5 PEST CONTROL

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1 What is a pest?

A pest is any animal or plant which has a harmful effect on humans, their food or their living conditions. Pests include animals which:

- carry disease-causing micro-organisms and parasites, for example, mosquitoes which carry Ross River virus and Murray Valley encephalitis.
- attack and eat vegetable and cereal crops, for example, caterpillars and grasshoppers.
- damage stored food. For example, rats and mice may eat grain in silos, rice or biscuits in shops and homes and contaminate this food with their faeces (droppings) and urine.
- attack and eat farm and station animals. For example, feral dogs (dingoes) kill or maim many sheep and goats each year; foxes will kill poultry, lambs and many species of native wildlife; and feral cats also prey on native wildlife.
- damage clothing. Silverfish, for example, eat holes in clothes.
- damage buildings. For example, termites can cause considerable damage to timber in buildings.
- bite people. For example, bed bugs (so called because they often bite people in their beds) are very difficult and expensive to control. Their bites can cause great irritation to those bitten and, like mosquito bites, can become infected if scratched.

There are thousands of different kinds of pests which are harmful to humans. The great majority of these are types of insect.

Fig. 5.1: Some insect pests.
2 Pest control

The numbers of pests in communities, on farms and pastoral stations must be controlled. Control is necessary, so that people, their stock and food supplies are not destroyed or contaminated, and the health of humans is not put at unnecessary risk. Pest control is all the action taken to help keep the number of pests down to a level where the risk to people, their food and the environment is minimised.

3 Common pests

There are many different kinds of pests and only some of these create health problems in Indigenous communities. The control of these will be described in this chapter.

3.1 LIVING AND BREEDING PLACES OF COMMON PESTS

Listed below are the pests which are commonly found in Indigenous communities, along with information about their living and breeding places and food sources.

Flies

Rubbish, food scraps, open septic tanks, open leach drains, under eaves, dirty benches and tables, lawn clippings and animal faeces.

Cockroaches

Rubbish, food scraps, dirty benches and tables, drains, behind stoves and fridges, bathroom and kitchen cupboards, under floors of older houses, septic tanks and leach drains.

Mosquitoes

Cool, dark and damp places such as rain water in discarded refrigerators, car tyres and tins, and in septic tanks/leach drains, water storage tanks, protected corners of effluent ponds and natural bodies of water.

Fleas

Like sandy areas. They need blood to breed. They will also bite humans when there are no animals around. Many fleas are brought into houses on peoples clothes, having jumped onto them from outside their house. Fleas are also transported on bedding.

Fleas are usually found on animals like cats and dogs, so it is important that these animals are kept outside the house to reduce the likelihood of fleas infesting houses.
Mites

Live and breed on animals and people.

Rats and Mice

Rubbish, exposed food, storage places, kitchen cupboards and holes in walls. They are also found in pipes, insulation, under buildings, in ceilings and in trees and gardens.

Bed bugs

Are transported from place to place in or on a persons luggage or their bedding. They hide in cracks and crevices during the day where people sleep and will seek a blood meal by biting a person in their bed during the night.

Bed bugs also need a blood meal to mature into adults. Bites can be very itchy and if scratched can become infected.

3.2 FLIES

There are many different kinds of flies. Three common types are shown below:

![Fig. 5.2: Common types of flies.](image)

Fly life cycle

Adult flies lay their eggs in moist organic material, for example, food scraps, animal faeces (droppings), grass clippings or dead animals. After a few hours the eggs turn into larvae, called maggots.

The maggots feed on the organic material and grow quickly. After four or five days the maggots move to dry soil and burrow down into it and turn into pupae. A special hard protective covering called a pupal case encloses each of the pupae while they continue to develop. Pupae are brown to black in colour and can sometimes be mistaken for mice droppings.
After four or five days, pupae turn into adult flies. They break out of the pupal case, burrow up through the soil to the surface and fly away.

Flies are able to travel many kilometres from their breeding place. However, if there are lots of flies around, it usually means there is a good breeding place nearby.

![Life cycle of the fly](image)

Fig. 5.3: Life cycle of the fly.

**Flies and disease**

When flies land on things like food scraps, manure, faeces or dead animals they pick up disease-carrying germs and germs. The germs are carried on their hairy bodies and legs and in their stomachs.

When the flies land on things like food, cups, knives and plates, the germs can be passed on to these articles. If people then eat the food or use these articles when eating food, they will get the germs into their bodies and may become sick.
Flies feed by putting a special substance from its stomach onto the food through its long, hollow, tube-shaped mouth. This special type of mouth is called a proboscis. The special substance which comes from the fly’s stomach makes the food liquid and the fly then sucks this up through its proboscis.

Germs from the fly’s legs and body, and from the liquid that comes from its stomach, get onto the food while it is eating. Some of these germs will be left behind on the food after the fly has gone.

This is a list of the diseases caused by germs and parasites which come from flies.

**Diseases in Indigenous communities caused by germs carried by flies**

**Bacterial diseases:**
- salmonellosis
- shigellosis
- trachoma.

**Viral diseases:**
- hepatitis A

*Fig. 5.4: How flies spread germs which cause such diseases as food poisoning and hepatitis A.*

When people have cuts and sores on their bodies, disease-carrying flies can land on them and cause them to become infected.
Fig. 5.5: Flies spread germs which cause cuts and sores to become infected.

Bush flies can carry a germ which causes a serious eye disease called **trachoma**. These flies are attracted to the salt in the tears (moisture) from people’s eyes. As bush flies go from one person’s eyes to another, they can pass on this disease from one person to the next. The common house fly is also attracted to the moisture around people’s eyes. These flies can pass on germs which cause other kinds of eye infections, such as pus eyes.

Fig. 5.6: How flies spread germs which cause trachoma.
Controlling flies

Probably the best method of fly control is to make sure the flies have no place where they can breed. Some of the ways of getting rid of breeding sites around the home are listed below.

- Wrap all food scraps tightly.
- Make sure the rubbish bin has an undamaged, tight-fitting lid that stops flies from getting in.
- Empty the rubbish bin regularly (at least weekly and more frequently if there are many people visiting or there is a house with a large family).
- Make sure rubbish is disposed of properly at the rubbish tip and covered regularly.
- Make sure the toilet is clean and working properly.
- Make sure the toilet vent pipes are fly-proofed.
- Make sure that septic tanks and leach drains are not damaged and have proper sealed lids.
- Remove dog and other animal faeces daily if possible.
- Dispose of faeces and dead animals to the rubbish tip as quickly as possible.

The EHP should make regular checks around the community to identify possible fly-breeding places. If maggots are found they should be killed immediately and the breeding site cleared of all organic material. After this, these places should be checked regularly.

3.3 COCKROACHES

There are many different types of cockroaches and most of them can spread disease. The three main types of cockroach in Australia are the German Cockroach, Australian Cockroach and the American Cockroach.

The German Cockroach is one of the smallest of the cockroaches and is probably the most commonly found species inside buildings. Adults are 12 to 15 mm long, have a light amber/brown colour with two dark stripes on the head.

*Fig. 5.7: The German Cockroach*
German Cockroaches are mostly found in and around kitchens, pantries, storerooms and other food handling areas. They prefer to be near food, moisture and warmth. They do not fly.

The **Australian Cockroach** is larger (30 to 35 mm) and is able to fly. It is dark brown with clearly defined yellow markings on the head and the front wings. This cockroach prefers plant food and is usually found outdoors. For example, under the bark of trees and among woodpiles.

The **American Cockroach** is one of the largest of the cockroaches (30 to 45 mm). It is red brown in colour with a pale yellow border around the head and it can fly. The American Cockroach prefers warm and moist conditions. It is a very widespread pest which lives in wall and roof cavities, sewers, drains, cellars, grease traps and rubbish dumps. It can be found around any food preparation area.

**Cockroach life cycle**

After mating, the female cockroach produces an egg case. This egg case can be either carried by the cockroach or left in a secure place until the young are due to hatch. When she is ready, the female cockroach leaves the egg case in a quiet, dark, warm location.

The eggs then hatch, these are called **nymphs**, they look much like a small version of an the adult. Cockroaches do not undergo a series of marked changes like flies and some other insects. Cockroach nymphs grow to adult size by a series of moulting processes.

In each of these, the nymph sheds its hard outer covering for a new, larger one. Depending on the type of cockroach it may take from one to twelve months for a nymph to grow to adult size.

**Note:** When cockroaches moult, they will be white in colour, after a day or so they will return to their original colour of brown to dark brown, depending on the species.
Cockroaches and disease

Like flies, cockroaches can carry many disease-causing germs on and in their bodies. Because their natural homes include rubbish, dirt and filth they readily pick up germs from these areas. They then walk over food, cutlery, crockery and cooking equipment, benches, tables and other places in the home and pass the germs on to people.

Diseases in Indigenous communities caused by germs carried by cockroaches.

