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Pesticide use in schools and school grounds

Kevin J Buckett and Peter N Di Marco

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Foreword

This booklet has been prepared by the Environmental Health Service of the Health Department of Western Australia, in conjunction with the Education Department of Western Australia and the Western Australian Department of Agriculture, to provide guidance on pest management for anyone using pesticides in or near schools. It has been reviewed by the Directors of Environmental Health of each State and Territory, and the Commonwealth and, to expedite publication, they have undertaken targeted consultation only.

This document can be used as an information base, a reference document and a guide to the practical control of pests in and around schools.

The booklet is not an exhaustive treatise intended to cover all aspects of pest management in schools and school grounds, but rather a guide to the approach which should be taken to control pests while minimising risk to the school community and environment.

Comments on the booklet should be forwarded to:

Toxicology Section
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Health Department of Western Australia
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The illustrations of booklice and ticks on pages 20 and 22 respectively are reproduced, with permission, from ‘Urban Pest Control in Australia’ by P Hadlington and J Gerozisis, NSW University Press, 1985.

Disclaimer

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This monograph has been developed to address some of the community concern over the use of pesticides in schools. They aim to provide information on pests and pesticides, and how pesticides can be used safely as a component of integrated pest management.

The document is intended for school principals, teachers, parent organisations and pest management technicians. They may also be useful for people involved in pest management in buildings other than schools, to local government officers, and to interested members of the public.

The monograph includes:

- suggested practices for integrated pest management;
- information on pesticides, including their toxicity and safe use;
- a list of pests and the pesticides which may be used against them;
- a code of practice for pest management technicians;
- a list of organisations which can be contacted for more information or advice.

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1. Introduction

Pesticides are important tools in pest control. However, there is considerable community concern over their use. Some of this concern is well founded, but some is based on lack of knowledge and inadequate information.

This monograph has been developed to address this concern by providing information on pests and pesticides, their toxicities and how they can be used safely. They also describe a system of integrated pest management which advocates other methods of pest control and, when these are not enough, the rational use of pesticides as a component of pest control.

1.1 Scope

The monograph is intended for, but not restricted to, school principals, teachers, parent organisations and pest management technicians. They also offer guidance for pesticide applications near or around schools and may, therefore, be of interest to local government officers and the general public.

The monograph is not a manual for pesticide use, but rather a guide to practices which are recommended for the control of pests in and around schools.

The monograph is not intended to promote any particular pesticides and they should not be taken to recommend any particular product.

The document includes:

- suggested practices for integrated pest management;
- information on pesticides, including their toxicity and safe use;
- a list of pests and pesticides which may be used against them;
- a code of practice for pest management technicians;

2. Integrated pest management

Integrated pest management includes a range of options to control pests. These include prevention as well as physical, chemical and biological control.

2.1 Prevention

Whenever possible, infestation by pests should be prevented by eliminating the environment and conditions they prefer (e.g. low standards of hygiene may encourage cockroaches and rats) or by creating barriers (e.g. simple fly screens; removing brush and leaf litter from around buildings to prevent spiders; screening or removing pooled water to inhibit mosquitoes).

Food, including small scraps, can support large populations of some pests. All foodstuffs should therefore be stored in resealable containers with close-fitting lids. Food scraps should be cleaned up regularly and thoroughly.

Rubbish bins and waste food bins should have tight-fitting lids and be cleaned regularly. Waste materials should not be left in or near buildings where other products which are liable to infestation are stored.

Appropriate physical barriers will also reduce indoor infestations. Screen the bottom of doors and ensure window fly screens are in good repair. Cracks in floor boards and around skirting should be sealed. Waste pipes through walls and floors are common entry points for a number of pests and these should also be properly sealed. However, sealing should not interfere with the normal ventilation of the building.

Unless they are needed for security reasons do not leave lights on at night as they attract insects such as moths, which in turn attract spiders.

2.2 Control

Sometimes pests get out of control, despite all good intentions and precautions. In such cases it is important to consider all options available to control them. Follow these simple steps for good pest management practice:

- Identify the pest correctly.
- Determine the range of options to discourage or control the pest (physical, chemical, biological).
- Select the best option suited to your needs.

When pesticides are needed, use as little as is necessary for effective control of the pests. 'General' chemical spraying to form a barrier against a range of pests is generally not recommended.

If pesticide baits are used, it is important that these be presented as the most readily available source of food for the target.

2.3 Pesticide treatment

Following these simple steps will go a long way towards reducing or avoiding concern about the application of pesticides:

- Identify the range of pesticides registered for your needs. Information on this can be obtained from the Education Department or your pest management technician.
- Ask for the Material Safety Data Sheet (MSDS) and any additional toxicological information available from the pest management technician or the manufacturer of the product.
- Where possible, select the least dangerous pesticide that will do the job effectively.
- Read the directions and precautions on the label and ensure that they are followed closely.
- Ensure staff are trained adequately to use pesticides (e.g. gardeners, cleaners).
- Inform the school community (teachers, children, parents) of your intentions and involve them in the decision making process.
- Inform the school community and, when appropriate, neighbours of the school when the pesticide will be applied.
- Consider signposting areas to be sprayed to ensure that people, and especially children, are kept a safe distance away during pesticide use.
- Apply the pesticide so that children, teachers and the public are not exposed or exposed as little as possible (e.g. during the school holidays or weekends).
- If a spillage occurs, it should be cleaned up quickly and effectively. If a spillage has occurred, the principal or supervisor should be warned of what has happened before the area is reoccupied.
- After application inside a building, ensure that any 'no-entry period' given on the pesticide label has elapsed and that the rooms are thoroughly ventilated prior to reoccupation. Re-entry into a building while a pesticide smell persists remains one of the most common reasons for concern after treatment.

Remember, whether warranted or not, pesticide use can cause stress or even outrage when people feel they have not been kept informed or that safety concerns have not been fully addressed.

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3. Pesticides

3.1 What is a pesticide?

A pesticide is a chemical which kills or controls pests - for example, insects, weeds, rodents, fungi, spiders and snails. The major pesticide groups are:

- Insecticides
- Herbicides
- Rodenticides
- Fungicides
- Molluscicides
- Algicides

Typical insecticides

- Pyrethrins or pyrethroids: often supplied in aerosol cans.
- Organophosphates: diazinon, chlorpyrifos - found in home garden products and some pet collars, although some products are restricted to authorised people only.
- Carbamates: bendiocarb, propoxur, carbaryl - found in rose and tomato dusts and flea powders as well as in restricted products.

