clothes should be washed carefully.

6. WASHING CLOTHES

Working clothes should be washed every day in clean water.

How does this stop you taking pesticides into your body?

Removing and washing clothes will prevent absorption from surface of the body.



Wash clothes everyday with clean water

2. HAND SPRAYMAN - PUBLIC HEALTH

When spraying a hut the spraymen should wear

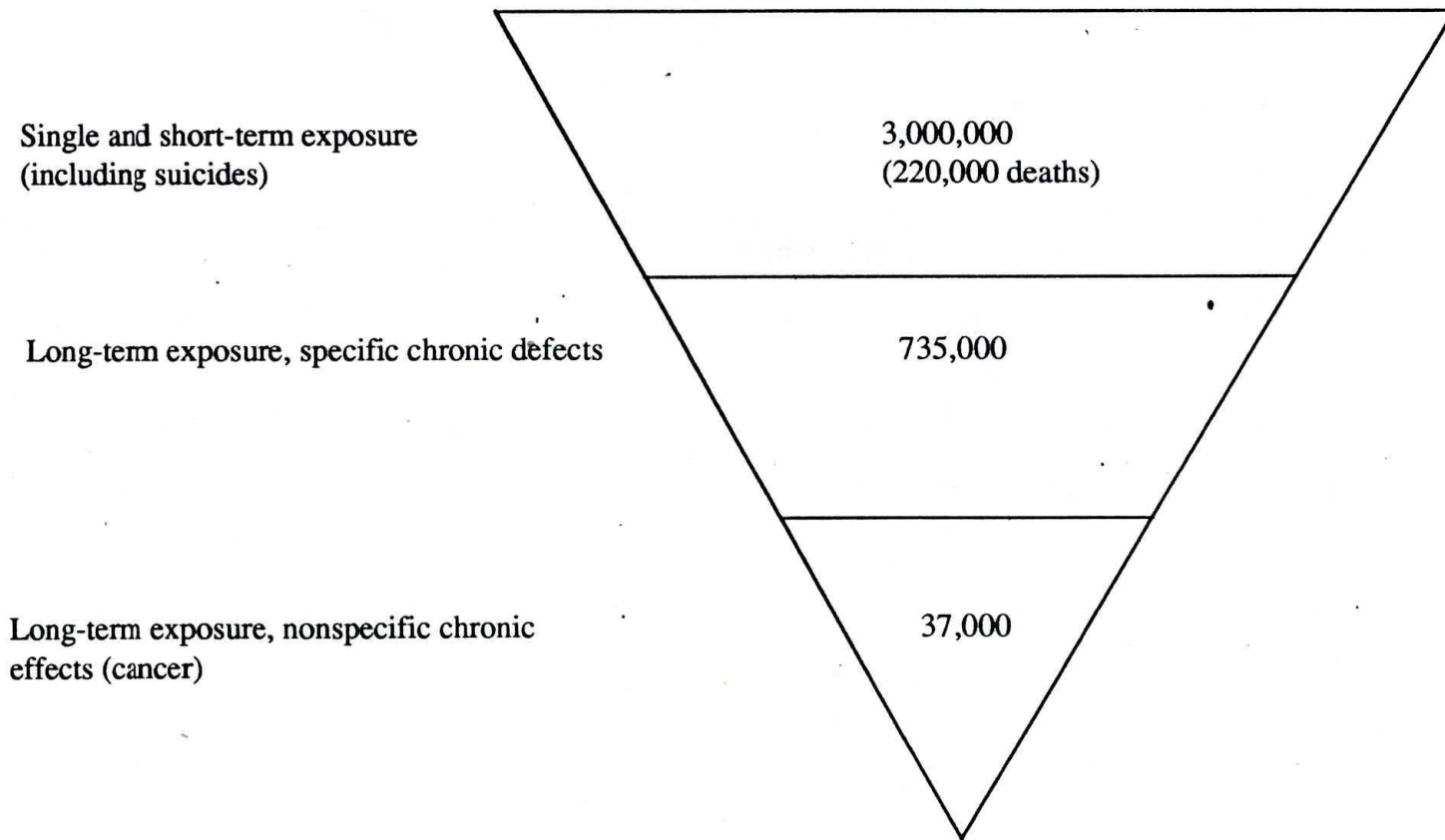
- (i) an overall
- (ii) boots
- (iii) a brimmed hat
- (iv) a pair of spectacles.

Some men prefer a scarf around the face but this should not become wet.

All clothes must be washed daily. Particular attention should be given to washing inside the clothing.



Estimated overall annual public health impact of pesticide poisoning*



*Source WHO

3. MIXED AND BAGGER

A mixer handles concentrated pesticide and a man who is bagging pesticides also handles concentrated pesticide thus must take extra care.

He should wear

- (I) an overall
- (II) gloves
- (III) boots
- (IV) a clean cloth over his mouth and nose
- (V) an apron.

If a man is mixing a highly toxic pesticide he also needs

- (VI) a respirator containing a cartridge, which should be replaced at least daily.
- (VII) A pair of glass spectacles.

All clothes and equipment must be washed daily, inside and out.

4. SUPERVISOR

A supervisor must set a good example for his men.

He should wear an overall, boots and he should have a pair of gloves to wear if he handles pesticides.

All clothes must be washed daily, inside and out.

5. MAINTENANCE ENGINEER

A maintenance engineer may look after pumps, vehicles or planes. He may also come into contact with pesticides.

He is often forgotten.

He should wear: Overall, apron, gloves

If an engineer is to work on anything that contains pesticide, make sure that he knows this. He should also know the precautions to be taken. He should have facilities for washing contaminated parts with which he is working.

6. FLAGMAN

A flagman, if he is to be used at all should wear:

- (I) overall
- (II) brimmed hat
- (III) boots

He should stand to the side of the swathe, on the windward side. Clothing must be washed daily and the man must shower after work.

7. AIRCRAFT LOADER

An aircraft loader can be seriously at risk.

- He must wear:
- (I) overall
 - (II) gloves
 - (III) boots
 - (IV) apron
 - (V) cloth to cover mouth and nose.

All clothing must be washed daily.

Clean water should always be available in ample quantity at airstrip.

C Protection of body

Educational objective: to define in more detail the clothing and equipment used for protection of different parts of the body.

1. TRUNK AND PARTS COVERED BY OVERALL

An overall is probably the most convenient way of protecting the body.

A good overall covers 85% of the skin.

