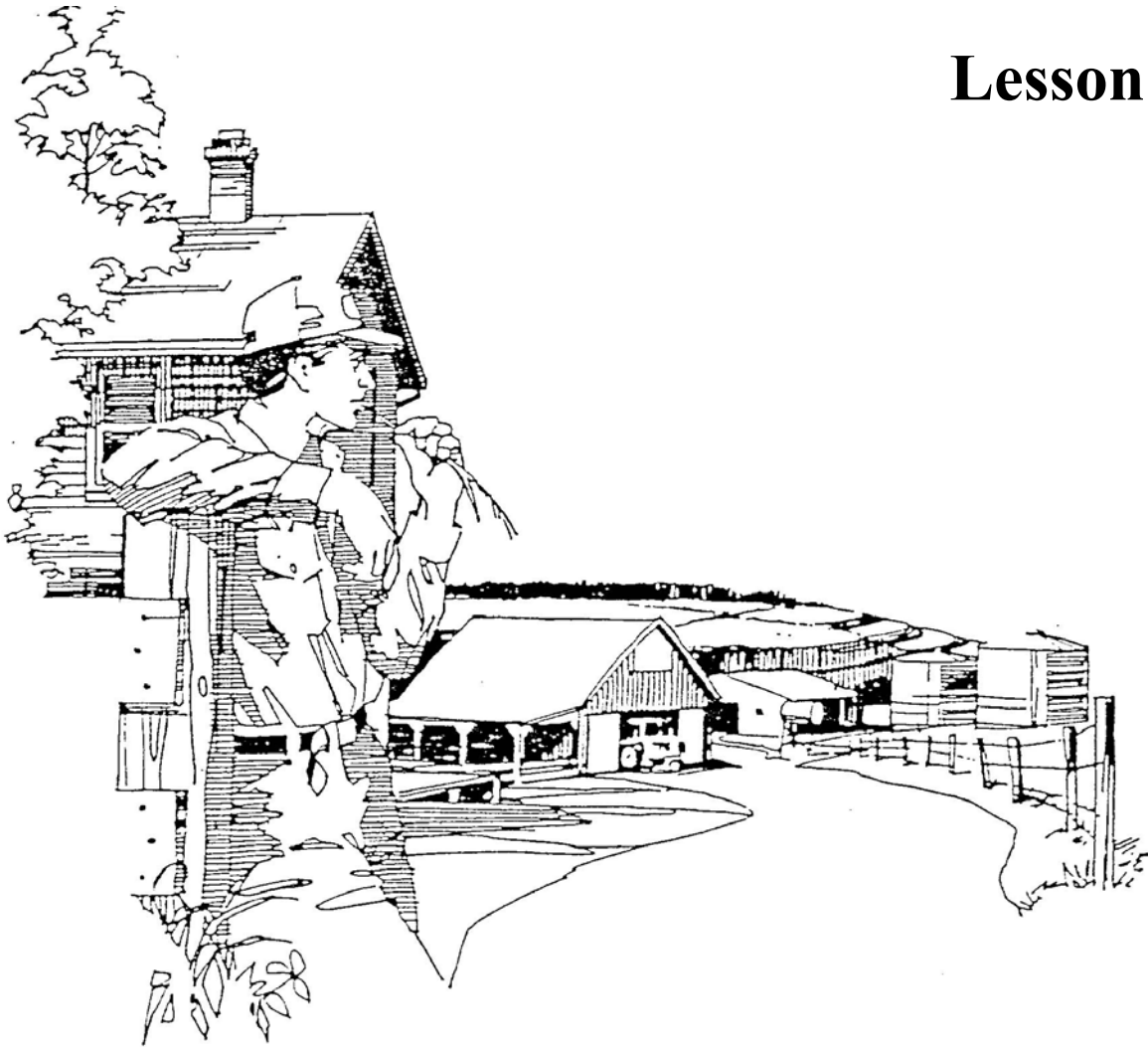


Pesticide Applicator Course for Agricultural Producers

Lesson 4



Toxicity

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Lesson 4

Toxicity

What You'll Learn!

The purpose of Lesson 4 is to help you understand toxicity so you can assess the hazards of pesticide use and avoid risks.

By the time you complete this lesson you should be able to:

- define hazard and toxicity;
- list four routes of pesticide exposure;
- list precautions to avoid oral, dermal, respiratory, and eye exposure;
- define acute and chronic exposure;
- define acute and chronic toxicity;
- identify the toxicity of a pesticide through its LD₅₀ value and production guide information;
- understand pesticide label toxicity symbols.