Typical herbicides

- Non-selective: glyphosate, a general all-purpose weedkiller.
- Selective: bromoxynil, dicamba, 2,4-D, MCPA, used for weed control.

Typical rodenticides

- Anticoagulants: warfarin, bromadiolone, brodifacoum: rat and mouse killer.

Typical fungicides

- Chlorothalonil, copper, mancozeb: used on plants and home grown vegetables.

Typical molluscicides

- Metaldehyde, methiocarb: snail killers.

Typical algicides

- Benzalkonium chloride, chlorine, copper, hydrogen peroxide: used to control algae in swimming pools.

3.2 Safe pesticide use

Pesticides are intended to kill or control pests (the target organisms) by interfering with some of their biological processes. As the processes may be the same or similar in other organisms, including humans, these non-target organisms can also be affected. Generally, however, pesticides are designed to be more toxic to the pest than to other organisms; nevertheless, they must be treated with respect.

If pesticides are used carelessly, there may be a risk of damaging health, as well as obtaining less than optimal effects on the pest.

No pesticide can be regarded as completely safe in all circumstances and pesticides should always be used carefully. However, the risks are low when they are used according to the directions given on the label. These directions are designed, among other reasons, to avoid or minimise exposure to the user and

bystanders. Exposure, or the amount that comes into contact with the body, is a very important contributor to risk, and therefore an important factor in the safe use of pesticides.

Pesticides can be used safely by applying the following principles:

- Select the right pesticide.
- Buy the right amount.
- Always read and heed the label.
- Take care in preparing and applying pesticides.
- Store pesticides safely.
- Dispose of unwanted pesticides and empty containers properly.

Selecting the right pesticide

Buy the least dangerous chemical for the proposed use. The proposed use must be described on the label.

An indication of how dangerous a pesticide may be is found on the main label.

Pesticides labelled **DANGEROUS POISON** are the most dangerous and are only allowed to be purchased and used by licensed pest management technicians and other authorised persons.

Pesticides labelled **POISON** are moderately toxic and are more freely available.

Pesticides labelled **WARNING** or **CAUTION** have low toxicity and have no restrictions on their sale or use.

Pesticides with no such heading have very low toxicity, although they also need to be handled with care.

A range of pesticide products is available for most pests and the information on the label and the MSDS (Material Safety Data Sheet) will help you select the least toxic.

However, toxicity is not the only factor which should be considered.

It is also important to consider how the pesticide is presented and how it is to be used, since these may increase the risk of exposure of people to the pesticide during or after its use.

For example, herbicides packaged as granules which are spread on the ground are often safer than liquid forms which must be sprayed because spraying increases the risk of exposing the operator or bystanders, particularly if spray drift occurs. Granules, however, may be more easily ingested by some non-target organisms such as birds, and small children may also pick them up. Therefore, they may not always be appropriate, particularly around pre- schools and child care centres.

Similarly, some pesticides are made to be persistent to provide long term control of a pest. The increased time these pesticides are present may increase the risk of exposure. However, their use may be preferred because they avoid the need for repeated applications necessary with some short-lasting pesticides.

It is also important to consider how toxic the pesticide is to the pest compared to other organisms. Some pesticides are particularly toxic to their target species, but not so to humans, making them very useful for safe pest control. In addition, because they are so potent to target species, only very small amounts need to be used.

For example, while most synthetic pyrethroids are generally of low toxicity to mammals, some are very toxic .However, all are more toxic to insects than to mammals. In fact, they may be hundreds of times more toxic to insects than mammals, and can be effective in controlling insects at very low concentrations. This is because mammals have enzymes which are able to break down pyrethroids before they have an effect, whereas insects do not. Thus, pyrethroids are effective when used in very small amounts, and this group of pesticides has a very good safety record.

Synthetic pyrethroids have become probably the most common pesticides found in aerosols around the home. Because of their widespread use and the perception that they are safer than other pesticides, synthetic pyrethroids are described more fully in Appendix 2.

When in doubt, seek expert advice to help you choose the most appropriate pesticide for the job. A list of names, addresses and telephone numbers of the organisations you can contact is included at the end of this booklet (Appendix 3).

Buying the right amount

Buy only as much as you need for a particular task. This is not only economical but avoids problems with storage or disposal of unused material.

Pesticides may be available in a range of quantities and packaging. Generally, pesticides considered safe for domestic use are packaged in smaller quantities than those available to authorised persons only.

Reading and heeding the label

The label is the most important source of information for safe pesticide use. Read it carefully and familiarise yourself with all instructions and warnings before you use the pesticide.

The label tells you all you need to know about the product, including usage, mixing and safety instructions.

The information found on the label is the result of careful research and testing to determine how much pesticide should be used to obtain the required effect on the pest with least harm to non-target organisms.

A typical label will indicate:

Toxicity:	indicated by one of the following three warning signs written in large letters:
DANGEROUS POISON -	indicating high toxicity
POISON -	indicating moderate toxicity
WARNING or **CAUTION** -	indicating low toxicity

If there is no warning on the label this means that the pesticide is of very low toxicity (Note: some manufacturers label such products with 'WARNING' although this is not required by law).

Ingredients	a list of the active ingredients and their concentrations in the product
Use	describes where the pesticide should be used - crops, pests, situations
Application	describes how and how much of the pesticide should be used - strength of mixture, time to use, weather conditions, method of application
Protection	lists the appropriate protective apparatus to ensure safety to the user, e.g. gloves, boots, overalls, hat, goggles, respirator
Precautions	a number of precautions will be given, e.g. 'do not eat, smoke or drink while using'; 'wash hands and equipment thoroughly after use'
Irritation	a warning will be included if the product could cause skin or eye irritation on contact
First-aid	instructions for the appropriate first-aid steps to take if the product is swallowed, spilt on skin, or if vapour or spray mist is inhaled
Manufacturer	name and address of manufacturer and sometimes a contact telephone number for additional information

The label is a legal document which has been approved and registered by the National Registration Authority (for agricultural and veterinary chemicals). Inquiries about pesticide registration should be directed to this body, whose address is listed in Appendix 3.