National dress can also be used as overall if

- it is made of cotton so that it can easily be washed and dried.
- it covers the body without openings.
- it has long sleeves.
- it is long enough to cover the top of the boots, if these are worn.
- it is repaired or replaced when it becomes worn out.

2. HEAD AND NECK

If the overall covers 85% of the skin, the next most exposed area is the head and neck.

If the overall does not button up to the neck, a scarf should be worn.

If any spray or dust is liable to land on the head, a wide brimmed hat should be worn.

3. LOWER LEGS AND FEET

Pesticide can be absorbed through the skin of the lower legs and feet, especially as these are often wet by a spray or by sprayed vegetation.

The best protection is rubber boots.

Wear overall outside the boots.

After work, wash the boots inside and out and leave upside down to dry.

If boots are not available, shoes can be used if they are in good condition and the overall reaches right down to the top of the shoes. Sandals should not be worn.

4. HANDS

Hands must be protected particularly by those handling concentrated pesticides - baggers and mixers.

Gloves should be in good condition, waterproof and without holes. They should have a length 2-3" below the elbow and should be worn outside the shirt sleeves so that any liquid does not wet the shirt.

They should be washed before removing. After removing soak in solution of washing soda for one hour. Then wash them inside and out. Put on a peg, fingers uppermost to dry.

5. RESPIRATOR

1. Protection from inhalation of spray mist or dust is necessary if a highly toxic pesticide is being used, and desirable if other pesticides are used. A clean cloth over mouth and nose can be used, so long as cloth does not become wet.
2. If highly toxic pesticides are used, a respirator containing a cartridge is necessary.

The respirator must be:

- well fitting around the nose
- worn whenever spraying or dusting
- put down in a clean place when not in use or kept in a clean plastic bag
- washed daily and hung up to dry
- replaced if it becomes loose, worn or torn.

The cartridge must be changed daily or more often if breathing becomes difficult, particularly due to dust.
The cartridge should be destroyed after use and are good only for intermittent exposure. With continued use the absorbent layer becomes ineffective.

6. EYE PROTECTION - VISOR

Eye protection is needed for:

- spraying high crops
- mixing and bagging highly toxic pesticides.

A visor of clear plastic can be used, with a headframe or attached to hat.

Visors

- may need to be wiped occasionally with a clean soft rag
- should be put down carefully to avoid scratching
- should be washed as often as possible
- should be replaced when scratched or cracked.

7. WASHING PROTECTIVE EQUIPMENT

Washing of clothing and equipment daily is important.
Use clean water to wash and then more clean water to rinse.
Spread out or hang things to dry.
Dispose of washing water carefully as it contains pesticides.

D. Protection by technique

Educational objectives: (1) to define those factors in technique, according to the job, that provide protection and minimize exposure, (2) to lay stress on the training functions of supervisors.

1. SPRAYMAN, AGRICULTURE

1. Protection from pesticides require good technique. Each man must be trained.

2. The sprayman should:

- always hold the wand away from the body
- always spray into the wind
- always spray to one side
- avoid walking through newly sprayed crop.

He should also be instructed to:

- report leaking equipment
- wash any drops of pesticide off the skin as soon as possible.
- wash between pump charges if possible and always before eating, drinking or smoking.

2. SPRAYMAN, PUBLIC HEALTH

1. Protection from pesticides require good technique. Each man must be trained.

2. The sprayman should:

- always hold the wand away from the body especially when spraying upper walls and eaves.
- always stand to avoid spray drift from draught from doors and windows.
- always spray slowly and systematically.

He should also be instructed to: report leaking equipment, wash off any drop of pesticide from the skin as soon as possible, wash hands between pump charges if possible and always before eating, drinking or smoking.

3. MIXER

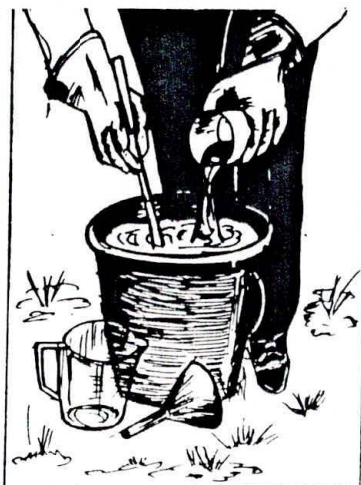
The mixer should be trained to:

- wear gloves
- use a long paddle - never stir with his hands
- stir slowly enough to avoid splash
- pour carefully
- not leave used containers lying around

Subsidiary points

Also he should be instructed to:

- wash any drops of pesticide off the skin as soon as possible



Always use measures, stirring rods and gloves when mixing chemicals.



Never use hands for scooping or stirring pesticides.

4. BAGGER

The bagger should be trained to:

- wear gloves
- weigh the pesticide carefully
- put the pesticide in the bag gently to avoid dust
- avoid touching the outside of the bag with gloves
- put the bag on a clean surface for closure
- keep the surrounding area clean.

He should also be instructed to:

- wash any powder off the skin as soon as possible
- always wash hands before eating, drinking or smoking



Mixers who handle highly toxic chemicals must wear a visor

5. SUPERVISOR

The supervisor must set an example.

Whatever he is doing, he should always **take all the precautions** and use the **proper technique**.

He must:

- train each new spraymen
- regularly check the techniques of all spraymen
- regularly check the equipment so that faulty or leaking equipment is repaired.
- always ensure a supply of clean water for washing.