You'll need to know all these things to qualify for certification.



Explanation of Terms - Toxicity and Hazard

Almost all compounds (pesticides, salt, coffee, vitamins, etc.) are toxic to humans if the dosage is high enough.

You must understand pesticide toxicity to avoid harming people or the environment.

Toxicity is a term used to describe the degree to which a substance is harmful or poisonous. It describes the potential a pesticide has for causing harm.

Pesticides vary in toxicity. A small amount of a highly toxic pesticide will cause severe effects. A larger amount of a less toxic pesticide would be required to cause a similar effect.

The effects of pesticide poisoning in humans can vary from mild to severe. The toxic effects of most poisonings do not cause permanent damage, although recovery could take a long time. Some effects of poisoning cause permanent damage.

Toxicity can be either acute or chronic. Acute toxicity means the ability of a substance to cause ill effects which develop soon after exposure (i.e., a few hours to a few days). Acute toxic effects could occur, for example, if you splashed pesticide on yourself or if you were exposed to drift while spraying. Symptoms of acute toxicity may be relatively mild such as nausea, headaches, or stomach cramps, or as severe as convulsions, coma, or death.

Chronic toxicity means the ability of a substance to cause ill effects, which last a long time. Chronic toxic effects may not appear for some time after exposure. They may last many years and are often irreversible.

Examples of chronic toxic effects include:

- skin rashes;
- damage to major organs such as the lungs or kidneys;
- damage to the nervous system;
- reduced body weight
- birth defects (chemicals causing birth defects are called teratogens);
- genetic mutations which may be passed on to future generations (chemicals causing genetic changes are called mutagens);
- cancer (chemicals causing cancer are called carcinogens).

Chronic toxic effects can result from a single severe exposure or repeated exposures over a period of time. For example, a severe exposure to the herbicides paraquat or diquat causes acute effects such as nausea, chest pain, and vomiting as well as chronic effects resulting in kidney, liver, and lung damage. Repeated exposure to other pesticides can cause skin rashes or breathing difficulties.

You can't change the toxicity of a pesticide, but you can minimize the hazard in its use. Hazard is the degree of danger involved in the way you handle or use a pesticide.

The hazard of a pesticide depends on both its toxicity and the chance of exposure to the pesticide. Minimize hazard by using pesticides with the lowest toxicity when possible, and following safe handling procedures to protect yourself from exposure.

Measuring Acute Toxicity (LD₅₀ Values)

Acute toxicity is measured by LD₅₀ values. The LD₅₀ value is the amount of pesticide (lethal dose) in one treatment which kills 50% of the animals (such as rats and mice) in a test. These treatments are through the skin (dermal) or through the mouth (oral). The LD₅₀ value is given in milligrams of pesticide per kilogram of body weight of animal (mg/kg body weight).

LD₅₀ values are only a guide to the toxicity of pesticides. It provides a means to measure the relative toxicity of one pesticide compared to another. People of different age, sex, weight, or health may be affected differently.

The more toxic the pesticide, the less is needed to kill an animal. Therefore, *very toxic* pesticides have *smaller* LD₅₀ values and *slightly toxic* pesticides have *larger* LD₅₀ values. For example, a pesticide with an LD₅₀ of 5 mg/kg is 100 times more toxic than a pesticide with an LD₅₀ of 500 mg/kg.

Here are examples of LD₅₀ values for four pesticides.

Pesticide Active Ingredient	Oral LD ₅₀ (mg/kg)	Dermal LD ₅₀ (mg/kg)
aldicarb	0.93	3.15
diazinon	108	455-900
malathion	1000	4,100
atrazine	3,080	7,500

It is interesting to compare the LD₅₀ values of certain pesticides with the LD₅₀ values of common household materials. The following three compounds have low acute toxicity compared to some pesticides. However, if you consumed enough of them they could certainly cause toxic reactions.

Compound	Oral LD ₅₀ (mg/kg)
acetylsalicylic acid (aspirin)	1,000
sodium chloride (table salt)	3,320
ethylene glycol (antifreeze)	3,460

Pesticides are grouped according to their LD₅₀ values. The groups are: very toxic, moderately toxic, and slightly toxic.