Bacterial diseases:

- salmonellosis
- shigellosis.

Viral:

- gastroenteritis
- hepatitis A.
Controlling Cockroaches

All of the suggestions listed to control flies will also help control cockroaches. However, there are other kinds of actions which can be taken to keep cockroaches away from living areas. For example:

- keep food in containers which have tightly fitting lids
- store food handling equipment and containers up off the floor
- where possible, fill in small cracks and crevices (holes), in which cockroaches could hide. It is especially important to fill in cracks and crevices around pipes in walls
- clean shelves and inside and underneath cupboards regularly. This will reduce the build-up of food particles
- when required, apply a low toxicity liquid or gel insecticide to those areas where cockroaches may hide, especially cracks and crevices inside and around the outside of buildings, behind stoves and fridges and underneath the shelves of cupboards. There are many suitable insecticides that can be used to effectively control cockroaches. Before insecticides are used, people should be encouraged to regularly clean in and around their houses to reduce the cockroaches’ food source.

3.4 MOSQUITOES

The adult mosquito has a proboscis similar to a fly except that it has a needle-sharp end which is used for piercing the skin of a person or other animal to suck blood.

When mosquitoes pierce the skin to suck blood, this can result in the transmission of many serious diseases among humans and other animals. However, most mosquitoes do not carry disease-causing germs, but only annoy people with the itchy ‘bites’ they cause. If people scratch their mosquito bites this can break the skin and lead to secondary infections.

Fig. 5.9: The mosquito.
Mosquito life cycle

Mosquitoes, like flies, undergo a complete change in appearance as they develop from the egg to the adult. Mosquitoes need water to complete their life cycle, and this water must remain until the adult mosquito is able to fly. If the water should drain away or dry up, the larvae or pupae will die.

Female mosquitoes often lay their eggs on a water surface. After a few days the larvae (which are called wriggles) hatch from the egg and begin to feed on organic matter in the water. The wriggles stay in calm, protected water as they cannot breathe properly in rough water. The wriggles breathe through a siphon (tube), the opening of which is pushed above the water surface. Rough water will stop them from being able to breathe.

Some mosquitoes, however, will lay their eggs in moist areas just above the water level, for example, on leaves, blades of grass or on mud next to a waterhole. These eggs will lay dormant (asleep) for a period of time when the conditions are not right for them to hatch, for example, if it is too dry. When the conditions are right, such as when the rains come, the area floods, or there are high tides, the water will cover the eggs and they will hatch within 1 to 2 days.

After several days the wriggles change body form and become pupae which are also called tumblers. The tumblers do not feed but they do move around.

After 1 to 4 days the adult mosquito comes out of the pupal case. It stays on the surface of the water until it dries out and then flies off. This drying off time is dangerous for the mosquito because it is easy for it to be attacked and eaten by other insects, frogs or birds.

The length of the life cycle will vary from one type of mosquito to another, but usually takes between 5 and 10 days at temperatures above 30°C and up to 3 weeks at temperatures lower than 20°C. A rise in the temperature of the water may speed up life cycle.

Adult female mosquitoes may live for several weeks.
Mosquitoes and disease

Before the female can lay her eggs, she must have a blood meal. She gets this blood by sticking her proboscis into the person or animal’s skin and sucking out the blood, often called a mosquito ‘bite’. The time when biting is most likely is at dawn and dusk.

If a mosquito takes a blood meal from a person or animal that is infected with these virus germs then the virus will grow inside the mosquito. If it later bites another person or animal, it may pass on some of the virus germs, and that person or animal may catch the disease. This cycle can go on and on, infecting lots of people and animals and causing a disease outbreak with lots of sick people.
Many people all over the world have died as a result of diseases transmitted by mosquitoes.

Diseases in Indigenous communities caused by germs and carried by mosquitoes

**Ross River virus disease**

The mosquitoes likely to carry Ross River virus breed in salt marshes, tidal flats, shallow freshwater swamps, poorly maintained sewage lagoons and containers such as old tyres and drums.

**Murray Valley encephalitis (also called MVE)**

The mosquitoes likely to carry Murray Valley encephalitis virus breed in open, shallow freshwater swamps and poorly maintained sewage lagoons.

**Barmah Forest virus disease**

The mosquitoes likely to carry Barmah Forest virus breed in salt marshes, tidal flats, shallow freshwater swamps, poorly maintained sewage lagoons and containers such as old tyres and drums.

**Kunjin virus disease**

The mosquitoes likely to carry Kunjin virus breed in open, shallow freshwater swamps and poorly maintained sewage lagoons.
To keep an eye on whether Murray Valley and Kunjin viruses are around, sometimes there are ‘sentinel chicken flocks’ in communities. Chickens will get these diseases before people do so blood samples are taken from the chickens to see if there is any of the virus around that might affect people living in the community. The EHP may be able to help by caring for (feeding and watering) the chooks and taking blood samples that are sent to a laboratory for testing. Sentinel chickens are no good for knowing if Ross River or Barmah Forest virus are around.

**Dengue fever**

At the moment, dengue fever is only a problem in north Queensland because it’s currently the only part of Australia where the dengue fever mosquito breeds. The dengue mosquito breeds in water-holding containers, including rubbish left lying around people’s yards. This mosquito will bite indoors and during the day. The risk of dengue in north Queensland can be reduced by regularly emptying water if it has collected in containers in the yard or by removing these containers altogether.

**Controlling mosquitoes**

As with most insect pests, the best way to control mosquitoes is to get rid of their breeding sites. This means making sure that water is not allowed to collect in unwanted equipment and containers which are left lying around.

These containers might include:

- car bodies and panels, engine blocks and tyres
- tin cans, plastic containers, drums, lids and jars

Mosquitoes can also breed in:

- water which has collected in blocked gutters and drains
- water tanks, septic tanks and leach drains which do not have lids
- still areas of water in sewage lagoons
- pools of water lying under leaking taps.
Fig. 5.13: Common mosquito breeding places.

It is important to make sure that there are always lids on water tanks, septic tanks and leach drains and that sewage ponds are kept free of grass and other vegetation around the edges.

For those mosquitoes which do manage to breed somewhere and become a pest in the community, it is important to keep them out of houses.
Putting up flywire on all door openings and windows is a good way of keeping mosquitoes out. Wearing cover-up clothes and using insect repellent on exposed skin reduces the risk of being bitten when outside during the biting times. Loose clothes are best because mosquitoes can bite through clothing which is tight against the skin, even jeans. Sleeping children and babies should be protected with mosquito nets. Insect repellent should never be used on babies – cover them with a net instead.

Sometimes when the mosquitoes are really bad or if there is lots of mosquito disease around, the mosquitoes might need to be controlled using pesticides. There are two types of pesticides – one that kills the wrigglers in the water and one that kills the adult mosquitoes that are flying around. A properly trained person who has a special pesticide license will need to do this work.

3.5 **RODENTS (RATS AND MICE)**

Rodents comprise a group of furred, warm blooded animals which include rats and mice. In Australia, there are a number of introduced (feral) rodents which are pests around homes, shops and warehouses. These are:

- the ground rat (also called the Norway rat)
- the roof rat (also called the climbing or black Rat)
- the house mouse (also called the field mouse).

**Fig. 5.14: Rodents show picture of a typical house mouse**

Rats and mice differ in size, mice being much smaller than rats. Ground and Roof Rats are similar in size. However, they differ in some ways.
Rodents and disease

Rats and mice, like other animals which live in rubbish tips, drains, sewers and other unhygienic places, pick up disease-causing germs from their environment. They then become carriers of these germs and can spread dangerous diseases by entering our houses. Six hundred years ago, roof rats and their fleas were responsible for spreading the bacteria which caused bubonic plague (the Black Death) throughout Europe. Twenty-five million people died in this plague.

Rats and mice may pass disease-causing germs to humans in several ways, such as:

- carrying disease-causing germs from sewers, drains and rubbish tips to food, kitchen benches, storage areas and utensils
- depositing infected urine or faeces on food utensils
- depositing infected urine or faeces in places where people can come in contact with it
- biting people
- passing the germs to household pets, which then pass them on to humans.

Fig. 5.15: Differences between Ground and Roof Rats.
Fig. 5.16: Rats spread germs which cause disease.

Diseases in Indigenous communities caused by germs carried by rodents

Bacterial diseases:

- leptospirosis
- rat-bite fever
- salmonellosis.

In addition to being major pests because they spread disease, rats and mice also cause significant problems in other ways, for example:

- they can destroy large amounts of stored grain in bulk stores and silos by contaminating it with their urine and faeces
- their habit of constantly gnawing (chewing) causes much damage to doors, skirtings, upholstery, books, food and other packaging, wires, cables and pipes.
Controlling rodents

All of the good hygiene practices listed for other pests will also help to keep rodent numbers low. It is also possible to design a building that makes it difficult for rats or mice to enter, although as long as people have access to buildings, these rodents will often also find a way to gain entry.