Taking care in preparing and applying pesticides

Without doubt, the people most at risk from the harmful effects of pesticides are those who are responsible for their preparation and application. However, others may also feel concerned about or threatened by this activity, particularly when they see technicians wearing protective clothing and equipment ('moon suits').

Many pesticides are sold as concentrates which must be diluted in water or some other solvent before they are applied. Instructions on how to do this are included on the label. It is of utmost importance that these instructions, including the use of appropriate protective clothing, are followed.

To ensure safe and worry-free use:

- Have soap, water and towels available.
- Wear protective clothing and equipment as required.
- Open containers carefully with proper tools on a stable surface where they will not tip or spill easily.
- Open, pour and mix pesticides in a well ventilated area, free from obstructions and where bystanders cannot be contaminated.
- Be careful to pour properly or decant from the container avoiding splashing and spurting. **NEVER** use your mouth to siphon liquids or to blow out an obstructed spray nozzle.
- Clean up any spills promptly. This can be done by covering with sand, sawdust or 'kitty litter' before sweeping up and disposing in a bin. Make sure you have these materials available in case of spills.
- Follow the additional procedures for mixing and applying pesticides as described in the code of conduct for pest management technicians (section 6).

Storing pesticides safely

Information on special conditions for pesticide storage will be found on the label. In general, however:

- Store only in original containers, which should be resealed and still have an intact label.
- Do not decant into drink bottles or containers used for food.
- Keep out of the reach of children and pets.
- Do not store under the sink or with foodstuffs.
- Store aerosols away from sunlight.
- When pesticides are stored in a school shed, ensure that the shed is in good repair and that windows and doors are adequately secured.

Disposing of unwanted pesticides and empty containers properly

- Do not dispose of pesticides down the drain; they should be finished, or disposed of, according to the instructions on the label.
- Dispose of old pesticides, which are no longer needed, by arrangement with the environmental health officer of your local council or shire.
- Do not incinerate aerosol cans.
- Wrap up and dispose of small empty containers in the rubbish bin. Larger containers (e.g. over 2 L) may be rinsed three times and the washings used for dilution of further spray solutions. The larger containers should then be perforated and placed in a rubbish bin.

Specific disposal instructions may be found on the label of some pesticides. Disposal by licensed pest management technicians is governed by specific State and Territory regulations.

3.3 Poisoning

Poisoning occurs when pesticides enter the body following exposure either through the mouth by swallowing, through the lungs by inhalation or through the skin.

The extent of poisoning depends on the amount that is absorbed into the blood stream and the internal organs of the body. This may be all or only a fraction of the amount to which one is exposed.

The extent of poisoning also depends on what happens to the chemical once it is absorbed from the exposed surfaces. For example, whether it broken down quickly, excreted, retained in the body or changed into a more dangerous chemical.

There are two types of pesticide poisoning:

Acute - usually the result of a single heavy exposure.

Chronic - resulting from numerous low exposures to a chemical over a period of time.

Chronic poisoning is usually harder to detect as the effects may take a long time to develop and it is more difficult to establish a cause-and-effect relationship.

Both acute and chronic poisoning may occur from improper use, or when appropriate protective equipment has not been worn.

What are the symptoms?

Symptoms vary according to the pesticide used and the degree of exposure or the amount that gets into the body. They are often non-specific; there are a number of diseases which may produce similar symptoms.

Nevertheless, some or all of the following symptoms soon after contact with a pesticide should be investigated further as they may indicate poisoning.

Mild poisoning	headache, fatigue, skin irritation, loss of appetite, dizziness, weakness, nervousness, nausea, sweating, diarrhoea, eye irritation, insomnia, thirst, restlessness, irritation of the nose or throat, sore joints, changes of mood
Severe poisoning	vomiting, loss of reflexes, difficulty in breathing, involuntary muscular twitching, visual disturbances, convulsions, unconsciousness, severe secretion or salivation, fever, thirst, increased rate of breathing

If you have any of these symptoms after being exposed to a pesticide, you are advised to contact the Poisons Information Centre(tel 131126 from anywhere in Australia) or see a doctor. Whenever possible, take the label or pesticide container with you so that the chemical can be easily identified and appropriate treatment given.

3.4 Pesticide toxicity

Pesticides can be grouped according to their chemical types (e.g. organophosphates, synthetic pyrethroids). Chemicals within these groups, or types, generally have similar pesticidal properties and broadly similar toxic effects on humans. Although there are exceptions, classifying pesticides in these groups is a useful and simple way to assess the relative hazards of products before selecting which is the most appropriate to use.

Although pesticidal and toxic effects are generally similar in quality within each type, it is important to recognise that potency can vary considerably. For example, all organophosphate insecticides act by interfering with a chemical found in nerve cells and produce toxic effects which are similar in nature. However, some do this at very low concentrations and have very high toxicity (e.g. fenamiphos) while others are effective only at higher doses and have only low toxicity (e.g. malathion).

As for poisoning, pesticide toxicity can be either acute (single high dose) or chronic (frequent low doses over a long period). Because pesticide applications in schools are likely to be infrequent, the potential for acute poisoning is the most important consideration of toxicity.

Acute toxicity

The dangers to health associated with short term exposure to high concentrations of pesticide are indicated by the results of studies on animals which measure the lethal dose (LD_{50}, see Appendix 1), and which assess skin and eye irritation, skin sensitisation and allergic responses. This information is found on the label or in the MSDS.

Commonly used pesticides (according to a survey of pest management technicians) are listed in the following table. Their types and their hazard rating are included in the table. The pesticides are classified into groups of increasing hazard. Within the groups pesticides are listed in alphabetical order.

The table is based on the International Programme on Chemical Safety 'WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 1994-1995', produced by the United Nations Environment Programme, the International Labour Organisation, and the World Health Organisation.

The WHO hazard classification system depends on the acute oral and dermal toxicities (LD_{50} values) and the physical form (solid or liquid) of the pure technical active ingredient. The nature of the hazard, for example whether poisoning produces permanent damage or only short term effects, is also considered.

The hazard rating in the table does not take into consideration mixtures of active ingredients with other ingredients in the products as purchased or used. The LD_{50} values of these products may be much lower because the active ingredients are diluted with a number of additives, thus reducing the hazard.

Additives may include propellants, solvents, emulsifiers, or a number of other chemicals. These chemicals can make the toxic properties of the product different from the active ingredient, particularly the irritant properties to the skin and airways.