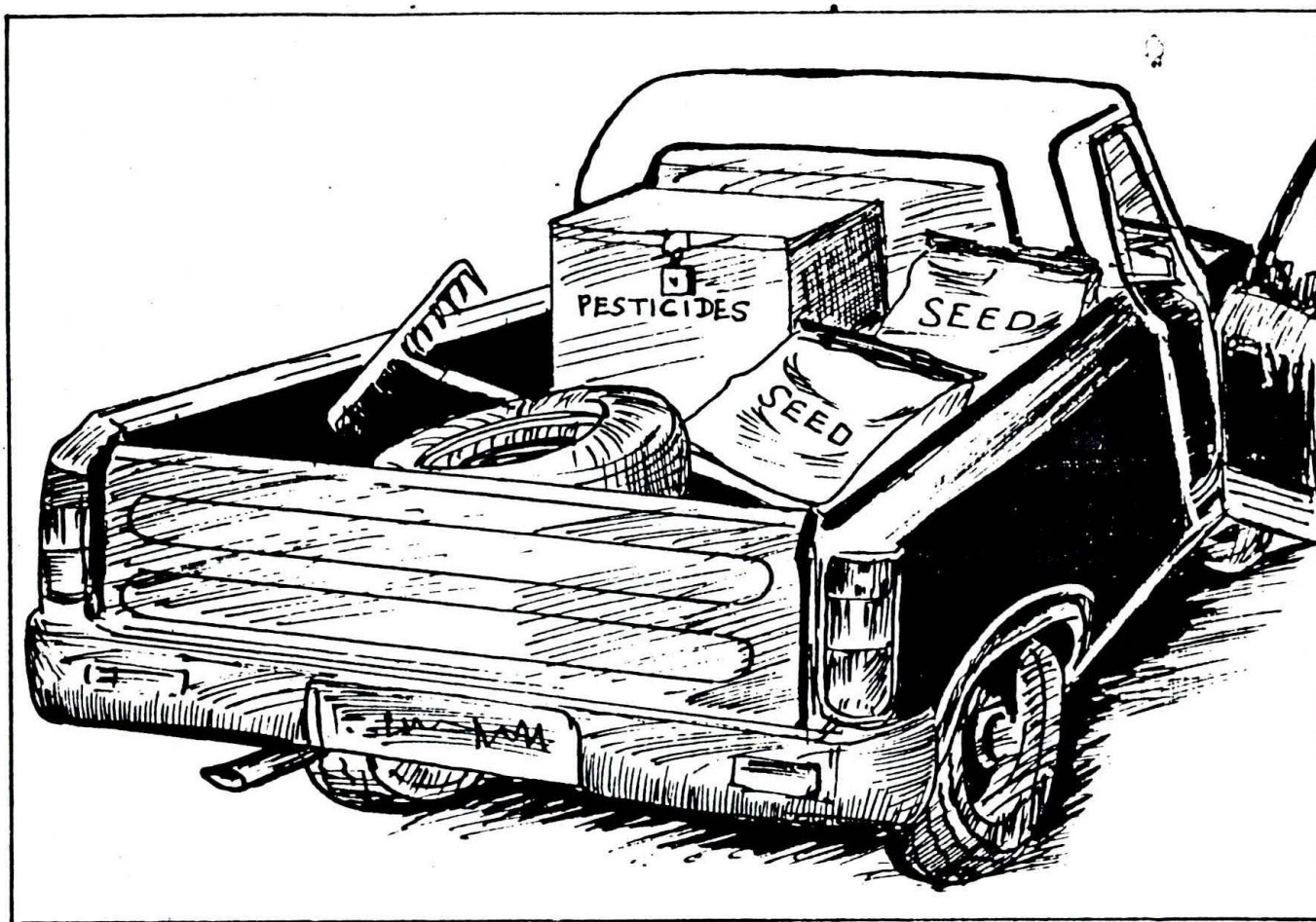
The supervisor should always wash his own hands before eating, drinking or smoking.

6. PILOT

The pilot must avoid all contact with pesticide as far as possible. He should:

- keep his boots clean by not walking in areas where pesticide has been split on the ground.
- fly with ventilators closed while spraying.
- avoid flying back through swathe, or over sprayed areas: turn into wind whenever possible.

Organophosphorus spray mist in the eye can cause double or blurred vision even though there may not be other symptoms of poisoning. If this occurs the pilot must land immediately and not fly for at least that day. The eyes must be washed with water.



Pesticides should be carried in a separate locked container.

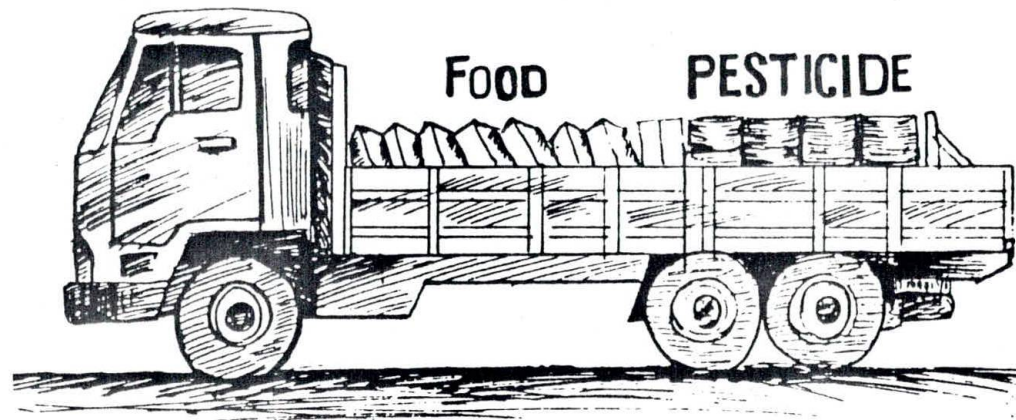
E. Protection of others

1. CARRIAGE BY TRUCK

1. Those concerned in using pesticides must protect other people - the young, old and other people's property, especially chickens, ducks and other animals.
2. Never carry pesticides in the same truck with food, especially food as flour, sugar etc. Many people have been killed by eating food contaminated with pesticides in this way.

Any pesticide spillage in a truck should be cleaned up with a lots of water which is allowed to drain into a pit.

- 1) Open type truck should be used but ensure that goods are protected against rain.
- 2) Do not place packing under heavy loads of other items.
- 3) Do not use hooks in loading bags.
- 4) Clean vehicle after unloading.



Never carry food stuffs and pesticides together.

2. CARRIAGE BY BOAT

Never carry pesticides with food in the same boat.

If pesticides are carried regularly in a small boat, always put them in the same place, and never put food in this place.