Flywire doors and window screens also help to keep rodents out of houses.

Other methods of controlling rats and mice are to use traps and poison baits. Ensure that baits are placed well out of the reach of children and pets, such as cats and dogs.

3.6 BED BUGS

Bed bugs are small insects about 4-6mm in length. They are flat in shape and when they hatch are cream in colour, turning reddish brown as they mature. When they have a blood meal they turn dark brown. There is no evidence to date that these insects transmit disease. They are often brought into a house by people who may have recently travelled interstate, overseas or visited relatives in a nearby town or community. Bed bugs attached themselves to luggage, bedding, furniture and so on. Then when any of these items are brought into a house, the insects run off and hide and wait for a person to bite. They often bite while a person is sleeping.

Bed bugs can quickly infest most areas of a house, particularly bedrooms and are difficult and very expensive to treat/eradicate. Often people have to throw away their mattresses and start again. Simply buying a new mattress will not get rid of bed bugs, as rooms have to be treated with insecticides and where possible steam or a combination of both.

The life cycle is as follows:

- Eggs—clusters of three or more stuck together, they are white in colour.
- Eggs hatch in 6–17 days and form nymphs, (nymphs shed their outer skin, 5 times).
- Nymphs turn into adults after 5–12 weeks.
- Adults are very mobile as they are good walkers and can run.

Controlling Bed Bugs

- Thoroughly inspect used bedding (including mattresses and bed frames) before it is brought into a house.
- Inspect luggage before it is brought into a house and never put your luggage or that of others onto your bed, as bed bugs attached to the outside of the luggage will jump off and infest your bed.
• If bed bugs are found, a combination of treatments is likely to be necessary for all rooms of the house, particularly bedrooms. It is likely that both insecticides and steam will have to be used. Insecticides alone will not kill the eggs, whereas steam will kill all growth stages. It is recommended that only a properly trained person is brought into treat for bed bugs. Two or more treatments might be required to eradicate these insects costing many hundreds of dollars, so preventing them infesting a house in the first place is important. Educating a community on the ways bed bugs can travel and where they could be found in a house is important. There are brochures available from the Dept of Health, the local government or council or from the Dept of Health web site. There is also a national Code of Practice developed for the control of these insects.

4 Environmental conditions which encourage pests

Where an EHP surveys a community and finds some of the conditions listed below, it is likely that some pests will be found in the community.

• Faeces or dead animals lying around.
• Septic tanks and leach drains with lids broken or missing.
• Pools of water caused by leaking taps.
• Overflowing effluent drains.
• Objects such as old tyres and other water-holding containers left lying around which could collect water.
• Rubbish, including food scraps, left lying around.
• Blocked and/or unclean toilets.
• Grass growing in sewage lagoons.

Homes with:

• food left uncovered in kitchens
• unclean tables and bench tops
• unclean cupboards and shelves
• unclean kitchen floors.
4.1 SIGNS THAT THERE ARE PESTS IN A HOUSE

It is easy to know when flies and mosquitoes are in a house because they usually annoy people and are easy to see.

Where houses are not properly cleaned, there can be a significant number of cockroaches, which can be often seen during the day. Large cockroach infestations can produce a sickly smell and leave much faecal material around.

Rats and mice usually hide during the day and are rarely seen, unless in large numbers.

Listed below are some of the signs which show that pests are around.

**Signs of cockroaches include:**
- lots of little black droppings
- a sweet, sickly smell
- dead cockroaches
- empty egg cases
- chewed labels and paper.

**Signs of rats and mice include:**
- teeth marks and damage from chewing
- rat and mice droppings
- greasy smears from the rats’ fur mark their runways
- rat and mice holes
- running, chewing or scratching noises.
Signs of bed bugs include:

- dark blood spots on bedding
- adult bed bugs hiding in the seams of mattresses, bed frames, etc.
- small white clusters of eggs sticking to the mattress seams
- people complaining of being bitten.

Fig. 5.18: House mouse and rat droppings (faeces).

5 Pesticides

5.1 WHAT ARE PESTICIDES?

A pesticide is a substance used to kill feral animals, insects, fungi or plants. There are thousands of different pesticides in use today. Pesticides are used in houses, shops, offices, storerooms, sheds, gardens, farms, pastoral stations and many other places.

Most of the pesticides used today are chemicals which have been developed in a laboratory by scientists and produced in factories. Some pesticides are quite hazardous, as they can be harmful to humans and other living things.

They can contaminate land, the air, food crops, water ways and seriously harm or kill native animals, pets and domestic animals.

In addition to being hazardous to the user, pesticides can also cause great harm and sometimes death to a person or other living things nearby, if the instructions on the pesticide container are not followed carefully.
Pesticides come in three different forms:

- **solids**, which come in powder form (like flour), or in crystal or granular form (like sugar)
- **liquids**, which look like milky water
- **aerosols**, which are sprayed out in a fine mist.

### 5.2 PEOPLE AND PESTICIDE POISONING

While pesticides are useful for the control of various pests, many of them are hazardous chemicals. They are hazardous because they can poison the land, the water and the air.

It is very important to only use pesticides in accordance with the label directions which are found on the pesticide container. When people using pesticides become careless they run the risk of poisoning themselves, other people and animals and plants.

Animals which are intended to be killed with pesticides are called **target animals**. Animals (including people) which are not intended to be killed when a pesticide is used are called **non-target animals**.

Pesticides can enter the human body in three ways, which are outlined below.

**Oral entry**

This type of entry is through the mouth in the food we eat or the liquids we drink. Also, if there is any pesticide on our hands it can get into the body when the hands are licked, when the face is wiped near the mouth, or when a cigarette becomes contaminated and is put into the mouth.

**Respiratory entry**

Pesticide sprays, vapours or powders can be breathed in through the mouth and nose.

**Dermal entry**

Pesticide spray which lands on the body can be absorbed through the skin and eyes. Pesticides are commonly absorbed very quickly through the eyes, forehead and forearms.
Some of the ways by which careless use of pesticides can cause people or other animals to be poisoned accidentally include:

- not reading the label
- putting pesticide in a food or drink container, such as a drink bottle. Children may eat or drink the pesticide by mistake
- leaving pesticide baits in places where children and pets can get them
- not using protective clothing or equipment when mixing or spraying a pesticide
- contaminating uncovered food and drink or cooking/eating utensils while carrying out a spraying operation
- spraying in windy conditions so that the spray drifts away to other areas
- spraying areas which do not need to be treated
- not moving other people and animals away from the spraying area.

All of these careless practices greatly increase the chance of someone being harmed by accidentally absorbing (taking into the body) some of the pesticide either orally, dermally or through respiration.
5.3 PESTICIDE LABELS AND POISON SCHEDULES

Pesticide labels

It is often stressed that the most important few minutes in pest control is the time spent in reading the label.

The label of a pesticide container has all the information needed for safe and effective use.

**READ THE LABEL**

The label on a pesticide container has three main functions:

- To tell the user what pest the product can be used on.
- To tell the user how to handle, use and store the pesticide safely.
- To tell the user how and when to apply the pesticide for the best effect.

By law, pesticide labels must contain:

- the name of the product
- its poison schedule in words which will alert the user of its level of toxicity
- the name of the active constituent (actual pesticide chemical in the container) and its strength.

**Note:** Pesticide containers will usually have only a small percentage of actual pesticide chemical in them. The other substances making up the product may include:

- solvents such as water, which help dissolve the chemical
- carrying agents which help distribute the chemical, for example, talc in the case of pesticide powders and gases in the case of aerosol sprays.

- the pests which the product will control
- the rate of application of the product (how much of it to use)
- the time and method of application
- directions for handling the product safely
- first aid procedures in case of an accident
- any special instructions or warnings about its use or disposal
- the net contents (weight when packed) of the container.
Here is an example of a label on pesticides which are often used in communities:
It is important to always read the label on the pesticide container before using it.

Before buying or ordering a pesticide always answer the following questions:

- Is it the right chemical for the pests to be treated?
- Is it the chemical which is least harmful to people?
- What are the application precautions?
- What safety equipment is required?
- What equipment is needed to apply the chemical?
- What needs to be done to store the concentrate and dispose of leftover solution safely?
- What needs to be done to decontaminate (clean) equipment and clothing afterwards?

**Poison schedules**

Many of the substances used in people’s daily lives can be poisonous when used incorrectly, such as medicines, tablets, solvents, cleaning aids, glues and of course pesticides.

To help people know how poisonous a substance is, there are poison schedules.

These are lists of substances which are classified according to how toxic (poisonous) they are. Scheduled substances must all carry labels warning people that the substances:

- are poisonous or can cause injury
- must be used carefully by people
- must be kept away from children.

A substance which is considered poisonous or can cause injury is put into one of the poison schedules. There are eight different schedules.