Acute Toxicity	Oral LD₅₀ (mg/kg)	Dermal LD₅₀(mg/kg)
Very Toxic	less than 50	less than 200
Moderately Toxic	50 to 500	200 to 1,000
Slightly Toxic	over 500	over 1,000

Your production guide contains lists which give the acute toxicity rating (very toxic, moderately toxic, and slightly toxic) for active ingredients used in pesticides recommended in the guide.

The LD₅₀ value of a pesticide can be used to determine the amount of pesticide which would be lethal for a person of specified weight, as shown below.

If the oral LD₅₀ is	The approximate lethal dose for a 70 kg (155 lb.) adult is:
less than 50	a few drops to one-half teaspoon
50 to 500	half a teaspoon to two tablespoons
over 500	over two tablespoons

Note that a child who is one-fifth the weight of an adult would require only one-fifth the amount of pesticide to suffer the same toxic effects as the adult.

Measuring Chronic Toxicity

Chronic toxicity is measured by tests on animals such as rodents. The animals are exposed to small amounts of pesticides for a long time. They are then examined for a variety of chronic effects.

Evidence of chronic effects is usually associated with long-term exposure of test animals to relatively high doses. Thus people who run the greatest risk of developing chronic effects are applicators exposed to high levels of pesticides over many years.

Remember: symptoms of chronic toxicity may be caused by exposure to a pesticide months or years in the past. Anyone handling pesticides should minimize exposure and eliminate the possibility of chronic effects.



Quiz 4.1

Using what you've learned so far in Lesson 4, fill in the blanks in statements 1 through 6 below.

1. The degree to which a pesticide is harmful or poisonous is known as its _____.
2. The degree of danger involved in the way a pesticide is used or handled is known as its _____.
3. The ability of a pesticide to cause lasting ill effects is known as _____.
4. The ability of a pesticide to cause ill effects which develop soon after exposure is known as _____.
5. The hazard of a pesticide depends on both _____ and _____.
6. The amount of pesticide in one treatment which kills 50% of test animals through dermal or oral exposure is known as the _____.
7. On the next page is a list of pesticides, accompanied by their oral and dermal LD₅₀ values. Rate the degree of acute toxicity for each pesticide according to its oral and dermal LD₅₀ values. Use the letters V, M, and S to indicate "very toxic," "moderately toxic," and "slightly toxic." Keep in mind that a pesticide's acute toxicity rating based on the oral LD₅₀ value *may* be different than its acute toxicity rating based on the dermal LD₅₀ value. The first pesticide has been rated for you.

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Pesticide	Oral LD50 Value (mg/kg)	Acute Toxicity Rating	Dermal LD50 Rating (mg/kg)	Acute Toxicity Rating
trifluralin (treflan)	> 10,000	S	>2,000	S
chlorothalonil (bravo)	> 10,000		> 10,000	
oxydemeton-methyl (Metasystox R)	65-80		20	
iprodione (Rovral)	3,500		> 1,000	
carbofuran (Furadan)	8 - 14		2,550	
glyphosate (Roundup)	4,320		> 7,940	
paraquat (Gramoxone)	150		236	

8. In the space provided below, list the pesticides named in Question 7 in order of oral toxicity, starting with the *least* toxic.

- a) _____
- b) _____
- c) _____
- d) _____
- e) _____
- f) _____
- g) _____

9. In the space provided below, list the pesticides named in Question 7 in order of dermal toxicity, starting with the *most* toxic.

- a) _____
- b) _____
- c) _____
- d) _____
- e) _____
- f) _____
- g) _____

Now check your answers against the Answer Key at the end of the lesson. If you've done well, continue with Lesson 4. If not, review those sections that gave you trouble before proceeding any further.

Pesticide Label Toxicity Symbols

As you learned in Lesson 2, precautionary symbols and wording are required on pesticide labels. Some of these symbols help you quickly identify the toxicity of a pesticide. The symbols and words refer to the toxicity of the pesticide formulation. The skull and crossbones symbol tells you the pesticide is poisonous. The stop sign, diamond, or triangle shape around the symbol tell you *how* poisonous.

There is usually a signal word near the symbol: **DANGER** for the stop sign, **WARNING** for the diamond, and **CAUTION** for the triangle.

**DANGER
POISON**



Highly Toxic

**WARNING
POISON**






Moderately Toxic

**CAUTION
POISON**



Slightly Toxic

The following symbols are used when a pesticide has one or more of the properties in the list below.