As well as the oral LD_{50}, the dermal and inhalational LD_{50} values are also found in the MSDS. These give an indication of how dangerous the pesticide may be when absorbed through the skin or inhaled.

The numerical value of the LD_{50} is generally higher for dermal exposure than for oral intake because less chemical is absorbed through the skin than after ingestion.

Inhalational toxicity is generally expressed as the lethal concentration of the chemical in the air rather than the lethal dose, and is therefore called the LC_{50}. Inhaling pesticides can be hazardous during mixing and spraying as the chemicals are easily taken into the body through the lungs.

When a pesticide is purchased it normally consists of a mixture of the active pesticidal ingredient and a number of additives. This formulation is often diluted with a solvent or water before it is used in the pest treatment. Because of this dilution, the risk of poisoning from the pesticide as used in the treatment will be much lower than for either the pure active ingredient or the commercial product formulation.

ACUTE TOXICITY

Hazard rating	*Chemical*	*Type*	*Class*
Unlikely to present acute hazard in normal use	Amitrole	Triazole type	Herbicide
	Boric acid	Miscellaneous	Insecticide
	Chlorothalonil	Miscellaneous	Fungicide
	Cyromazine	Insect growth regulator	Insecticide
	Dithiopyr	Miscellaneous	Herbicide
	Fluazifop	Miscellaneous	Herbicide
	Glyphosate	Phosphonic acid type	Herbicide
	Hydroprene	Insect growth regulator	Insecticide
	Mancozeb	Dithiocarbamate	Fungicide
	Methoprene	Insect growth regulator	Insecticide
	Piperonyl butoxide	Synergist	Insecticide
	Propyzamide	Amide type	Herbicide
	Tetramethrin	Synthetic pyrethroid	Insecticide
Slightly hazardous	Allethrin	Synthetic pyrethroid	Insecticide
	Dicamba	Plant hormone type	Herbicide
	Hydramethylnon	Miscellaneous	Insecticide
	MCPA	Plant hormone type	Herbicide
	Malathion	Organophosphate	Insecticide
	Mecoprop	Plant hormone type	Herbicide
	Metaldehyde	Miscellaneous	Molluscicide
Moderately hazardous	Bendiocarb	Carbamate	Insecticide
	Bromoxynil	Miscellaneous	Herbicide
	Carbaryl	Carbamate	Insecticide
	Copper sulphate	Inorganic	Algicide
	Chlordane	Organochlorine	Insecticide
	Chlorpyrifos	Organophosphate	Insecticide
	Cypermethrin	Synthetic pyrethroid	Insecticide
	Cyfluthrin	Synthetic pyrethroid	Insecticide
	2,4-D	Plant hormone type	Herbicide
	Deltamethrin	Synthetic pyrethroid	Insecticide
	Diazinon	Organophosphate	Insecticide
	Fenthion	Organophosphate	Insecticide
	Heptachlor	Organochlorine	Insecticide
	Permethrin	Synthetic pyrethroid	Insecticide
	Methiocarb	Carbamate	Molluscicide
	Propoxur	Carbamate	Insecticide
	Pyrethrins	Pyrethrum derivatives	Insecticide
Highly hazardous	Dichlorvos	Organophosphate	Insecticide
	Fenthion	Organophosphate	Insecticide
	Omethoate	Organophosphate	Insecticide
	Warfarin	Anticoagulant	Rodenticide
Extremely hazardous	Arsenic trioxide	Arsenical	Insecticide
	Brodifacoum	Anticoagulant	Rodenticide
	Bromadiolone	Anticoagulant	Rodenticide
	Fenamiphos	Organophosphate	Insecticide

Chronic toxicity

It is possible to compare pesticides according to their chronic toxicity; however, this is more difficult to do than acute toxicity. There are limitations because long-term exposure to chemicals can affect different organs, at different times, to different extents, and with different outcomes. Some effects may be marked but reversible, some long-lasting, and some may be fatal.

Nevertheless, pesticides can be compared based on an amount which does **not** cause an effect, provided the limitations of this approach are kept in mind (see Appendix 1).

Information on safe levels of exposure is obtained from long-term studies using animals, the results of which are used to set an Acceptable Daily Intake (ADI) or a Tolerable Daily Intake (TDI) for humans.

The ADI and TDI are the amounts which, when taken into the body every day for a lifetime, are not expected to cause adverse health effects. To account for differences in weights between people, and between adults and children, the values are given as a certain amount per kilogram of body weight.

ADI values are only set for pesticides which are used in food-producing crops or crops used as stock feed because residues may be found in food. However, they also allow assessment of how much pesticide can be taken into the body from sources other than food without harm. TDI values are set for other pesticides (see Appendix 1).

Pesticides may thus be ranked according to their ADI or TDI values as shown in the following table. The higher the value, the lower the toxicity of the substance.

Acceptable Daily Intake (ADI) (mg/kg body weight/day)

more than 0.1	*0.1 - 0.01*	*0.01 - 0.001*	*less than 0.001*
Copper (TDI)*	Bromoxynil	Arsenic (TDI)	Amitrole
2,4-D	Carbaryl	Bendiocarb	Chlordane
Glyphosate	Chlorothalonil	Methiocarb	Fenamiphos
Methoprene	Chlorpyrifos	Diazinon	Heptachlor
Propyzamide	Cyfluthrin	Dichlorvos	Omethoate
	Cyromazine	Dithiopyr	
	Deltamethrin	Fluazifop	
	Dicamba		
	Permethrin		
	Piperonyl butoxide		
	Propoxur		
* *provisional value*	Pyrethrins		

4. Risks to health

Health risks associated with pesticides are dependent on two factors: hazard and exposure, ie how dangerous the pesticides are and how much gets into the body.

As it is generally not possible to change how dangerous a particular pesticide is, risk can be reduced by avoiding or minimising exposure. When exposure is zero, there are no risks to health, no matter how dangerous the pesticide is.

Hazard

Hazard is the capacity of a pesticide to cause harm to a person, animal or the environment. For example, leukaemia is one hazard of benzene; intellectual impairment is one hazard of lead for infants.

Exposure

As already mentioned in section 3.3, people may be exposed through skin contact, by inhaling or by swallowing the pesticide. Care should always be taken to reduce the possibility of exposure as far as practicable. Even highly toxic chemicals can be used safely providing they are controlled in such a way as to ensure minimal exposure.