Pesticides may be unscheduled, or may be listed in Schedules 5, 6 or 7.

**Unscheduled:** These are very low in toxicity and are unlikely to cause harm to humans, provided they are used in accordance with label directions, most aerosol cans fall within this area.

**S5 Pesticides:** These have low toxicity and available to the public but require caution in handling, use and storage.

**S6 Pesticides:** These have moderate toxicity and available to the public and also require caution in use, handling and storage.
S7 Pesticides: These have **high to very high toxicity**. These pesticides are extremely hazardous and dangerous to health and have a high potential for causing harm at low exposures. They require special labelling, handling and use and are not available to the general public.

Pesticides undergo laboratory tests to establish their level of toxicity. The chemical is tested on ‘test animals’, such as rats, mice and rabbits, to see how much chemical is needed to kill an animal. These tests establish the pesticide’s LD50 (lethal or killing dose).

**The lower the LD50 the more toxic (more poisonous) the chemical.**

The schedules will take into account the substance’s toxicity, any special precautions or warnings and any other relevant factors which relate to how poisonous it may be.

5.4 **PROTECTION OF THE ENVIRONMENT AND NON-TARGET SPECIES**

Pesticides are designed to kill. When people use them they are aiming to kill a particular kind of pest. Because pesticides are poisonous chemicals, great care must be taken when using them, so that non-target animals and plants are not killed.

For example, if a house is being sprayed for cockroaches it is important not to harm any of the adults, children and pets such as dogs and cats who may live there. All of these animals make up the non-target animals in the house.

*Fig. 5.20: Spraying for pests can affect non-target animals.*
As well as protecting non-target animals and plants when pesticides are used, it is also important that every effort is made to protect the rest of the environment. Some pesticides are very poisonous and will last in the environment for a long time where they can poison the land, the water and the air.

This can happen when pesticides are used incorrectly, or when treated materials which should never be touched by people come into contact with them. For example, moving termite treated soil from beneath a building to use in a children’s playground.

**Non-biodegradable and biodegradable pesticides**

Some pesticides do not break down for a long time. These types of pesticides are often used when something must be protected from pest attack for a long period of time, for example, protecting houses from termite attack.

Pesticides which remain in the soil or on the treated surface are also often called residual chemicals.

When residual pesticides get into the environment they can remain poisonous and active for many years. If applied incorrectly or used in the wrong place, these chemicals may spread to other land areas and possibly to the water supply.

Sometimes people do not know that the chemical is in the ground and may dig up the soil. They may then use it for a garden or some other purpose which brings other people, their pets and other animals into contact with it. As a result, many non-target animals can be affected by pesticides in this way.

Prior to 1996, some pesticides were non-biodegradable. Some of them, such as D.D.T and Dieldrin can still be found in the environment today, although they are no longer available and have not been used for many years.

Scientists nowadays are developing pesticides which are biodegradable. These chemicals stay active long enough to do the job required and then they break down into simple and harmless chemicals like water and carbon dioxide. Scientists are also developing less toxic residual chemicals. For example, pesticides used to protect houses from termites.

**Pesticides and the food chain**

In nature, plants are eaten by animals. These animals are in turn eaten by other animals, which are eaten by other animals, and so on. This is called the food chain.

Along the food chain there are many different ways pesticides can accidentally contaminate animals and plants which could then be eaten by humans. Pesticides can enter the food chain at different points.
Below is an example of how pesticides can enter the food chain.

After an insect pest has been killed by a pesticide the chemical may stay in its body and still be active. If another animal eats the insect’s body the pesticide will be transferred to its body and it may also be harmed by the pesticide. The second animal may of course be eaten by a third animal and it too could be harmed by the pesticide and so on.

In the example of the food chain given in this picture, pesticide has entered and killed the target pest, the grasshopper. However, the pesticide in the grasshopper has found its way into three useful non-target animals via a food chain.

![Diagram of a food chain]

**Fig. 5.21: An example of a food chain.**

**Using pesticides correctly to protect the environment, including people**

When a pesticide spray is used, it is important to protect the environment by following the rules listed below.

- Ensure that the correct pesticide for the job is chosen and applied in accordance with the label directions.
- Only spray those areas that need to be treated.
• Only mix or use sufficient pesticide solution that is necessary to do the job, that is, **do not overspray** or use too much concentrate.

• Only spray in low wind conditions. Try to have as little spray drift as possible and preferably none at all. Do not spray where the wind exceeds 15kmph.

• Ensure that there is no pesticide left at the end of the treatment. Leftover pesticide must be either be used on the next job or buried. If the pesticide is buried there is always the risk that it may contaminate rivers, swamps and underground water supplies. Every effort should be made to reduce the chances of this happening.

• Ensure that all other people and animals are moved well away from the spraying area and that they stay away until it is safe to return.

• Ensure that people who have had the inside of their homes treated are advised to open windows and doors to get rid of any chemical smell which might be present when they return.

• If treating the inside of a home, ensure that the chemical has dried before people re-enter the house.

*Fig. 5.22: It is important when spraying pesticide in a building to make sure everyone is outside.*
5.5 ADVANTAGES AND DISADVANTAGES OF USING PESTICIDES

The use of pesticides to control pests can cause concern to some people. People can become worried about the effects of the continued use of pesticide on the environment and its impact on human health.

There are good reasons (advantages) for using pesticides and there are reasons for not using them (disadvantages).

Advantages of using pesticides

- Applying pesticides is not difficult, provided users are properly trained.
- Modern pesticides are very effective. This means that nearly all the target pests which come in contact with these pesticides are killed.
- Results are quick. This means the pests are killed within a very short time.
- Using pesticides can be an economical (cheap) way of controlling pests. Pesticides can be applied quickly and there is not the high labour cost which might apply to other methods of control, such as removing weeds by hand.

Disadvantages of using pesticides

- If pesticides are not used correctly, they can affect human health or cause serious injury or death to the pesticide operator, other people or household pets.
- Pesticides can also directly affect other non-target animals. For example, a gardener spraying his garden to kill caterpillars will probably also kill harmless ladybird beetles and praying mantises.
- If pesticides are used incorrectly or applied wrongly, they may find their way into places where they are not wanted, for example, they might be washed into rivers or into the soil.
- Pesticides can enter the food chain.
6 Other methods of pest control

The use of pesticides to control pests should always be the last resort. Other action can be taken around homes and communities to control pests. Most of these actions simply relate to clean and healthy living.

6.1 HYGIENE AS A METHOD OF PEST CONTROL

When houses and yards are kept clean, there is no food for pests and nowhere for them to live and breed, and this in turn means that there are few pests.

Pests can be controlled by practising good hygiene in the following ways:

- Clean up after meals. Put food scraps in the bin, and wash and dry plates, cups, glasses, cutlery and cooking pots after use.
- Put all rubbish into the bin.
- Wrap all food scraps tightly in paper before putting them in the bin.
- Keep all the benches, cupboards and floors clean and free of food scraps.
- Regularly clean behind stoves, refrigerators and other household appliances.
- Keep food in containers with tight-fitting lids.
- Use the toilet properly. Make sure that all urine and faeces goes into the pedestal pan and that the toilet is flushed after use. Toilet paper is the only kind of paper that should be flushed down the toilet.
- Make sure the toilet is clean and the cistern works correctly.
- Make sure that all septic tanks and leach drains are well sealed.
- Make sure that the community rubbish tip is operated correctly with the rubbish being buried regularly.
- Use flyscreens to stop pests entering the house and seal holes around pipes.

There is little point to having a pesticide program to control domestic pests if the relevant hygiene factors are not addressed as well. The pests will soon return if good hygiene is not maintained.

6.2 BIOLOGICAL CONTROL METHODS

Biological control methods can also be used to control pests. These methods include using natural enemies of the pest and biologically interfering with their ability to breed. Pesticides are not used.
Two examples of biological control methods are:

- the use of Australian native fish to feed on mosquito larvae in water bodies
- the use of the dung beetle to break down and bury cow faeces so that it is no longer available as a breeding place for flies.

However, biological control methods can go wrong. One such example was the introduction of the giant cane toad to Queensland some years ago to control cane beetles. It was thought the toad would feed on the cane beetles and so reduce their numbers. But the toad was not successful in controlling cane beetles. Instead the poisonous toads multiplied rapidly, and have now become a major environmental pest in Queensland, the Northern Territory, and are likely to enter the Kimberley region of Western Australia.

There are other areas where biological products have been successfully introduced to control pests. One such example is the use of BTI to control mosquito larvae. BTI is a *larvicide* composed of a toxin producing bacteria. The mosquito larvae are killed when they eat the bacteria. BTI will not kill mosquito pupae.

BTI comes in liquid and granule form and is added to water bodies. BTI will not be effective if the dose rate for the amount of water is not correct. The correct method of application is very important to get the best results.