 DANGER POISON	 WARNING POISON	 CAUTION POISON
oral LD ₅₀ (mg/kg) less than 500	oral LD ₅₀ (mg/kg) 500 - 1,000	oral LD ₅₀ (mg/kg) 1,000 - 2,500
dermal LD ₅₀ (mg/kg) less than 1,000	dermal LD ₅₀ (mg/kg) 1,000 - 2,000	dermal LD ₅₀ (mg/kg) 2,000 - 5,000
respirator required	respirator advisable in confined spaces	respirator advisable in confined spaces
corrosive, eye effects irreversible	eye effects severe, reversible	eye irritation
fatal and irreversible chronic effects	non-fatal, irreversible chronic effects	non-fatal reversible chronic effects

Note: The precautionary poison symbol does not tell you if the pesticide is poisonous through the mouth, through the skin, or by breathing. The PRECAUTIONS section on the label provides this information. Examples of precautionary statements are:

- "Harmful or fatal if swallowed"
- "Rapidly absorbed through the skin"
- "May cause skin irritation"
- "Vapors may be fatal if inhaled"
- "Causes irreversible eye damage"

Symbols or precautionary statements are not on labels if the pesticide has very low toxicity.

Know the precautionary symbols and warning statements used on pesticide labels. Know how they indicate the toxicity of the pesticide. Use this information to help select safety gear and procedures for handling pesticides.

Routes of Exposure

Remember: the hazard of using a pesticide is reduced by using the least toxic pesticide and protecting yourself from exposure.

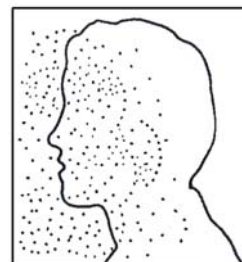
Pesticides can enter your body in four ways:

- through your skin (dermal exposure)
- through your eyes (eye exposure)
- through your mouth (oral exposure)
- through your lungs (respiratory exposure)

The longer you are exposed to a pesticide, the greater the damage that is likely to result.

Dermal Exposure

Dermal or skin exposure is the most common route of poisoning for pesticide applicators. Skin contact may occur from a splash, spill, or drift when mixing or applying a pesticide. It may also result from pesticide residue on application equipment, protective clothing, or treated surfaces.



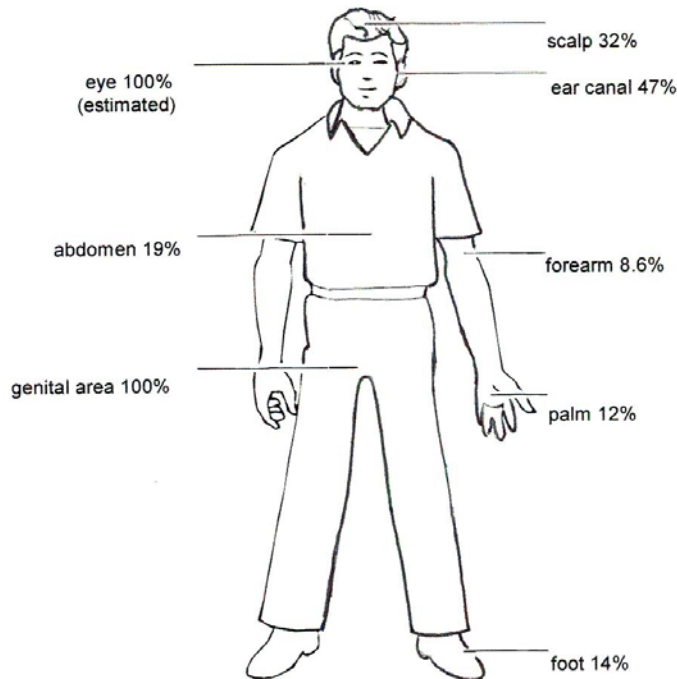
The skin of certain parts of the body absorbs pesticides more readily than others. The head (especially the scalp and ear canal) and the genital areas are particularly vulnerable.

The type of pesticide formulation used affects how much pesticide is absorbed. Wettable powders, dusts, or granules are less readily absorbed through the skin than liquids such as emulsifiable concentrates. A cut, gash, or abraded skin will increase the rate of skin absorption.

The hazard from skin absorption is highest when you mix pesticides. This is because you are handling concentrates with a high amount of active ingredient.