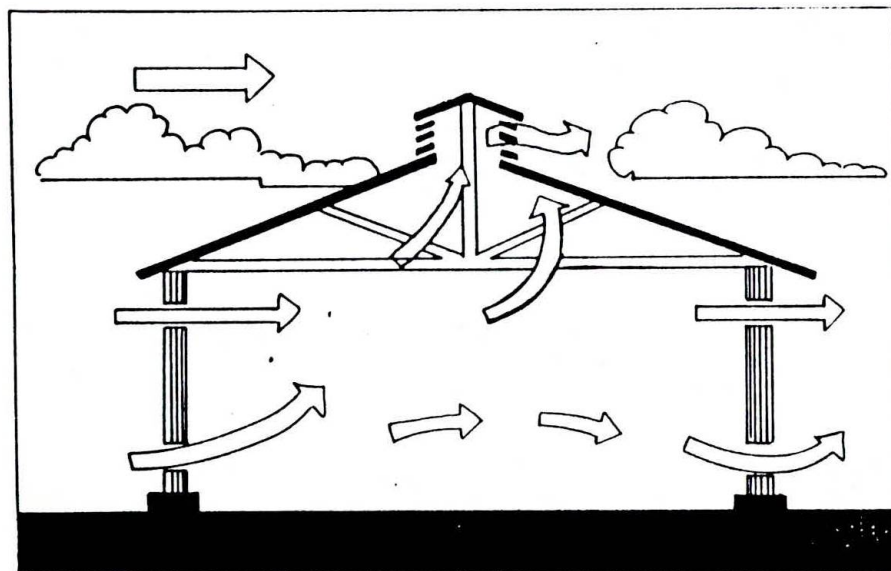
Otherwise scrub and wash the place where pesticides have been carried with plenty of water. If there are any signs of spillage, ask a health worker how to decontaminate the area. Avoid contaminating small streams.

3. STORE

All pesticides are dangerous in large quantities and must be kept in a safe place, away from children and from anyone else who might steal or misuse them.

All pesticide depots must have a good safe storehouse that can be closed off to prevent unwanted entry.

All pesticides must be stored in clearly labelled containers. Often the original container is the best.



Warehouses should be well-ventilated

4. LOCK ON STORE

All pesticide storehouses need a strong lock on the door.

The person who holds the key may often also be the person who keeps records of the pesticides that arrive and leave the storehouse - (and making sure that older pesticides are used first).

- Storehouse should be
- 1) away from populated area
 - 2) on well drained land
 - 3) located away from domestic water supply.
 - 4) made of non-combustible material
 - 5) having impervious floor.
 - 6) well ventilated
 - 7) emergency exit must be available.



Stores should be locked securely.

5. PUBLIC HEALTH; GOODS OUTSIDE HUT

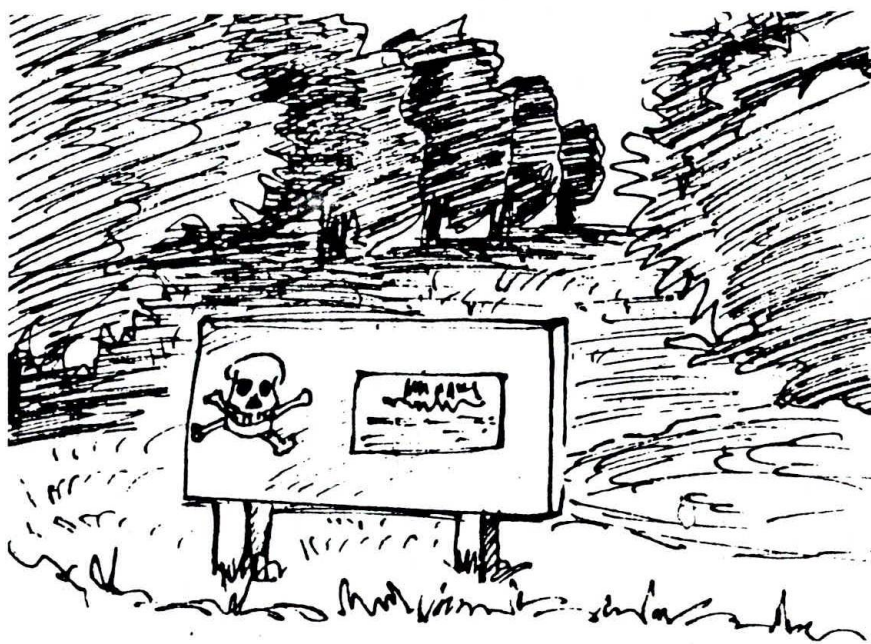
When spraying the inside of a house make sure that all food, cooking pots and bedding are brought outside.

When spraying eaves, make sure that spray does not drift on to household goods stacked outside the house, or on to any food.

6. RE-ENTRY INTO SPRAYED AREAS

If the pesticide sprayed is of moderate or low toxicity, no one should enter the sprayed area before the spray has dried on the crop.

If the pesticide sprayed is of high toxicity, it will be necessary for people to stay out of the crop much longer. The time may be given on the label or the agent can be consulted. If any doubt allow two days at least.



SECTION VIII: ENVIRONMENTAL PROTECTION

Water

Many human disease vectors are controlled by spraying or treating the surface water with insecticides. Herbicides are often applied to water in tropical areas to control aquatic weeds. In addition, water may be polluted by:

- discharges of surplus pesticide, after spraying operations;
- water used for washing spraying equipment being poured into rivers, ponds, or lakes.
- crops to be sprayed being planted right up to the water's edge.
- accidental spillage of pesticide formulations.
- run-off, leakage and erosion from treated soil.
- fall-out of pesticides from polluted air.
- application of pesticides to rivers or ponds, to kill fish, which are then removed and eaten.

Any of these routes may lead to contamination of drinking water. Nevertheless, average exposure to pesticides from drinking water is generally low, although serious incidents do occur occasionally.

WHO has recommended standards for drinking water for organic constituents, including pesticides.

FOOD RISKS FROM PESTICIDES MAY INCLUDE:

STORAGE IN FARMER'S KITCHENS AND SUBSEQUENT USE AS FOOD BY MISTAKE.

SPILLAGE IN STORES INTO FOOD WHICH IS SUBSEQUENTLY SOLD AND EATEN

MISTAKEN USE FROM WAREHOUSES (MARRIAGE PARTY IN U.P.)