### 7 Types of pesticides and how they enter animals and plants

Pesticides can be grouped according to the types of pests which they kill:

- Insecticides—insects.
- Herbicides—plants.
- Rodenticides—rodents (rats and mice).
- Bactericides—bacteria.
- Fungicides—fungi.
- Larvicides—larvae.
There are also other ways to group pesticides. For example, they can be grouped according to the chemicals in them or to the method of application.

### 7.1 HOW PESTICIDES ENTER ANIMALS AND PLANTS

#### Insecticides

It is important to know the target insect’s habits when choosing the insecticide and which form (solid, liquid, granule or aerosol) to use. For example, flying pests such as adult mosquitoes are best attacked by aerosol sprays or fogs (droplets in the air), while crawling insects are best treated with surface powders, sprays or granules for dermal and/or oral entry.

Insecticides kill insects by getting inside their bodies where they then act as poison.

There are three different ways insecticides can get into an insect body.

These are:

- **Dermal Entry**
  
  The insecticide enters the body through the skin. In insects, the skin is called the _cuticle_. Insecticides of this kind are called **contact poisons**.
  
  Dermal entry can happen when:
  
  » aerosol spray droplets hit the insect
  
  » insects walk over and thereby come into contact with powder or granule forms of insecticide.
• Oral Entry

The insecticide enters the body through the mouth when the insect eats it. Insecticides of this type are called ingested poisons. The insecticide may be ingested by the insect:

» as a poisonous bait (a food to which insecticide has been added)

» when it ‘grooms’ (cleans) itself after the poison comes into contact with its body.
• Respiratory Entry

The insecticide is breathed in by the insect. These insecticides are called **inhaled poisons**.

Insects do not breathe through the mouth as most animals do. They breathe through **spiracles** (small holes along the side of the abdomen).

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**Fig. 5.26: Respiratory entry.**

**Herbicides**

Herbicides are used to kill plants. This may be by:

- killing that part of the plant which they touch
- killing the plant when they are absorbed into it through the leaves, stems or roots.

**Rodenticides**

Rodenticides are used to kill rodents. These poisons are usually put into food to make poisonous baits which rodents eat.
8 Pesticide treatment program

A pesticide treatment program is designed to get rid of pests by using one or more pesticides. Pesticides should not be used unless there is a definite need to do so and where a pest problem has been identified, such as extensive cockroach infestations in people’s houses.

Before a pesticide application program is undertaken, alternative methods of pest control must be considered, such as domestic hygiene measures.

In applying a pesticide it is extremely important to choose the correct one for the job and to apply it safely and in accordance with the label directions.

8.1 CHOOSING THE CORRECT PESTICIDE

In choosing the correct pesticide for a treatment program there are a number of factors that should be considered:

- Which of the available pesticides will control the target pest or pests?
- Of these, which would be the better pesticide to use? The choice should take into account the required application method and the pesticide’s level of toxicity.
- How is it applied?
- For how long will it control the pest?
- How toxic is it to humans and other non-target species?
- Can it cause damage to the environment and how might this occur?
- Is it biodegradable?
- How much pesticide is required for the job?

The pesticide selected in the end should be the least toxic to humans and other non-target species and be easy to apply, yet effective in the control of the target pest.

All of these questions need to be considered carefully before the final choice of pesticide is made. If for some reason there is not enough information supplied with the product to answer all the questions, it is important to get this information before buying or using the pesticide from the people who sell it.

If there is any doubt about any aspect of pesticide use, check with an EHO at your local government. It may also be possible to contact the manufacturer directly.
Once the pesticide has been chosen, there are a number of questions which need to be answered in relation to the pesticide itself, the equipment and the application method. These are outlined below.

**The pesticide**

- How much of the job will one container of pesticide do? Will more be needed and if so, how much? Does it need to be mixed with anything? If so, what and how much?
- Where and how should it be stored?
- How should containers and leftover pesticide be disposed of?

**The equipment**

- What application equipment is needed?
- What protective clothing and equipment is required?
- How should the protective clothing and equipment, and the application equipment be cleaned?

**The application method**

- What warnings are given?
- What safety measures are necessary while the pesticide is being used?
- How must the pesticide be applied?

### 8.2 INSECTICIDE TYPES

Most of the pesticides used around houses are insecticides. They are used to kill the many insect pests that annoy people and/or affect their health. The majority of insecticides belong to several basic groups which are broadly defined by the chemicals used to make them. These are inorganic insecticides, organic pyrethrins, synthetic pyrethroids, organophosphorous insecticides and insect growth regulators.

**Inorganic insecticides**

These insecticides are of mineral origin and include substances such as arsenic trioxide powder (used in termite treatments) and boric acid (used in cockroach treatments). Some of them are not commonly used these days. This is because they are often highly toxic to mammals (furred, warm-blooded animals), are non-biodegradable, or simply because easier methods have been found.

Most inorganic pesticides have a stomach poisoning action. For this reason they are usually in solid form and are applied as baits.
**Organic pyrethrins**

These are made from certain plants. The most widely used natural insecticide is **pyrethrin** which is obtained from a type of chrysanthemum flower.

Pyrethrin has a number of advantages as an insecticide:

- It is a **broad spectrum insecticide**. This means it will kill a wide range of insect pests.
- It has low toxicity to mammals.
- It acts quickly, that is, it has a **fast knockdown**.
- It is biodegradable (breaks down fairly quickly).

The main disadvantage of pyrethrin is that it has little or no residual action.

**Synthetic pyrethroids**

This is a group of synthetic insecticides. This means they are insecticides which have been chemically manufactured (man-made) to work like naturally occurring pyrethrins. This group of chemicals are generally low in toxicity to humans, but are very effective against a wide variety of insect pests.

Examples of synthetic pyrethroids are:

- bifenthrin
- permethrin
- bioresmethrin
- tetramethrin
- deltamethrin
- Coopex, Cislin, Crackdown and Biflex are four commercial products in this group.

*Fig 5.27: Synthetic Pyrethroid*
**Organochlorine insecticides**

These are synthetic organic compounds which contain chlorine. They include substances such as DDT, dieldrin, chlordane, heptachlor and endosulphan.

Organochlorines are mainly used as contact and oral poisons which act on the nervous system. Because of their persistence in and impact on the environment, organochlorines are no longer used to treat pests in or around buildings.

Only one organochlorine is currently registered and it is used only in agriculture under permit. All other organochlorines were deregistered for use in Australia in 1996.

**Organophosphorus insecticides**

These are synthetic organic pesticides which are manufactured from carbon chemicals and also contain phosphorus. They include chlorpyrifos, dichlorvos, malathion, diazinon and temephos.

Some pesticides in this group are very toxic to mammals, such as people, kangaroos and dogs, and other animals such as bees and fish. Their use is restricted to prevent exposure to non-target species.

Organophosphates tend to break down in the environment more rapidly than organochlorines but some of them do remain active for months or years. A number of organophosphate insecticides have been developed for the control of common household pests, for example: termites, flies, cockroaches, mosquitoes, and spiders. Some organophosphates contain solvents and can have a strong chemical odour. Some people object to this odour and as a consequence prefer only odourless pesticides be used around or in their homes.

**Carbamate insecticides**

These are manufactured compounds that are relatively unstable. That is, they usually break down in the environment within weeks or months. One of the most common carbamates is propoxur which is the active chemical in the product Baygon.

Carbamate insecticides act mainly as contact and oral poisons and are used as surface sprays or baits to control household pests.

**8.3 INSECTICIDE APPLICATIONS**

Insecticides are applied (used) in one of the following ways:

- **Surface spraying** for the control of crawling insects.
- **Space spraying** for the control of flying insects.
- **As baits, powders, dusts and granules** for the control of crawling insects.
• **As fumigation treatments** for the control of insects inside materials, such as timber, stored grain.

**Surface spraying**

Surface spraying with insecticides can include spraying floors, skirting boards, under benches, inside cupboards, outside walls, around the yard and at the rubbish tip. The insecticide is often applied as a liquid spray or paint so that the surface is effectively covered with the substance.

Liquid insecticides are usually dispensed (released) from some form of hand operated pressurised **sprayer**. There are a number of different sprayers, which are discussed below.

**Aerosol can**

The insecticide and a propellant are contained in one can. Examples are products like Baygon and Mortein. This is an easy and convenient method of killing small numbers of flying or crawling insects, but is usually expensive. Aerosol cans should be used only for small areas and are effective knock-down pesticides.

![Fig. 5.28: Using an aerosol surface spray. Picture of a pressurised can](image-url)
Pressurised (compressed air) sprayer

This sprayer, also called a hand pump sprayer, contains:

- a tank to hold the insecticide
- a plunger assembly to pump air into the tank and thus create pressure inside the tank
- a hose to deliver the insecticide from the tank
- a nozzle (or gun) from which the insecticide is sprayed. The nozzle also has some kind of tap to control the flow of insecticide. There are several types of nozzle which produce different spray shapes such as wide sprays for foundations or pin point sprays for cracks and crevices in cupboards.