Exposure can be affected by the amount and concentration of the pesticide, the form the pesticide is in (eg granules, dust, liquid), how it is used, and how long it is present (see also section 3.2).

Risk

Risk is determined by both the toxicity of a chemical (i.e. the amount required to cause an adverse effect) ***and*** the degree of exposure. If there is no exposure there will be no risk.

The concentration of the pesticide in the product is important when considering the potential for exposure. Pesticides are often present at a range of concentrations in different products and care should be taken that only the products intended for the target pests are used.

Although generally the intention is to package products, especially those for the home market, in forms which minimise the possibility of exposure, hence harm, this is not always possible.

For example, metaldehyde, a relatively low oral toxicity pesticide is packaged in the form of pellets to attract and kill snails. However, because it is in pellet form, it may be easy for a small child to eat a dangerous amount before he or she can be stopped. For the same reason and because the pellets are attractive to them, dogs are also at risk of poisoning from snail pellets.

This makes metaldehyde pellets potentially more dangerous than some other more toxic pesticides, which are not so easily ingested.

5. Pests

This section describes the more common pests, how they may be controlled in and around schools, and the types of pesticides which can be used.

The information in this section has been adapted from the 'Guidelines for use of pest control agents in schools' with permission from the WorkCover Authority NSW.

5.1 Insects and spiders

Before embarking on a program of chemical treatment against insects or spiders, it is important to consider that they are essential components of the natural environment. Spiders are important predators of flies and mosquitoes (and other spiders) and are also prey for birds and other species. Similarly, cockroaches, ants and flying insects play important parts in the ecosystem.

Low levels of infestation by these species can be tolerated. However, sometimes they do become a nuisance, or the infestations can become dangerous and control becomes necessary.

Infestations can often be inhibited by non-chemical means, for example by sealing cracks in walls or floors, using fly screens and removing potential breeding sites. When these strategies have failed, pesticides may be needed.

Cockroaches

Indoor control

Cockroach infestations are most common in areas where food is stored, prepared or consumed. Canteens, cafeterias and staff common rooms often require treatment. Low level infestations can also occur in offices.

Cockroaches generally prefer dark, warm and moist environments. They thrive in areas where there is a food and water source, and where there are cracks, crevices and gaps. Examining these areas may reveal signs of cockroach activity, such as faeces (like large fly droppings), cast off skins and egg sacs, and live cockroaches (feelers or legs protruding from gaps). A musty odour may be detected when there is a heavy infestation.

Indoor environments can be made less favourable for cockroaches by removing their sources of food and reducing their available shelter. Stored food should be sealed and bench tops should be cleaned to remove all traces of food and grease. Ensure floors, particularly surfaces under refrigerators and cupboards, are cleaned. Fill cracks and holes in walls and floors, particularly around ovens and hot pipes, with cement or other hard filler. Repair broken or cracked tiles, peeling lino, and damaged skirting boards. Ensure old cardboard boxes are removed.

Insecticides used for cockroach control are usually applied as crack and crevice treatments or baits. The frequency of application will be determined by the rate of reinfestation and the level at which cockroaches are perceived to be a problem. Reinfestation can be prevented by locating and treating all the breeding and living areas available to the cockroaches.

Registered pesticides:

Bendiocarb
Boric acid (dust)
Chlorpyrifos
Diazinon
Dichlorvos
Fenthion
Hydroprene
Methoprene
Propoxur
Pyrethrins
Synthetic pyrethroids

Minor cockroach infestations may be controlled by using baits (eg hydramethylnon, boric acid), particularly where other foodstuffs are not available, such as in staff rooms and offices or clean kitchens and canteens.

Sticky traps are useful for monitoring cockroach infestations but are rarely sufficient on their own to eradicate infestation.

Outdoor control

Cockroaches can form persistent infestations in outdoor areas such as stormwater and sewerage openings, grease traps, in waste disposal areas, compost heaps and gardens. Under the right conditions, cockroaches will move from these areas into buildings. This likelihood can be reduced by appropriate hygiene and sanitation standards.

The wood or bush cockroach is usually found in outdoor areas, under leaves, bark, rockeries and wood piles, and is an important species in the ecology of these areas. This species is black with a white margin around the edge of the body and is about 30 mm in length. As this is a beneficial species, outdoor areas should not be treated with insecticide unless absolutely necessary.

Ants

There is a large number of ant species in Australia, only a few of which have become pests in and around buildings. Most ant species nest outdoors and only move into buildings in search of food.

Argentine, Singapore and coastal brown ants are introduced species. Other species are native and are an integral part of the Australian environment and an important component of the food chain. They should not be destroyed if they do not pose a particular problem.

Ants are attracted by rubbish, decomposing material and spilled food or drink. Ensuring high standards of hygiene can inhibit ants from entering and establishing themselves in buildings.

When they build nests under buildings or pavement, large quantities of soil can be removed resulting in subsidence and structural damage.

Important pest species in Western Australia are the Argentine ant, Singapore ant, coastal brown ant, black house ant and white-footed house ant. These are small ants, less than 3 - 4 mm in length, which can be distinguished on the basis of colour and life style. The Argentine and Singapore ants are the most troublesome and difficult to control. Argentine ants have the potential to cause very serious infestations as they have multiple nest sites and are therefore difficult to destroy. In appearance they may be mistaken for coastal brown ants. Sighting of Argentine ants should be reported to the relevant local government, State and Territory authorities.

Outdoors, the larger meat ant (up to 14 mm) can be a problem as this species forms large colonies and gives a painful bite.

Jumper (or hopping) ants are found in South Eastern Australia including Tasmania. Their sting is painful for several days and some people will suffer severe allergic reactions to the sting.

Indoor control

Many species of ants enter buildings in search of food but only a small number will nest within the structure. Every attempt should be made to locate the nest before starting any control measures. Where the ants are nesting inside the building, an application of residual insecticide may be required in the roof, wall or floor cavity.

Only short term control is possible by treating the ant trail alone; the nest should also be located and treated.

Currently available ant baits generally control only minor ant infestations, and some species will not accept the baits at all. However, some baits are effective against some species.

The nest should, if possible, be located by following the ant trails. If the nest is in a dry area, an insecticidal dust or granules may be used. If in a wet area, baits or liquid formulations are more appropriate.