USE ON FRUITS/VEGETABLES FOR APPEARANCE JUST BEFORE SENDING TO MARKET (BRINJAL)

ORGANIC CONSTITUENTS OF HEALTH SIGNIFICANCE

Constituent	Unit	Guideline Value	Remarks
aldrin and dieldrin	ug/l	0.03	
benzene	ug/l	10 ^a	
benzol (a) pyrene	ug/l	0.01 ^a	
carbon tetrachloride	ug/l	3 ^a	tentative guideline value ^b
chlordane	ug/l	0.3	
chlorobenzenes	ug/l	no health-related guideline value set	odour threshold concentration between 0.1 and 3 ug/l
chloroform	ug/l	30 ^a	disinfection efficiency must not be compromised when controlling chloroform content
chlorophenols	ug/l	no health-related guideline value set	odour threshold concentration 0.1 ug/l
2, 4-D	ug/l	100	
DDT	ug/l	1	

Constituent	Unit	Guideline Value	Remarks
1,2 dichloroethane	ug/l	10 ^a	
1,1-dichloroethene ^d	ug/l	0.3 ^a	
heptachlor and heptachlor epoxide	ug/l	0.1	
hexachlorobenzene	ug/l	0.01 ^a	
gamma-HCH (Lindane)	ug/l	3	
methoxychlor	ug/l	30	
pentachlorophenol	ug/l	10	
tetrachloroethene ^d	ug/l	10 ^a	tentative guideline value ^b
tetrachloroethene ^d	ug/l	30 ^a	tentative guideline value ^b
2,4,6- trichlorophenol	ug/l	10 ^{a,c}	odour threshold concentration 0.1 ug/l
trihalomethanes		no guideline value set	see chloroform

^aThese guideline values were computed from a conservative hypothetical mathematical model which cannot be experimentally verified and values should therefore be interpreted differently. Uncertainties involved may amount to two orders of magnitude (i.e., from 0.1 to 10 times the number)

^bWhen the available carcinogenicity data did not support a guideline value but the compounds were judged to be of importance in drinking water and guidance was considered essential a tentative guideline value was set on the basis of the available health released data.

^cMay be detectable by taste and odour at lower concentrations

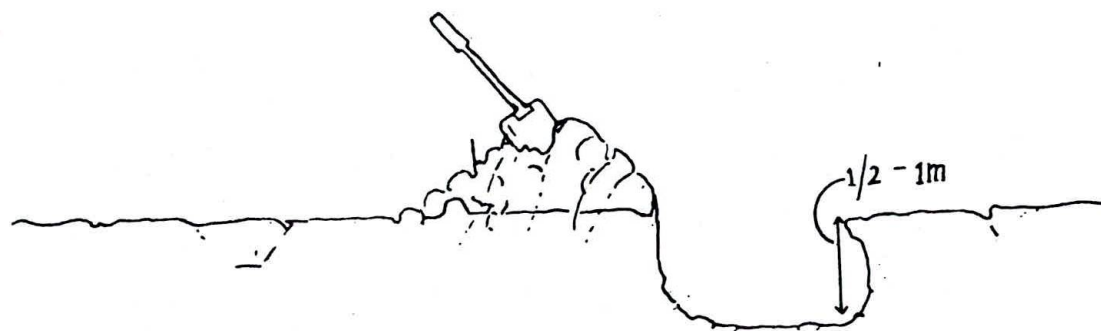
^dThese compounds were previously known as 1,1-dichloroethylene tetrachloroethylene and trichloroethylene respectively.

1. DISPOSAL OF WASH WATER PIT

1. It is important that the pesticide should be used where it is needed and that it should not contaminate the surroundings elsewhere. This is particularly to protect children, birds and useful animals.
2. The picture shows a hole $\frac{1}{2}$ -1 metre deep, but not so deep that it has filled with water.

In this hole are poured:

- water in which hands have been washed
 - water in which pumps have been washed
 - water in which working clothes have been washed
 - water used to clean spills.
3. The hole should be
 - more than 100 metres away from streams, wells or houses.
 - dry before anything is poured into it.
 - filled in as soon as most of the water has soaked away.



Wash water pit

2. DISPOSAL OF WASH WATER - IN PUMP

If there is shortage of water, or it is not possible to dig a dry hole, washings can be stored to use the next day to make up the pump charges, until it is all used up. It is important that the supervisor should make sure that the water is not misused for drinking. He should mark the container and keep it closed and secure from use by any person who might not know what it was. Treat it as if it were pesticide.

3. DISPOSAL OF CONTAINERS - BURYING

Used pesticide containers must be collected and disposed off safely. They always contain some concentrated pesticide. The best way is to dig a pit, crush the containers and bury them. The pit should follow the same rules as the pits for washing disposal, but will often need to be deeper. The top of the containers in the pit should be $\frac{1}{2}$ metre below ground level.

I What are the other rules for siting a pit?

The rules are:

- (1) The burial site should be such that leakage of buried pesticide should not contaminate surface water or ponds.
- (2) Water should be buried under minimum half a meter soil.
- (3) Pit should not be dug in an area of low water table and pit should be dry at the time of burying containers wear?

II What clothing should the person burying containers wear?

Clothing for persons burying containers.

- i) overall
- ii) gloves
- iii) boots
- iv) cloth over mouth & nose

4. DISPOSAL OF CONTAINERS - BURNING



If containers cannot be buried, they should be burned.

Warning - the smoke may contain poisonous fumes

The rules are:

- make fire in a shallow pit
- keep at least 100 metres away from any well, river, or house.
- keep to the side where the smoke is blowing away from the person tending the fire.
- do not leave until all containers are burned.
- cover pit.

What clothing should a person burning containers wear?

The person should wear.

1. An overall & fire resistant clothing. Nylon and other synthetic fabrics are prohibited to avoid fire hazard.
2. Loose clothing should also be avoided to prevent fire hazard.
3. Face should be covered over mouth and nose with clean cloth or a respirator
4. Boots and gloves are also essential.

5. DISPOSAL OF RESIDUES AND UNWANTED CONCENTRATE

1. The disposal of large quantities of unused pesticide is more difficult. (large quantities include unopened containers).

It should never:

- be put in any river, lake or sea.
- given away to anybody else for any use what so ever.
- used for any other use than those mentioned on the label or for which it has been purchased without the permission of the purchaser.

2. Possible solutions

- deep burying

Observe rules for burying containers

- incineration in factory boilers provided chimney is high, away from built up area, and good wind is blowing.
- For burning pesticides a temperature of 1000°C or more is recommended.
- storage in caves which are then sealed off.

If in doubt, discuss with public health authorities.

DECONTAMINATION OF DRUMS

1. Drums may be decontaminated under some circumstances.

This can only be done with certain pesticides - especially organophosphorus compounds. 5% sodium hydroxide solution and a lot of water is required.

2. The rules are:

- Establish a control depot for decontamination
- make sure washings can be disposed of safely
- make sure all men wear protection - overall, apron, boots, gloves.
- obliterate pesticide labels.
- mark drums clearly 'not to be used for food or drink'.

For full details, consult manufacturers of pesticide.