Compressed air sprayers usually have a relief valve set in the tank. This valve will release the pressure inside the tank if it becomes too high. The valve can also be used (in most cases) to relieve the pressure after spraying.

Compressed air sprayers can be made of stainless steel or of strong plastic.

*Fig 5.29: Compressed air sprayers*
Steps to take before mixing and applying pesticides

Prior to mixing any pesticide, ensure all equipment is checked and repaired where found to be faulty.

**Note:** Before checking and or filling spray equipment put on personnel protective equipment (PPE) and where necessary wash the spray equipment.

To fill the sprayer with insecticide, first read the label and put on any additional personal protective equipment required.

Before the plunger assembly is unscrewed from the sprayer, release the pressure relief valve, this is usually located towards the top of the sprayer, then carefully unscrew the plunger.

**Note:** Sometimes there will still be some air left in the sprayer even though the pressure relief valve has been activated, so take care when removing the plunger as pesticide residue may escape and could contaminate hands and eyes.

Place a small quantity of clean water in the sprayer, this will assist in the mixing process. It will also reduce the likelihood of the operator being splashed with undiluted pesticide when pouring the pesticide into the sprayer.

Carefully read the label for the amount of pesticide required to treat the pest and place the appropriate amount of pesticide into a measuring jug, then carefully pour it into the sprayer.

Next, slowly add the required amount of water to the sprayer in accordance with the label, being mindful of the capacity of the sprayer and careful not to overfill the sprayer.

After the sprayer has been filled, screw the plunger on tightly. If there is an adjustable nozzle on the end of the lance, check to make sure it is off and the handle or plunger (depending on the type of sprayer) is used to pump up the pressure. When enough pressure is produced (usually about 10-20 pumps) the sprayer is ready for use.

**A number of precautions should be remembered while using the sprayer and applying the insecticide:**

- The trigger on the lance or the nozzle tap should not be turned on or activated unless the lance is pointed at the area to be sprayed.

- Care should be taken to make sure that spray does not drift onto the operator or anywhere it is not intended. If weather conditions deteriorate and it becomes windy, spraying should cease or be delayed. Even in low wind, wind direction must be noted and action taken to reduce the effect of any spray drift.
If appropriate, a nozzle hood can be fitted to the sprayer to reduce spray drift. These are often used with herbicides.

- The spraying area should be cleared of other people, pets and food bowls while the insecticide is applied.

**Note:** Fish and birds are very susceptible to pesticide poisoning, so great care must be taken not to allow spray drift to contaminate them or their food.

- The operator must be wearing the correct protective clothing and equipment during the whole spraying operation.
- Spraying should be carried out in the cool times of the day.
- The operator must be upwind of spray drift, if any, and must not smoke or eat while applying the insecticide.

At mealtimes and tea-breaks, the operator must wash their hands and face with soap and cool to warm water (i.e. not hot water) and remove aprons and gloves before eating or smoking.

- At the end of the operation the spray equipment must be thoroughly cleaned. Dispose of any pesticide left over and rinse the spray equipment with water. The nozzle and hose are best cleaned by partly filling the tank with clean water, pumping up the pressure and spraying water through the nozzle, ensuring the waste liquid does not create a health hazard or harm to the environment.

Periodically the sprayer should be cleaned with a brush and warm soapy water and any faults repaired.

**Motorised back pack sprayer**

This sprayer is mounted on the operator’s back. Instead of using a hand pump to create pressure inside the tank, a small petrol engine drives a pump which pumps the insecticide to the nozzle which is fitted with a control tap.

It is essential these sprayers are well maintained, as contamination of the user can occur without them knowing. It is not unusual for leaking equipment to be mistaken for sweat, as using this type of equipment is hard work. Therefore, it is essential this equipment is checked regularly.

This type of sprayer is useful for large scale operations. The same precautions for the hand pump sprayer also apply to motorised sprayers.
Large and small capacity power sprayers

This type of sprayer is used by professional pest control operators for medium- to large-volume spraying or continuous spraying. A petrol motor connected to a pump and pesticide emulsion tank is mounted on a trailer, or the back of a ute or truck. Chemical flows are controlled by various taps. Hose reel/s are connected to the pump which to allow large area to be treated without the need to shift the vehicle.
Smaller battery-powered sprayers which can be mounted on trolleys are available and may be useful in applying pesticides in community situations. Batteries must be kept charged to prolong battery life.

**Note:** If using lithium batteries on the sprayer, ensure the correct charger is used for charging this type of battery.

**Applying pesticides by paint brush**

A very simple way to apply liquid insecticide is to use a paint brush to spread it over the required surfaces. It is a particularly good method for crack and crevice treatments in food areas, such as kitchen and house cupboards, along skirting boards, and in some types of shops. This method can be used also for small areas which need treatment or when it is important to have no spray drift.

![Fig. 5.32: Crack and crevice painting treatment.](image)

**8.4 OTHER PESTICIDE APPLICATIONS**

**Rodenticides**

Rodenticides used in communities may either be in pellet or solid block form. Great care must be taken in placing these baits, as cats and dogs are known to eat them. These baits must be kept out of the reach of children and should be placed in lockable bait boxes. Where bait boxes are placed outside a building in full view of the public they should be secured at all time.
If an EHP needs to use rodenticide baits, check with the EHP supervisor or the Shire EHO before using them.

The label will provide the general precautions (safety rules) and baiting method. The positioning and number of rodenticide baits is particularly important.

It is difficult to guess the number of rodents to be treated, so it may be necessary to use a trial-and-error method. For example, a number of baits are positioned and checked each day to see if they are being eaten away. If all the baits are being taken, the number of baits should be increased to make sure all the rodents are killed.

Baits must be put in places where:

- the mice and rats are known to rest or search for food, such as in cupboards
- they cannot be reached by children or pets.

Baits should be in containers clearly marked with the name of the rodenticide. If the containers are used outside, they may need to be firmly anchored and weatherproofed. Baits become ineffective when they are wet or covered in dust or soil. Change uneaten baits regularly.

It is also important to remember where the baits have been put, so that any unused baits can be picked up once the program is finished.
Other pesticides

The EHP may be required to apply other pesticides, such as adulticides, larvicides (for mosquito control) or herbicides in their environmental health activities. Be sure all the correct Personal Protective Equipment (PPE) and spray equipment is available and that use and storage information is known. If in any doubt seek advice from the EHP supervisor or the local EHO. It is always good practice to contact these people before a different pesticide or application method is used.

9 Protective clothing and equipment (personal protective equipment)

As pesticides are poisonous, it is extremely important that anyone using them be protected from the chemical, including the spray and fumes. Appropriate protective clothing and equipment must be used to provide a barrier between the pesticide and the body to stop the pesticide getting into the body.

Protective clothing and equipment must prevent dermal (skin and eyes), respiratory (lungs) and oral (mouth) entry of the pesticide into the body. Therefore, the protective clothing and equipment must cover all of the operator’s body. The different kinds of protective clothing and equipment are described below.
9.1 PROTECTIVE CLOTHING

Overalls

Full-length overalls which button at the neck and wrists should be worn. Trouser cuffs should be worn outside boots.

Waterproof apron

Where splashing may occur, such as in dog dipping, a full-length waterproof PVC apron and rubber boots should be worn.

![Diagram of protective clothing]

Washable hat

A wide-brimmed hat will stop pesticide getting on to the operator’s hair and then into his/her body. The hat should be made of washable material so it can be cleaned easily after use.

PVC gloves

Gauntlet-type PVC gloves are required. These are gloves which cover the arm to just below the elbow as well as covering the hand.

Some types of gloves deteriorate quickly in contact with pesticides and must be checked regularly for cracks, especially between the fingers. Cracked gloves should not be used for spraying.
Note: Gloves that are cotton lined should not be used as they are difficult to decontaminate.

Boots

Only PVC boots in good condition should be worn. If the boots are damaged or cracked, chemical can soak into the material and be absorbed into the body through the feet. If chemical has soaked into the boots or they are cracked or damaged they must be replaced.

Thorough cleaning of boots is very important and should be done properly. Boots should also be inspected regularly for any signs of damage or cracks.

Care and maintenance of protective clothing

All protective clothing should be inspected frequently and regularly to make sure it is clean and in good working order.

The operator must put on all of the required protective clothing before the spraying operation starts. At the end of every spraying operation all protective clothing should be thoroughly washed, rinsed and allowed to dry in an airy environment. Protective clothing should be washed on its own and not with other clothing.

If spraying is to be done on two or more days in a row, protective clothing should be washed at the end of each day’s spraying operation.

9.2 PROTECTIVE EQUIPMENT

Pesticide application must not be undertaken without a respirator.