Registered pesticides:

Bendiocarb
Boric acid
Carbaryl
Chlorpyrifos
Diazinon
Dichlorvos
Fenthion
Hydramethylnon
Propoxur
Synthetic pyrethroids

Outdoor control

If necessary, outdoor ant control should concentrate on finding the nest or nests and direct treatment of these and adjacent areas. Some species (eg Argentine ants) form a series of interconnected nests which may be found along the edges of concrete paths and between paving bricks. These may require the insecticide to be applied over a more extensive nesting area. The pesticides listed under 'Indoor control' may be used.

Fleas

Fleas feed on the blood of host animals. Hosts may be cats, dogs, rats, birds, rabbits and people. The bite causes itching and can become infected.

Sometimes feral cats, dogs or rats may deposit fleas in sub-floor areas of buildings or in outdoor play areas. School and domestic pets may also be a source of fleas which can be inadvertently carried into buildings.

Fleas can be prevented by removing access to the sub-floor by cats or rats, and by minimising feral animal activity in and around the school. School pets should be kept free of fleas by regular inspection and treatment. Consult a veterinarian for advice on how to do this. Ensure that animal cages are regularly

cleaned and that carpet and upholstery are vacuumed. Insecticides may occasionally be needed to remove flea infestation.

Registered pesticides:

Bendiocarb
Carbaryl
Diazinon
Dichlorvos
Fenthion
Hydroprene
Methoprene
Propoxur
Synthetic pyrethroids

Flies


Flies are the vectors for a number of human diseases. Each fly may carry a number of human pathogens and these may be spread from feeding matter (eg faeces, rotting flesh or vegetation) to humans. Therefore, flies pose a particular hazard to public health.

The best way to control flies is to inhibit their breeding. Flies lay eggs in material which will be suitable for the hatched maggots to use as food. This may be human or animal faeces, rotting vegetation, decaying matter, and meat or fish, with different species of fly showing different preferences.

Adult flies can travel many kilometres from their breeding site under appropriate conditions. It is therefore not possible, nor ecologically desirable (flies are an important part of the food web) to eradicate them completely. However, flies should not be tolerated inside buildings.

Numbers can be reduced in and around buildings by cleaning or removing any material which they may use as sources of food and for breeding. Store foodstuffs in airtight containers and clean up food scraps quickly. It is also important to ensure fly screens are in good repair.

Outside, rubbish bins should be cleaned regularly and secured with tight-fitting lids. Leaf mould and fallen fruit should be cleared, and any animal carcasses or faeces removed. Any material which may decompose should be cleaned quickly as very little time is required for it to become fly-blown.

Open compost heaps containing food scraps and lawn clippings, which can be the source of many flies, are illegal in some States. Use a proprietary compost bin where the high temperatures of the composting material prevent housefly breeding. Additional information on composting is available from the Environmental Health Section of your local government.

Fly traps can be used to control flies outdoors. These are available commercially through outlets such as hardware stores. Flies are gregarious insects; once a few flies are trapped, others will join them.

For indoor fly control, try using a fly swat. If this fails, use household sprays which kill flying insects. Insecticide use will be reduced if the flies are sprayed when they have landed. However, only use for localised control when flies are present and do not use repeatedly as a preventative treatment or over large areas.

Registered pesticides:

Diazinon
Dichlorvos
Fenthion
Malathion
Propoxur
Pyrethrins
Synthetic pyrethroids

Additional information on ways to control breeding of flies is available from the State and Territory Environmental Health Services or your local council (see Appendix 2).

Mosquitoes

Mosquitoes are responsible for the transmission of several serious human diseases, including malaria, Ross River virus (RRV) and Australian Encephalitis (AE). However, they are also an important food source for a number of native fauna, including lizards, frogs, fish, insects and birds, and are therefore important in Australia's ecology.

Adult mosquitoes rest in sheltered and shaded areas such as under eaves and in the lee of walls, and are found particularly in humid shade such as the underside of leaves and in shrubbery.

Mosquitoes require water in which to breed. The larvae (wrigglers) live under the surface of still water and breathe air through the surface meniscus. Removing or periodically flushing static water, e.g. around plant pots, roof gutters, bird baths and drains, will destroy the larvae and reduce the numbers of adult mosquitoes.

Additional information on mosquito breeding and control is available from the State and Territory Environmental Health Services or from your local government.

Mosquitoes are slow flying and are easy to swat. However, they often go undetected until they have punctured the skin in order to feed. Wearing loose-fitting clothing can prevent this and it may be advisable to keep children indoors during times of peak mosquito activity.

Personal insect repellents are the best chemical method of preventing mosquito bites. Diethyl toluamide (DEET) is the most effective and widely used ingredient and is available in gels, aerosols, sprays and lotions in concentrations up to 80%. Wash off repellents at the end of the day and don't use products with concentrations greater than 20% DEET on infants and children. Mosquitoes may be attracted by light coloured clothing and some perfumes and aftershaves.

Indoors, mosquitoes may be killed by using household space sprays.

Registered pesticides:

Insect repellents
Diazinon
Dichlorvos
Fenthion
Malathion
Propoxur
Pyrethrins
Synthetic pyrethroids

Spiders

All spiders are predators and almost all produce venom to help subdue their prey. Most spiders are not dangerous to humans and should not be killed as they are important animals in the environment. A few species are dangerous to humans and it may be necessary to kill these when they are found in school buildings.

The huntsman spider and, very occasionally, the garden orb weaving spider may be found indoors. Although they seldom bite people, medical advice may be required if they do as some people may be allergic to their venom.

The redback spider bite has caused death in susceptible individuals and this spider should be treated with caution. Redbacks produce characteristic wispy nests with extended strands close to the ground.

Funnel web spiders are found in South East Queensland, through New South Wales to Victoria with a small pocket in the Mount Lofty and Southern Flinders Ranges in South Australia. Many, if not all, are dangerous to humans.

The bite of the white tail spider is often blamed for skin destruction over a large area as well as a range of other symptoms (eg headache, diarrhoea and vomiting). However this is controversial and the effects may, in fact, be due to the recluse spider which has been introduced recently from North America. (The white tail spider is indigenous yet problems have only been described in recent years suggesting a new agent is responsible.) Most reported bites are minor.