Protect yourself from dermal exposure. Remember:

- 1. Wear protective clothing and equipment when using pesticides or repairing contaminated equipment. (See Lesson 6.)**
- 2. Spray during periods when there is little wind.**
- 3. Do not reenter a sprayed field without protective clothing until the reentry time has elapsed.**
- 4. If your clothes become contaminated, change immediately. Wash affected areas of the skin.**
- 5. Change clothes as part of the clean-up after pesticide use at the end of the day.**
- 6. Wash and shower after using pesticides.**
- 7. Wear clean clothes at the start of each day during pesticide application.**

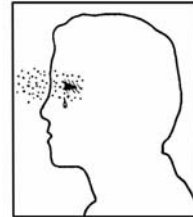


Eye Exposure

The eyes are very absorbent. Some pesticides irritate the eyes. Pesticides can cause chemical injury to the eye. They may also be absorbed through the eyes and poison you.

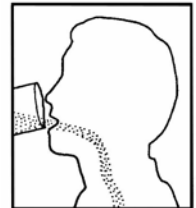
Protect yourself from eye exposure. Remember:

1. Wear eye protection when you measure or mix pesticides.
2. Don't wipe your eyes with contaminated gloves or hands.
3. Wear eye protection when pesticide sprays or dusts may contact your eyes.



Oral Exposure

The most severe poisoning usually occurs when pesticides are swallowed. This type of accident often happens when a pesticide has been put into an unlabelled bottle or food container. Children in particular have been poisoned by drinking from a soft drink bottle containing pesticides. Adults have mistakenly drunk from unlabelled containers or have been poisoned by drinking water from cups used for mixing pesticides.



Workers handling pesticides or application equipment can be poisoned if they do not wash their hands before eating, drinking, or smoking. Workers can also be poisoned if they swallow pesticides by trying to clear a spray line or nozzle by blowing on it while holding it to the mouth.



Protect yourself from oral exposure. Remember:

1. **Store pesticides in a locked area in their original containers.**
2. **Never put pesticides in an unlabelled bottle or food container.**
3. **Wash after handling pesticides and before eating, drinking, smoking, or using the toilet.**
4. **Never use your mouth to siphon pesticide liquids or clear spray nozzles.**



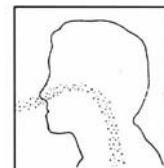
5. **Never leave pesticides unattended.**
6. **Avoid splashes or dusts when mixing pesticides.**
7. **Label your pesticide measuring containers.**

Respiratory Exposure

Pesticides can be absorbed through your lungs into your blood and poison you. Exposure through the lungs is very dangerous because the lung tissues absorb pesticides rapidly and completely. Some pesticides can also damage your nose, throat, and lungs.

Your lungs may be exposed to pesticides if you inhale powders, droplets, or vapors. Wettable powders are especially hazardous because they are dusty and can be inhaled during mixing.

Inhalation of spray droplets is a concern when you use high pressures, ultra low volume (ULV) formulations, or fogging equipment. The small droplets remain in the air for a long time and you can easily inhale them.



Many pesticides give off vapors. Fumigants are used because their toxic vapors are effective in controlling pests. Their vapors are the most hazardous to workers. Other pesticides which are toxic to pests as liquids or solids may also give off vapors toxic to people (e.g., fensulfothion, demeton, mevinphos, diazinon, disulfoton, carbaryl, parathion, and chlorpyrifos). Vapor hazard is greatest in enclosed spaces where there is little air movement (e.g., a spill in an unventilated storage area or application in a confined space such as a greenhouse). Wind or ventilation reduces vapor levels.

As temperatures increase, vapor levels of many pesticides increase. This is why it is generally recommended that pesticides should not be applied when air temperatures are above 25°C. Smell is not always an indication of pesticide presence. Some pesticide vapors have little or no smell to provide warning of their presence.

Protect yourself from respiratory exposure. Remember:

1. Wear an appropriate and properly fitting respirator:

- a) if it is required on the label;
- b) if pesticides are used or mixed in poorly ventilated areas;
- c) if there is a possibility of inhaling spray droplets, vapor, or powder.



2. Do not reenter a treated area too soon. Follow the reentry guidelines on the label.
3. Ventilate greenhouses or enclosed structures after pesticide application, before reentry.
4. Do not apply pesticides when air temperatures are above 25°C.