A respirator is a mask which fits tightly over the nose and mouth and holds a cartridge containing a special material. This material removes chemical fumes from the air so it is clean to breathe.

Fig 5.36: Respirator
The respirator should be carefully checked for damage before it is used. Valves, the rubber, cartridges, seals or straps may need replacing. The operator should also make sure that the respirator is fitted with the correct cartridge for pest control work.

The operator must make sure that the respirator forms a good seal with the face. **Beards or moustaches usually stop a good seal from being formed,** so those who use respirators must be clean shaven.

A good way to check the face seal or to see if the cartridges are still working, is to put an open bottle of nail polish remover or aftershave or perfume up to the cartridge or around the seal edges. If the person can smell it inside the respirator then the cartridge needs replacing or there is no face seal. If the substance can still be smelt after a new cartridge is used then the seal is at fault.

Respirators have to be stored in a plastic airtight container away from the pesticides and from other solvents. This is because the cartridges are very sensitive to the presence of chemical vapours such as petrol, turps and other solvents.

Cartridges have an approximate life of 4 to 12 hours of continuous use. If they are stored with the pesticides, they may quickly lose their effectiveness due to the presence of chemical vapours.

**Face shield and goggles**

A face shield is a mask that is used to protect the face and eyes when mixing chemicals. It gives protection from splashing. Shields can be used with a respirator although fitting the respirator under the shield can be difficult if using a single cartridge respirator. Often a twin cartridge respirator is easier to use under a face shield as they do not protrude as much. Goggles to protect the eyes may be a better option.

Shields and goggles should be used:

- when mixing chemicals
- when spraying for protection against spray drift
- when working in small confined spaces
- in dog dipping programs (because of splashing)

Shields and goggles must fit properly (goggles must form a good seal with the face) and not slip. They must be kept in good condition and cleaned after each job is finished or at the end of each day’s use.
10 Calculating and mixing the correct amount of chemical

10.1 CALCULATING THE CORRECT AMOUNT OF CHEMICAL

Pesticides purchased for spraying programs will come in the form of pesticide concentrate. This concentrate is very strong and must be diluted before use by mixing a small volume (amount) of the pesticide with a larger volume of water.

It is necessary to work out how much of the concentrate will be needed for the spraying job and how much water it must be mixed with. Only enough pesticide solution to fill the sprayer should be mixed at any one time.

The steps for calculating the correct amount of chemical are outlined below.

(a) Check the pesticide label to find the application rate at which the concentrate should be used. The application rate of a particular pesticide is the amount of mixed pesticide solution (chemical plus water) which is needed to treat an area of a particular size.

Some examples are:

- Use 10 ml concentrate per 5 L water to cover 40 square metres (40 m²)
- Mix 5 g powder with 5 L water to cover 20 square metres (20 m²)
- Use 1 packet of powder per 10 L water.

(b) Work out the area to be sprayed. This may be the area of a floor or the combined areas of skirting boards or the combined area of external (outside) building foundations.

(c) Using the application rate stated in the instructions, calculate the amount of pesticide concentrate needed for the size of the area to be sprayed.

(d) Calculate how much water is needed to dilute the pesticide to the correct strength.

It is very important that these calculations are done correctly. If they are not done correctly the pesticide will not be the right strength for the job. Help can be obtained from people such as the community nurse, school teacher, EHP supervisor or an EHO.
10.2 MIXING THE CHEMICAL

Once the amount of the concentrate and the amount of water needed to dilute it have been worked out, the water and the chemical can be mixed.

This dilution exercise should be carried out carefully because the pesticide chemical is dangerous.

These are the rules which should always be followed when diluting pesticide concentrates:

(a) Always work in the open and avoid breathing the fumes.

(b) Read the label and put on the appropriate protective equipment as indicated.

Depending upon the type of pesticide it may be appropriate to wear a respirator.

(c) Mix water and concentrate in a large clean container, such as a 10 L bucket. This container and any measuring cups must be used only for this purpose. They should be clearly labelled ‘DANGER—POISON: DO NOT TOUCH’. When they are not being used they should be stored safely in the equipment shed.

(d) Put a small amount of water into the bucket first. Place the required amount of pesticide into the water.

Rinse the measuring cup with clean water and add this solution to the bucket. Stir it so that it is thoroughly mixed into the water. Pour this solution into the sprayer tank and then add the rest of the water to the tank. Make sure this water is well mixed into the pesticide solution.

(e) Stir the solution carefully with a flat paddle (stirrer) and avoid splashing.

The safest paddles are made of plastic, aluminium or steel because these materials are impervious. This means the pesticide cannot soak into them. They can be washed and used again. Wooden paddles soak up the pesticide and must be disposed of immediately after use. This must be done with extreme care. It is best to bury them along with the empty pesticide containers.

Never leave the paddles lying around after use as they will be a danger to small children and animals.
11 Disposal of unused pesticide and empty pesticide containers

In a well planned spraying operation the amount of pesticide solution required for the job should have been worked out carefully so that there is little or no pesticide left over.

Pesticides are poisonous and it is bad for the environment and a danger to people and other animals to leave them lying around. Most of the pesticides used in environmental health work will not last very long after they have been mixed with water. This means that preparing too much spray is a waste of money and effort because the pesticide will not be effective if it is used later.

Unused pesticide

If there is any pesticide left over at the end of a spraying operation then it is important that it be disposed of correctly. This means getting rid of the chemical so that it has no harmful effect on the environment, including people and their pets.

Note: Rather than have pesticide left over, go back over the job and use up the small amount that may be leftover, particularly if the pesticide is being used on weeds or the outside of a building for insects.
If it is not possible to use up all the mixed pesticide, then the following steps should be taken to get rid of leftover pesticide safely:

(a) If further spraying is going to take place the next day then use any leftover pesticide on that job. However if no more spraying is planned then follow the procedure as below.

(b) Choose a place well away from community buildings and meeting/play areas, any streams, water supply areas, or low-lying areas where water may collect or there may be a high water table. Near the storage shed or at the rubbish tip may be appropriate.

(c) Dig a hole 50 cm deep.

(d) Cover the bottom of the pit with a 25 to 40 mm layer of hydrated lime. Pour the unwanted pesticide into the hole.

(e) Cover with soil.

Fig. 5.38: Unused pesticides must always be disposed of safely.
Empty pesticide containers

Empty pesticide containers must also be disposed of so that they cannot cause any possible danger to the environment, including people.

The best place to dispose of empty pesticide containers is at the community’s rubbish tip.

These are the correct ways to dispose of empty pesticide containers:

(a) All glass, metal or plastic containers should be rinsed out with water at least 3 times.

The wash-water should, of course, be disposed of correctly so that it does not become a danger. However, if the container is emptied as the spray solution is mixed, the wash-water can be added to the spray solution. The wash-water should have little effect on the strength of the solution. Paper packets cannot be rinsed out.

(b) The lids of all containers should be removed before disposal.

(c) Glass or plastic containers must be buried deep in an isolated area away from water supplies.

If it is safe to do so, it is a good idea to break glass containers before disposal. Plastic containers must be punched with holes so that they cannot be used to carry water.

(d) Glass or plastic pesticide containers which cannot be broken or punched with holes must never be left around in case people use them for some other purpose.

(e) Each metal container should be made unusable by punching holes in the top and bottom and then crushing it. Flattened containers are easier to bury or dispose of at the tip.

Never burn pesticide containers because they may give off poisonous gases. Never use these containers or any pesticide treated materials, such as wood, on fires.
If the EHP has any worries about the disposal of leftover pesticides or empty pesticide containers then he/she should contact the EHP supervisor or an EHO.

**12 Decontamination and maintenance of pesticide application equipment**

When a pesticide operation has been completed all of the equipment used must be cleaned properly, by following the steps below.

(a) Choose an area where the waste wash-water run-off will not affect water supplies, rivers, billabongs, the soil and plants or lie on the ground and create a danger to people, especially children, and animals. Near the storage shed may be appropriate.

(b) Wear protective clothing and equipment while cleaning the spray gear.

(c) Thoroughly rinse the equipment with water several times. It may be easier to partly dismantle the sprayer. Equipment should be washed occasionally with warm, soapy water.
(d) After rinsing, equipment should be reassembled, partly filled with water and tested to make sure there are no blocked nozzles or hoses and no pesticide left in them.

(e) The equipment should be stored so that any water still in it will drain out.

(f) Other containers, such as measuring jugs, used in the spray operation should be rinsed thoroughly and stored dry.

(g) Finally, the operator’s protective clothing should be removed, thoroughly washed and rinsed and then hung out to dry. It must be dry before being stored away.

**Do not wash protective clothing with other clothes.**

![Fig. 5.40: It is important to wash and dry all protective clothing every time it is used.](image)
13 Safe storage of pesticides and spray equipment

It is important that pesticide chemicals and spray equipment be safely and securely stored. They should be stored in a separate shed or at least in a separated and locked part of an existing equipment shed. The shed or storage area must be well away from dwellings and must only be used for equipment and maintenance materials. It must never be used for food storage.