The white tail spider normally lives outside, where it actively hunts insects and other spiders. However, it often enters homes and may hide under cloth and material on the floor. Clothing should always be hung up off the floor.

The black house spider bite is painful and may cause swelling, but it is not fatal. This spider builds a 'tunnel' type web, generally outside in tree bark and rocks, but also in vents, skirting board and ceiling corners inside.

The impact of spiders can be greatly reduced by changing their environment to make it less favourable. Leafy rockeries and damp overgrown gardens are the preferred habitat of white tails, while redbacks prefer to nest in dark containers or under loose wall sheeting, close to ground level.

If insecticides are necessary, apply directly to the webbing, into the burrow or into the cracks and crevices where spiders shelter. Once the insecticide breaks down areas tend to be rapidly recolonised. The 'general' spraying of outdoor areas or the exterior of buildings as a preventive measure is not recommended.

Registered pesticides:

Bendiocarb
Chlorpyrifos
Diazinon
Dichlorvos
Fenthion
Synthetic pyrethroids

Silverfish

Silverfish are fast moving and agile insects which can be found throughout a building, particularly in roof or wall voids and in sub-floor areas. Favoured habitats are undisturbed dark areas, such as store rooms and cupboards. They feed on a wide range of starchy products and often damage clothes, paper or paper products such as book bindings, photographs and wallpaper. They are most active at night and are seen only occasionally during the day.

Silverfish have a secretive lifestyle and infestations may go undetected until damage is noticed. Control may require the removal and fumigation of smaller objects as well as treatment of the affected area.

Registered pesticides:

Bendiocarb
Diazinon
Dichlorvos
Propoxur
Pyrethrins
Synthetic pyrethroids

Carpet beetles and clothes moths

These pests will normally be restricted to carpets, although they may also be found in soft furnishings and curtains. Clothes moths will also be found in cupboards and wardrobes.

Thorough vacuuming around the edges of carpets and under seldom-moved furniture will greatly reduce the impact of these pests. Application of a small amount of insecticide to badly infested areas of carpet may be necessary.

Registered pesticides:

Naphthalene
Propoxur
Pyrethrins
Synthetic pyrethroids

Booklice

Booklice (psocids) are small insects which feed on microscopic moulds and other fungi growing on materials such as books, woodwork, paper and leather. In buildings, booklice are most abundant in damp, dark rooms with poor ventilation; conditions which favour the growth of moulds.

Thoroughly cleaning, drying and airing the area is all that is normally needed to clear these pests. A light application of insecticide may be required for heavy infestations.

Registered pesticides:

Pyrethrins
Synthetic pyrethroids

Bees and papernest wasps

Bees and papernest wasps are found in most parts of Australia. They are generally not aggressive unless their nest or the area immediately adjacent to it is disturbed.

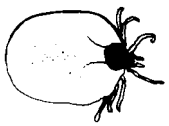
Control is only warranted where the bees or wasps build their hives or nests near doors or window sills or on low branches of trees or shrubs where they can be disturbed by children at play. If the nest is not obstructing activities, then children can be educated to keep away rather than resorting to chemical control.

It is advisable to contact an apiarist before tackling a bee hive. Papernest wasps may be controlled by direct application of insecticide to the nest, preferably in the late afternoon or early evening when all the wasps are on the nest.

Registered pesticides:

Carbaryl
Propoxur
Synthetic pyrethroids

Ticks



Bush (or Paralysis) ticks are found along the eastern coast of Australia in moist vegetated habitats. Their principal hosts are bandicoots but they will attach to other hosts such as livestock, cats, dogs and humans. Their bites may cause severe symptoms, including paralysis, in people.

Kangaroo ticks are blood sucking arachnids which grip onto the skin of kangaroos. They are found in many areas across Australia where there are sand plains covered with uncleared scrub and significant populations of bush kangaroos. They will also infest dogs, sheep and other animals under appropriate conditions. Their bites cause less severe symptoms than bush ticks.

When a tick has become gorged with blood, it falls from its host and shelters amongst foliage while the blood is digested. It then waits under foliage and will attach to a new host animal that brushes against it. This could be a school child or member of staff.

New school grounds, fringe metropolitan suburbs and country schools are most likely to be affected. Discouraging bandicoots and bush kangaroos, reducing undergrowth, wearing loose, baggy clothing and applying repellents can control the problem. Tick infestations can be severe enough to warrant pesticide treatment to areas of school grounds adjacent to bush.

Repellents against ticks are available. These contain dibutylphthalate (DBP) and they are smeared onto clothing. Repellents of this nature are useful for bushwalking in known tick-infested areas.

Registered pesticides:

Fenthion
Malathion
Pyrethrins

European wasp

The European wasp is an introduced insect which scavenges for food in and around urban areas. It is strongly attracted to meat products, sweets and other foods scraps, and soft drinks. These wasps are often very aggressive when disturbed.

Nests of the European wasp are usually concealed in the ground, in wall or ceiling voids or behind retaining walls. In most cases the only sign of a nest is the constant stream of wasps into and out of the nest opening. European wasps are particularly aggressive if the nest is disturbed and individual wasps can sting repeatedly.

In their native countries, winter conditions and natural predators limit the wasp populations. Australian conditions are such that there is a potential for the European wasp population to increase uncontrolled. It is therefore important that these pests are destroyed by the appropriate authorities as soon as they are positively identified.

Control involves direct application of insecticide dust or liquid into the nest opening, and it may take up to two weeks for all wasp activity to cease. An active European wasp nest can present some risk to the operator during treatment. An effective knockdown aerosol may be required to reduce activity around the nest opening while the treatment is carried out.

Registered pesticides:

Dichlorvos
Malathion
Propoxur

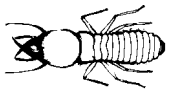
When a European wasp nest is identified, local government should be notified immediately. It will organise the treatment and removal of the nest.

Itchy caterpillars

Caterpillars of several species of moths shed hairs which are irritant to the skin and eyes. The most important cause of 'caterpillar dermatitis' in Australia arises from the caterpillar form of the mistletoe brown tail moth. The moth is found widely in south-eastern Australia. The caterpillar feeds on species of mistletoe which tend to be parasites on Eucalyptus species. The problem can be controlled by removing mistletoe growth from affected trees.