Quiz 4.2

1. Identify the signal words associated with the pesticide label precautionary symbols below.







2. A danger symbol is used if a pesticide has an oral LD₅₀ value of less than _____ or a dermal LD₅₀ value of less than _____.
3. A warning symbol is used if a pesticide has an oral LD₅₀ value of _____ or a dermal LD₅₀ value of _____.
4. A caution symbol is used if a pesticide has an oral LD₅₀ value of _____ or a dermal LD₅₀ value of _____.
5. List three ways to protect yourself from dermal exposure.

6. List three ways to protect yourself from eye exposure.

7. List three ways to protect yourself from oral exposure.

8. List three ways to protect yourself from respiratory exposure.

When you've completed the quiz, check your answers against the Answer Key at the end of the lesson. If you're satisfied with your results, go on to Lesson 5.

Looking Ahead

In Lesson 4 you have learned about different types of pesticide toxicity. Lesson 5 will cover how to recognize and deal with actual cases of pesticide poisoning.

Answer Key

Quiz 4.1

1. The degree to which a pesticide is harmful or poisonous is known as its toxicity.
2. The degree of danger involved in the way a pesticide is used or handled is known as its hazard.
3. The ability of a pesticide to cause lasting ill effects is known as chronic toxicity.
4. The ability of a pesticide to cause ill effects which develop soon after exposure is known acute toxicity.
5. The hazard of a pesticide depends on both its toxicity and the chance of exposure.
6. The amount of pesticide in one treatment which kills 50% of test animals through dermal or oral exposure is known as the LD₅₀ value.
- 7.

Pesticide	Oral LD50 Value (mg/kg)	Acute Toxicity Rating	Dermal LD50 Rating (mg/kg)	Acute Toxicity Rating
trifluralin (treflan)	> 10,000	S	>2,000	S
chlorothalonil (bravo)	> 10,000	S	> 10,000	S
oxydemeton-methyl (Metasystox R)	65-80	M	20	V
iprodione (Rovral)	3,500	S	> 1,000	S
carbofuran (Furadan)	8 - 14	V	2,550	S
glyphosate (Roundup)	4,320	S	> 7,940	S
paraquat (Gramoxone)	150	M	236	M

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8. a) trifluralin (Treflan)
 b) chlorothalonil (Bravo)
 c) glyphosate (Roundup)
 d) iprodione (Rovral)
 e) paraquat (Gramoxone)
 f) oxydemeton-methyl (Metasystox R)
 g) carbofuran (Furadan)
9. a) oxydemeton-methyl (Metasystox R)
 b) paraquat (Gramoxone)
 c) iprodione (Rovral)
 d) trifluralin (Treflan)
 e) carbofuran (Furadan)
 f) glyphosate (Roundup)
 g) chlorothalonil (Bravo)

Quiz 4.2

1.



WARNING.



CAUTION.



DANGER.

2. A danger symbol is used if a pesticide has an oral LD₅₀ value of less than 500 or a dermal LD₅₀ value of less than 1,000.
3. A warning symbol is used if a pesticide has an oral LD₅₀ value of 500 - 1,000 or a dermal LD₅₀ value of 1,000 - 2,000.
4. A caution symbol is used if a pesticide has an oral LD₅₀ value of 1,000 - 2,500 or a dermal LD₅₀ value of 2,000 - 5,000.
5. To protect yourself from dermal exposure:
Wear protective clothing and equipment.
Spray during periods when there is little or no wind.
Do not reenter a sprayed field without protective clothing until the reentry time has elapsed.
Wash and shower after using pesticides.
If your clothes become contaminated change immediately. Wash affected areas of the skin.
Change clothes as part of the clean-up after pesticide use.
Wear clean clothes at the start of each day's pesticide application.

6. To protect yourself from eye exposure:

Wear eye protection when you measure or mix pesticides.

Wear eye protection when pesticide sprays or dusts may contact your eyes.

Don't wipe your eyes with contaminated gloves or hands.

7. To protect yourself from oral exposure:

Store pesticides in a locked area in their original containers.

Never put pesticides in unlabelled bottles.

Wash after handling pesticides and before eating, drinking, smoking, or using the toilet.

Never leave pesticides unattended.

Avoid splashes or dust when mixing pesticides.

Label your pesticide measuring containers.

8. To protect yourself from respiratory exposure:

Wear an appropriate and properly fitting respirator.

Do not reenter a treated room or area too soon.

Follow the reentry guidelines on the label.

Ventilate greenhouses or enclosed structures after pesticide application, before reentry.

Do not apply pesticides when temperatures are above 30°C.