APPENDIX

INCIDENTS OF HUMAN POISONING

ENDRIN

1. An operator spraying endrin in the village of Bitkuli, district Bilaspur, Madhya Pradesh, was taken ill and removed to hospital. He recovered after treatment. Incident occurred in September, 1964. Recorded by Plant Protection Officer.
2. About 100 people were taken ill and one died in Bombay after eating rice that had been contaminated with endrin. Incident occurred in 1964. Recorded by Officer of the Directorate General of Health Services.
3. A man was transferring endrin 20 per cent emulsifiable concentrate from a 23 litre drum to a five litre container by siphon, he swallowed some endrin by accident and died after 2-3 hours. Incident occurred in the village of Sedesinghwala, Punjab. No date given. Recorded by the Plant Protection Officer, Pathankot.
4. A boy died after spraying endrin continuously for 2-3 days. He did not remove or wash his clothes which were soaked in the spray, or take any precautions against skin contact or inhalation of spray. Incident occurred in the village of Thara, Punjab. No date given. Recorded by the Plant Protection Officer, Pathankot.
5. About ten People died after spraying endrin for plant protection. Incident occurred in Ludhiana in 19.04.65. Recorded by Office of the Directorate General of Health Services.
6. A farmer carried on his head a leaky 18 litre tin of ready-to-use endrin emulsion. He was drenched with the insecticide and died. He also smoked without cleaning his hands. The incident occurred in the village of Harika Kalan-Muktasar, Punjab. No date given. Recorded by Burmah Shell.

7. Three farmers and a woman died and several others became unconscious in some villages of Kotkapura in the Punjab during spraying operations with endrin on cotton. Recorded from "Eleftheria" August, 1964.

PARATHION

1. Some cases of poisoning of spray operators of State Agriculture Department said to be due to their not observing the recommended precautions. These were said to be relating to the use of gas masks, overalls and gumboots. None were fatal, atropine and oxygen were used in hospitals. The men were also said to have eaten food without washing their hands. Incidents occurred at Patna City Gaya Hazaribagh and Muzaffarpur in the State of Bihar. No dates given. Recorded by Plant Protection Officer.

2. A few non-fatal cases of poisoning, when spraying agricultural crops, were reported in Kerala State in 1963 and 1964. There were two fatal cases. One man died in the field while spraying parathion on paddy in the village of Vaikam. A boy aged 19 who was engaged in spraying parathion in a tea estate felt giddy, went home, ate his meals, vomited and died. Recorded by the Plant Protection Officer.

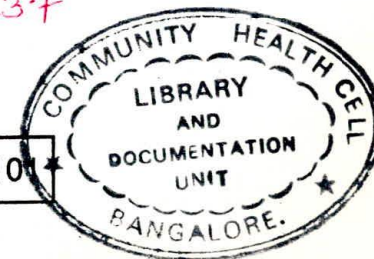
3. Between 15th April and 5th May 1958, at least 104 persons died eating food contaminated with parathion in Kerala State. Contamination occurred from leaking containers during transport. This was the subject of a judicial inquiry, and the findings were published by the Ministry of Health in 1958.

4. Three cultivators using a dust containing parathion on their cotton crop developed symptoms of poisoning. They received medical treatment and recovered. The incident occurred at the village of Barwaha, Khargaon district, Madhya Pradesh during September, 1964. Recorded by the Plant Protection Officer.

5. A man spraying against jute pests with parathion fainted but recovered after medical treatment. He was said to have chewed pan just before he fainted. The incident occurred in Chhattia Gram Panchayat in the Cuttack District of Orissa in 1959. Recorded by the Deputy Director of Agriculture.

6. From the Punjab, a few isolated casualties of workers who used parathion emulsion for spraying cotton and other crops, said not to have taken proper precautions during the handling of the pesticide, are reported. No

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specific places, nor dates given. Not stated whether casualties fatal. Recorded by the Locust Control and Plant Protection Officer, Chandigarh.

7. A labourer died while spraying parathion in the village of Sadhasinghwala in Faridkot, Punjab. No date given. Recorded by Burmah Shell.
8. An operator spraying parathion for an unspecified purpose was taken ill and died shortly after admission to hospital. The incident occurred at Bilaspur town, Madhya Pradesh in May, 1965. Recorded by the Plant Protection Officer, Bilaspur.
9. Several cases of poisoning that occurred while spraying cotton were admitted to hospital. Atropine injections were given, one died, the others recovered. The incident occurred in the Punjab. No places and no dates given. Recorded by Burmah Shell.

DDT

1. Two men died after eating chutney, in which, it was stated, they had put DDT powder instead of salt by mistake. The incident occurred at Chugran near Jullunder in 1965, 13th June. Recorded by the Hindustan Times of Tuesday, 15th June, 1965.
2. When used in malaria control operations, oil solutions or emulsions occasionally caused dermatitis on workers. No dermatitis occurred with water wettable suspensions. Recorded from Madhya Pradesh, 1964. Recorded from the Office of the Directorate of Health Services, Madhya Pradesh.

BHC

1. Reported instances of giddiness, vomiting and dermatitis in public health spraying crews using BHC in Madhya Pradesh 1964. Recorded from the Office of the Directorate of Health Services, Madhya Pradesh.

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2. Cases of food poisoning were reported in Bombay as a result of eating rice stored in bags which were reported to have been treated with 5 per cent BHC. The incident occurred in January 1963. Reported from the Office of the Directorate General of Health Services, Delhi, 1965.

DIELDRIIN

1. Reported that some of the men in the public health spray crews using dieldrin and convulsions and became unconscious. Irritation to the eyes and mucous membranes was common and troublesome. There was some dermatitis. Recorded from the Office of the Directorate of health Services, Madhya Pradesh, 1964.

PHOSPHAMIDON

1. A farm worker died of phosphamidon poisoning. it was reported that the spraying machine failed and he started swabbing the crop with a piece of cloth which he drenched in phosphamidon spray liquid. The incident occurred at the village of Jangirana near Giddenbaba. No date recorded. Recorded by Burmah Shell.

ORGANO-MERCURIALS

1. Two people had greatly swollen hands and severe dermatitis after treating seed with organomercurials with their bare hands. Incident occurred in Assam. No date given. Recorded by the Plant Protection Officer.

COPPER SULPHATE

1. 176 people retched and vomited after a feast. All meals were served on plantain leaves contaminated with an insecticide used for spraying coconut trees. Copper sulphate was detected on the leaves and in the stomach wash. Copper sulphate is an ingredient in the insecticide mixture used for coconut spraying. The incident occurred in Pampady, Kerala, on 25th February, 1963. Reported from the Office of the Agriculture and Rural Development Department.