The storage shed should:

- be constructed of fire resistant materials
- be well ventilated
- be secure and lockable
- have water available
- have a floor that can be washed if spills occur. The floor area must have raised edges so that any water and spilled chemical can be contained
- have a drain system and disposal area with a pit nearby so that any excess or spilled materials can be washed down and drained away. This area can also be used for decontaminating equipment
- be labelled clearly on the outside that there are dangerous materials stored inside
- have high metal shelves for the storage of pesticides.

Also there should be a supply of sand or some other some absorbent material, such as sawdust or kitty litter close to the shed to use in the event of a pesticide spill. A high fence around the shed and disposal area would help keep people away. However, this may not be possible if the shed is used for other equipment storage.

Fig. 5.41: A pesticide storage shed.
There are rules which should be followed for the safe storage of pesticides in the shed:

- Pesticides should always be kept in their original containers. The outside of the containers should be kept clean and the labels kept in good condition so they can always be read.
- Containers should be checked regularly for leaks or corrosion.
- Protective clothing and equipment should not be stored close to pesticides.
- Spray equipment should be stored in the pesticide storage shed and should be hung up so that any water left in after washing will drain out.

14 Cleaning up a pesticide spill

Accidents sometimes happen. If all or part of the operator's clothing becomes saturated (soaked or wet) with pesticide at any time:

(a) The spraying must be stopped immediately and any wet clothing taken off.
(b) Any part of the operator's body which might have come into contact with pesticide must be washed immediately with plenty of soapy warm water. Do not use hot water as this opens the pores of the skin allowing pesticide to contaminate more of the skin, and to enter the body more easily.

Another possible danger occurs if pesticides spill onto the ground. These steps must be followed to clean up a pesticide spill:

(a) The clean-up team must wear protective clothing and equipment.
(b) Keep other people away from the spill area and carry out the clean-up immediately.
(c) The spill area must be covered with a layer of sand or other absorbent material thick enough to soak up the pesticide. It is equally important to make sure that the spilled pesticide does not spread. Building a bund (a small wall of soil or absorbent material) around the spillage area is the best way of containing the chemical.

Obviously, it is easier to clean up spillages outside buildings, especially on impervious surfaces, such as bitumen roads and concrete paths because they do not allow the liquid to soak away.

Spills on absorbent surfaces are more difficult to clean up. If this happens outside a building on absorbent soil, as much as possible of the layer of soil which has absorbed the pesticide will have to be removed. This area can then be covered with clean fill.
Inside a building a spill must not be allowed to spread. It must be covered with absorbent material. After the pesticide has been soaked up and the absorbent material is removed, the contaminated area will need to be cleaned.

(d) When the pesticide has been soaked up by the sand or absorbent material, scrape up the material and place it in a deep hole at least 50cm deep. This hole should be in a place well away from people, buildings, playgrounds, streams and water supplies. The rubbish tip is the best place to dispose of this material.

(e) Once the absorbent material has been removed from an impervious surface outside a building, the spillage area should then be washed thoroughly with water and soap/detergent. The water used for washing should not be allowed to run over the ground, or into water courses or storm drains. The wash-down water should be directed as much as possible into a 50 cm deep hole which can be covered with soil when the clean-up is finished.

The nature of the surfaces inside a building may make it difficult to carry out a wash-down and clean-up. For example: in the case of carpets, rugs and mats. This may require special cleaning methods or the removal of the floor covering.

**Advice on cleaning up major pesticide spills should be obtained from the EHO or the EHP supervisor.**

*Fig. 5.42: Pesticide spills must be cleaned up safely.*
15 Pesticides and fire

If a fire occurs in a pesticide storage shed or an area where pesticides are kept, special precautions must be taken as many pesticide vapours which are given off during a fire are very hazardous. Only properly trained people with self-contained breathing apparatus should attempt to put out chemical fires.

If in doubt about how to put out a pesticide fire, call the fire brigade or the police before taking any action to control the fire.

In the event of a pesticide fire, follow these steps:

(a) Make sure all the people downwind of the fire are moved out of the path of smoke and kept well away.
(b) Keep a safe distance away in case of an explosion.
(c) Approach the fire only if it is safe to do so. This must be done from the upwind side or at right angles. Do not work downwind.
(d) If the fire is small enough for you to handle, stay upwind and use soft streams of water so that you do not tear open paper containers or break jars.
(e) Spray drums containing liquids with water to keep them cool.
(f) Remember that self-contained breathing equipment is essential for anyone likely to be exposed to pesticide fumes or smoke in a pesticide fire.
(g) Take care not to allow excess water used to fight a fire to run into creeks or a drinking water supply.
(h) Call the fire brigade for all chemical fires, to report the fire and to get advice.

16 First aid procedures for pesticide poisoning

There are two types of pesticide poisoning:

Acute poisoning

This happens when someone has been exposed to a high dose of pesticide. This could occur when the pesticide is being mixed, for example, or if a hose breaks drenching the person or bystanders with liquid pesticide solution. Another example might be accidental ingestion of a pesticide, such as a child swallowing the chemical.
Chronic poisoning

This results from a person being exposed to a small amount of pesticide on many occasions over a long period of time. Chronic poisoning may happen when the operator repeatedly uses pesticide improperly, especially if they do not wear protective clothing and equipment or wears protective clothing which is not clean or is worn out, like wearing cracked or torn gloves.

16.1 SYMPTOMS OF PESTICIDE POISONING

There are a number of symptoms (signs) which may indicate that pesticides may be affecting a person’s health. However, these symptoms may be caused by other illnesses. The possibility of poisoning should always be considered when a person may have been exposed to pesticides.

Symptoms of mild poisoning

- headache
- sweating
- diarrhoea
- irritation of nose and throat
- eye irritation
- nausea
- fatigue
- changes of mood
- skin irritation
- insomnia
- loss of appetite
- thirst
- weakness
- restlessness
- dizziness
- sore joints
- nervousness.

Symptoms of severe poisoning

- vomiting
- convulsions
- loss of reflexes
- unconsciousness
- inability to breathe
- fever
- muscle twitching
- thirst
- constriction of eye pupils (eye pupils become small)
- increased rate of breathing.

16.2 FIRST AID

If someone shows any of these symptoms after being exposed to pesticides medical advice should always be sought.

*Fig. 5.43: Always seek medical advice if you think someone might have pesticide poisoning.*
First aid—acute pesticide poisoning

If a person suffers acute pesticide poisoning do the following immediately:

(a) Find out if possible the way the poison entered the body. This may either be through the mouth, nose, skin or eyes.
   » If the pesticide has been inhaled, move the person to fresh air.
   » If the pesticide is in the person’s eyes, quickly wash the eyes for 15 minutes with clean, gently running water. If there is no running water, bathe eyes from a container, frequently changing the water.
   » If the pesticide is on the skin, remove all contaminated clothing and wash the affected area thoroughly with soap and water.

(b) If the patient is not breathing, apply artificial respiration if possible.

(c) Read the label on the pesticide container for any first aid instructions and keep the label for the doctor. It is very important to be able to tell the doctor the name of the pesticide.
(d) If the pesticide is swallowed, and only if the person is conscious, rinse the mouth with plenty of water and read the label on the pesticide container for further instructions.

(e) Quickly arrange for the doctor, or Community Nurse or Health Worker to be called or take the person to the doctor, clinic or hospital immediately.

(f) Keep the patient warm and comfortable.

**First aid kit**

It is essential to keep a first aid kit on hand for emergencies. Syrup of ipecac was often used to make people vomit after they swallowed pesticide or other poison. However, **always follow the first aid instructions on the pesticide container label.** If in doubt, seek medical advice.

| Note: | Syrup of ipecac is now generally not available, so if the first aid instructions on the label say to induce vomiting, you may need to stick your fingers down the throat as this may do the same job (make sure you have washed your hands first). |

It is suggested that the EHP ask the Community Health Nurse what items should be included in a first aid kit, including those which might be needed for the emergency treatment of pesticide poisoning.

These items should be purchased and stored in a clean sealed container and kept close by when pesticide is being applied. When something from the kit is used, it should be replaced as soon as possible.

First aid charts and emergency contacts charts are available which give more details on first aid instructions for chemical poisoning emergencies. Charts and pamphlets on poisoning, first aid instructions, and artificial respiration are available from first aid training organisations in your state or territory.

The EHP should have access to these numbers in the office and when on spraying operations.

Other important telephone numbers which must be displayed in the office and kept on hand during spraying operations are:

- the Poisons Information Centre—13 11 26
- the local or nearest doctor
- the local or nearest hospital
- the local or nearest Police
- the local or nearest Fire Brigade
- the local or nearest Shire Council and the name of the EHO.