INCIDENTS OF TOXICITY TO DOMESTIC ANIMALS

ENDRIN

1. Two bullocks died in Motihari district following

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- consumption of sugarcane leaves that had been sprayed with endrin. The leaves were fed to the cattle despite the instruction that they should not be fed for 1.1/2 months after treatment. The incident occurred a few years back. No place or date given. Recorded by the Plant Protection Officer, Bihar, in 1965.
2. A buffalo and a cow died after drinking water from a paddy field treated with endrin. The cause of death was not proven since no post-mortem was done. The incident occurred at Gatori, Madhya Pradesh, in August, 1964. Recorded by the Plant Protection Officer, Madhya Pradesh, 1965.
 3. Straw paddy that had been sprayed with endrin against Gall fly was fed to cattle. The cattle became sick and one male and one female buffaloes died. A large stock of straw fodder was not used on account of this occurrence. The incident occurred at Sakoli village, Maharashtra State in June, 1964. Recorded by the Chief Officer, Package Programme, Bhandhara, Maharashtra, 1965.
 4. One bullock was poisoned and died after drinking 0.02 per cent endrin spray mixture that was being used for citrus psylla control in Katol village in the Nagpur District of Maharashtra State in January, 1962. Recorded by the Plant Protection Officer, Amravati, 1965.
 7. Large scale poisoning in farmer's animals has been reported in Faridkot due to endrin spray on cotton fields. The affected cases remained unconscious for a number of days and those that recovered looked pale and weak. It is reported that it takes weeks to regain the original vitality. No places, no dates. Recorded from the Directorate of Veterinary Services, Madhya Pradesh, 1965.
 8. A sick cow died after application of endrin 20 per cent to its wound. The application was intended as medicine to cure the wound. The application was intended as medicine to cure the wound. The incident occurred in the village of Mohtarai, Madhya Pradesh. No date given. Recorded by the Plant Protection Officer, Madhya Pradesh.

DIELDRIN

1. A few instances occurred of poisoning of cattle and domestic birds due to contamination of fodder when spraying dielderin in houses. No places, no dates. Recorded by the Office of the Labour and Municipal

Administration Department, Mysore.

2. Several instances of high mortality of poultry due to the use of dieldrin have been noticed. No places, no dates. Recorded from the Office of the Directorate of Health Services, Madhya Pradesh.

DDT and BHC

1. Cattle fed straw contaminated due to spraying with DDT showed twitching of the muscles, convulsions, etc. DDT was detected in the straw. No places, no dates. Recorded from the Office of the Agriculture and Rural Development Department, Kerala, 1965.
2. DDT causes great mortality in cats with all the formulations used for public health work. It is also reported to cause the death of young chicks when used for this purpose. BHC produced similar effects. Recorded from the Office of the Directorate of Health Services, Madhya Pradesh.
3. DDT has shown toxic effects on dogs and poultry. Recorded from the Office of the Directorate of Veterinary Services, Madhya Pradesh.

General

1. Two bullocks died after they were sprayed by a farm manager in Rajasthan with parathion or similar pesticide to prevent nuisance of flies. The Director of Agriculture, Rajasthan, issued a circular stating that no such measure should be taken without knowing the full composition of the pesticide to be used. No place, no date given. Recorded by Agricultural Extension Officer in 1963.
2. Some cases of poisoning due to pesticides are noticed when animals graze immediately after the pesticides are used on the plants. No details, no dates. Recorded by the Sub-divisional Animal Husbandry Officer, Biharshariff, Patna, Bihar, 1964.
3. Some case of non-fatal poisoning of cattle by pesticides other than those already recorded under endrin are reported. They were saved after veterinary treatment. No details, or dates given. Recorded by the Plant Protection Officer, Bihar, 1965.

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4. Statement that poisoning by parathion and other allied pesticides is increasing. When only a few animals are killed it goes unnoticed and only when a large number of animals dies, it is brought to the attention of the officials. Recorded from the Veterinary Disease Investigation Officer, Ranipet, Madras, 1964.
 5. Statement that the recorder had investigated one instance of heavy mortality of sheep which was suspected to be due to grazing on fields contaminated with parathion and another where the sheep had been dosed with a vermicide suspected of being contaminated with "Fytolon" copper oxychloride. In both instances the animals had acute diarrhoea followed by death. No places or dates are given. Recorded by the Veterinary Disease Investigation Officer, (Sheep and Goats) Madras, 1965.
 6. (a) Fish, frogs and earthworms both in the fields and in the neighbouring ponds and wells are dying due to the use of pesticides like endrin, "Basudin", parathion BHC and DDT and diazinon.
 - (b) Mortality of human beings, animals and poultry are noticed due to the intake of poisonous chemicals like parathion compounds. Recorded by the Director of Agriculture, Pondicherry.
 7. In most of the records where fish were recorded as killed, the records also stated that frogs and snakes were killed. These records are nearly all due to mortality endrin and parathion.
 8. A cock died in a village in Delhi in 1959 after eating the dead rat poisoned by zinc phosphide. Recorded by the Plant Protection Specialist, Ministry of Food and Agriculture Delhi.
 9. A dog died after eating a few dead rats poisoned by zinc phosphide in a Delhi village in 1964. Recorded by the Plant Protection Specialist, Ministry of Food and Agriculture, Delhi.

INCIDENTS OF TOXICITY TO FISH

The fisheries development adviser states that:

"It has to be noted that since no particular attention has been paid in India to study this aspect, the examples cited are only a few of the total occurrences in the country, there being no arrangements to collect the factual data."

(a) Incidents Recorded by the Fisheries Development Adviser.

1. The discharge from the Hindustan Insecticides Factory manufacturing DDT at Delhi has been suspected to have caused mass scale destruction of fish in Jumna river and the problem was referred to the Central Public Health Engineering Institute.
2. In 1962, fish mortality was observed in two tanks (2 acres perennial at Kalapet and 1.1/2 acres perennial at Lawspet). DDT and endrin had been spread in the adjoining fields from which the drainage entered the fish ponds. Another example in Pondicherry is of mortality of fish due to spraying of DDT and endrin in the nearby fields in the Pallivasal Kulam tank (one acre perennial) and Ayyankulam tank (1.1/2 acres perennial at Karaikal).

3. In Jammu and Kashmir, large scale fish mortality was observed in the ponds at Reasi and the Nehru Stream, where DDT was used in the city drains.
4. The Yamai tank at Islampur and one tank at Ramtek situated in Sangli and Nagpur districts respectively in the Maharashtra State and heavy mortality of fish on account of empty DDT containers having been cleaned in the tank water.
5. Mortality was observed in an acre tank in village Kachlone, District Raipur where empty containers of DDT had been washed.

In Lakhan Talav (3 to 4 acres water spread) mortality occurred on 2nd September, 1964. Investigations showed that endrin was sprayed in the fields in the catchment area two days earlier and rains occurred immediately after spraying.

6. At Gwalior, mortality of fish seed was observed on 7th September, 1963 in a nursery tank resulting in death of 12,000 fingerlings 3 to 4 inch long due to washing of empty DDT containers.

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7. Fingerlings were also killed in the Nalcha tank in the Dhar District due to spraying of pesticides on Singhara crop (Trapa crop) which was also cultivated in the same tank.
 8. In the Palace tank at Bangalore, fish mortality was reported immediately after a rainy day and was due to spraying of insecticides and pesticides in the garden in the upper reaches of the pond. A similar incident occurred in a pond near Chickballapur due to rains carrying folidol from the garden above. Similar incidents have been reported from Kalahandi, Korput and the Ganjam Districts in Orissa.
 9. In the Kuttanad area in Kerala, the Agriculturists are using various chemicals, such as endrin, folidol and DDT and considerable fall in the fishery wealth has been noticed in the Vembanad Lake and the canals lying between the paddy fields.
 10. Large scale mortalities of pond fish were noticed in 1961 in the premises of the Jute Agricultural Research Institute, Barrackpore, due to the contamination of pond water by folidol and endrin, which had been washed into the ponds by rain water from the

adjoining fields. The affected fish included Rohu, Catla and Mrigal.

(b)Records from other sources

ENDRIN

1. Following aerial spraying of endrin at 2 oz. active ingredient per acre on paddy fields near Bantumalli, Krishna District, Andhra Pradesh in 1964, fish, crab and snakes in small ponds and canals were found dead, a few cranes and crows also died after eating the dead fish. These effects are attributed to spray drift falling on the water. Recorded by Plant Protection Officer, Hyderabad.
2. Following aerial spraying with endrin and aldrin fish were found tanks near the crop field. This was attributed to gusts of winds carrying the spray and contaminating the tanks. The incidents occurred in tal areas of Mokameh and Burhiya, Bihar. No date given. Recorded by Plant Protection Officer, Patna, Bihar, 1965.
3. Following aerial spraying of cotton with 0.02 per cent endrin, fish were killed in the stream due to spray

drift contaminating the water. The incident occurred near Mahispur in the Amravati District in October, 1963.

4. Heavy rain on paddy fields sprayed with endrin caused flooding and overflow into village tanks where the fish were killed. The incidents occurred in the villages of Pandarwa, Gatori and Rahod, Madhya Pradesh in August, 1964. Recorded by the Plant Protection Officer, Madhya Pradesh.
5. During aerial spraying with endrin against sugarcane borer a large amount of the spray material was carried by wind and dropped over a tank. As a result the fish in the tank died. The incident occurred at Plassey, West Bengal. No date given. Recorded by the State Entomologist, West Bengal, 1965.
6. After endrin was used to control rice Hispa the recorder noticed dying of fish eight hours after spraying. The incident occurred in Jankia Gram Panchayat in the Puri District of Orissa in 1962. Recorded by the Deputy Director of Agriculture, Orissa, 1965.

DDT

A few reports of fish dying when spray equipment used by public health spray teams were inadvertently washed in tanks containing fish. No dates given.

Recorded by the Office of the Directorate of Health Services, Madhya Pradesh, 1964.

PARATHION

Fishes of all kinds died in fish farms after application of parathion and insecticides of M/S Sen, Dutta and Chapakhira, Nadia and Howrah Districts, West Bengal.

General

1. Some cases of fish mortality have been reported from small step wells due to washing in them of sprayers and other utensils used for spraying pesticides in the wells.
2. Poisoning of fish is common in the backwaters of the sprayed fields are let in. Whenever a large scale spraying campaign is organised, instructions are given to cultivators to drain away the water before spraying campaign is organised, and not to allow the water from sprayed fields into common canals. Which has been contaminated by endrin spraying or by washing drums and sprayers used in endrin spraying. Recorded by Plant Protection Officer, Kerala, 1965.
3. Where pesticides like endrin and parathion are sprayed, fish seed and fish die in large numbers in paddy fields especially during aerial operations. In this state

(Andhra Pradesh) paddy plots are good nurseries for multiplying fish seed and a large quantity of seed for cultivable species are collected from the irrigation channels every year by the fisheries department for stocking in various water sources. In view of the deleterious effects of endrin and similar pesticides on fish life, the Agriculture Department makes a special efforts to catch fingerlings. Record from the Director of Agriculture, Andhra Pradesh, 1965.

4. Some reports have been received of mischief makers killing fish in ponds with endrin emulsifiable concentrate which they poured into ponds. Recorded by the Plant Protection Officer, Bihar, 1965.

INCIDENTS OF TOXICITY TO BENEFICIAL INSECTS AND WILDLIFE

1. Considerable mortality to bees in artificial beehives occurred at Kumta. Parathion was being sprayed on the summer groundnut crop in the area and was suspected being the cause of death. The recorder thought this was likely. Recorded by the Plant Protection Officer, Dharwar, Mysore, 1965.

2. Poisoning of bees was occasionally noted when their pasturage had been sprayed to control harmful insects. Recorded by the Office of the Directorate of Health Services, Madhya Pradesh, 1964.
3. Silkworms were found to be very susceptible to DDT during its spraying for public health purposes. Recorded by the Office of the Directorate of Health Services, Madhya Pradesh, 1964.
4. In the tea and cardamom estates adjoining reserved forests, cases of deaths of Sambar and wild elephants were reported in Nilgiris and Madurai (Madras). The deaths were suspected to be due to the use of weedicides. Recorded by the Chief Conservator of Forests, Madras, 1964.
5. Reported that on the border of Kerala and Madras where wild elephants were a serious menace to the farmers crops the local farmers sprayed the banana trees in the locality with parathion emulsion. About forty elephants are reported to have died after eating the bananas. Recorded from the Directorate General of Health Services, New Delhi, 1965.