Another species, the bag shelter moth (or processionary caterpillar) forms silky 'nests' in Eucalypt (gum) or Acacia (wattle) trees and shrubs in many parts of Australia. If there are problems, the nests need to be removed by someone wearing appropriate skin protection. The nest and any silken threads attached to the trunk and the base of the trunk need to be removed and burnt to destroy the irritant hairs. If there is a recurrent problem the trees or shrubs (particularly those near playgrounds, classrooms and parking areas) may need to be replaced with other species.

Termites ('White ants')



The treatment of termite infestations and the installation of chemical barriers for termite protection must be done strictly according to the Australian Standard *'Protection of Buildings from Subterranean Termites'* (which may be modified by State and Territory regulations) and the NHMRC *'Code of Practice for the Safe Use of Termiticides'*.

Treatment against active termite infestation should only be undertaken by licensed pest management technicians.

The only chemicals currently allowed to be used in buildings are the organophosphate insecticide, chlorpyrifos (e.g. Dursban™, Deter™) the synthetic pyrethroid, bifenthrin (Biflex™) ; and arsenic trioxide. For the time being, organochlorines are allowed in the Northern Territory.

Particular care should be taken when these chemicals are used against termites. Treatment should not be undertaken during school hours when staff and students are present. All those not directly involved should be excluded from the area during treatment and warning notices should be placed at all entrances or approaches to the potential risk area. These notices must remain in place until treatment and clean-up are completed.

It is essential that sub-floor ventilation is checked before chlorpyrifos or bifenthrin is applied under floor boards, that all spillages are adequately cleaned and that treated rooms are thoroughly ventilated before they are reoccupied.

While arsenic trioxide is hazardous, only very small amounts (several grams) are needed by an experienced technician to control termites who must place it into active termite passages. It must be used at least two weeks before any other spraying as other sprays will repel termites so that they will not be exposed to the arsenic.

5.2 Mammals, birds and reptiles

Rats and mice

Rats are nocturnal and their presence may not be known unless particular signs are recognised. These include noises in roof spaces (although possums or birds may also be responsible), droppings found in corners, cupboards or roof spaces, tracks or signs of gnawing. Mice are generally active during the night but may also feed, and therefore be sighted, during the day if they feel safe.

A proper inspection of the premises will be needed to determine the presence of the rodents and their method of entry into the building.

Rodent infestation can be prevented by good hygiene and sanitation practices, and by using structural barriers. Rubbish bins should be regularly emptied and their storage areas cleaned. Scrap material (wood, bricks, anything that may form a cover) should be removed from the immediate vicinity of a building. Similarly, unwanted undergrowth which may allow safe access for rodents to a building should be removed.

Mice are able to enter a building through a gap as small as 6 mm, so check under door spaces and gaps around waste and service pipes and fill if necessary.

Rodents may be controlled in and around buildings by using baits, spring-back traps or a combination of both, depending on the particular circumstances. Successful control will depend on a knowledge of the rodents' trackways and feeding areas.

Where traps (sticky pads or spring-back) are used, they should be checked daily and any trapped rodents should be sealed in plastic bags and disposed of in the rubbish bin. Traps should not be set where children may accidentally set them off.

Baits should be placed in properly designed bait boxes, clearly marked 'POISON.' They should be inaccessible to children, pets and other non-target animals.

Place outdoor baits in clearly labelled, lockable bait stations. Remove and dispose of all baits and bait stations when they are no longer required.

Single dose rodenticides (such as metallic phosphides) are not recommended for use in and around schools. Liquid baits and gels are also inappropriate for use in the school environment because of the risk of young children finding and consuming the poison.

Because of the toxicity of rodenticides, it is advisable for schools to contact the Environmental Health Section of local government for help if a rat infestation is found.

Registered pesticides:

Sticky pad traps
Spring traps
Anticoagulants (bromadiolone, cholecalciferol, coumatetralyl)

Birds, snakes, possums and feral cats

Birds, snakes, possums or feral cats should be handled by experienced personnel only. Snakes, in particular, require expert removal by a trained ‘snake-catcher’. The Environmental Health Section of local government will provide advice on trapping and removal.

5.3 Weeds

As well as in the control of animal pests, integrated pest management is important in the control of weeds.

Weeds in ovals and flower beds can be a nuisance but can often be controlled by cultivation. For example, grass allowed to grow longer will 'out-compete' many broad-leaf weeds, which will be starved of sunlight and will die In flower beds, mulches will inhibit weeds; they will also help keep the soil moist and reduce the amount of watering needed. Small areas of lawn or flower beds can be weeded or the soil turned manually with little more effort than would be required to apply a pesticide.

To control weeds in sports ovals (where grass cannot be left to grow longer), larger flower beds and on footpaths, the use of herbicides may be required. As with other pesticides, before using herbicides it is important to identify the pest (in this case, the weed) which is to be controlled and to select the most suitable and least toxic chemicals.

The timing of weed control is important. You should attempt to control weeds before they flower and set seeds. This will reduce the need for control in future years. Bindii is a good example of a weed which, if not controlled before seeds are dispersed, can cause a persistent and widespread problem.

Herbicides can be categorised as selective (acting against specific species) or non-selective (acting against all plants), and pre-emergent (acting before the plant emerges from the soil) or post-emergent (acting on established plants). Herbicides may work by attacking plant tissue at their point of contact (contact herbicides) or by being absorbed by the plant roots or leaves and transported (translocated) through the plant attacking tissue elsewhere (translocated herbicides).

Herbicides are generally less toxic to humans and other animals than insecticides because they act on different biological functions. Insect biology is broadly similar to humans and other animals and this accounts for the increased toxicity of insecticides to non-target species. However, *paraquat* is an example of a herbicide with marked human toxicity and should not be used in schools.

The choice of herbicide depends on a number of factors including the species of weed, the time of year, presence of other plants and the toxicity of the chemical. Use only those herbicides approved for a particular use. Instructions on the label of the herbicides will assist in selecting the most appropriate one for the job. Some herbicides are harmful to wildlife and should not be used near ponds or streams. The label will inform how the herbicides should be used safely. As a general rule, Schedule 7 herbicides should not be used around schools if Schedule 5 or 6 herbicides are available.

Do not spray on windy days. When possible, use a herbicide spot applicator or 'wand' rather than spray. Dyes can be added to identify sprayed areas.

An appropriate 'no-entry' period will need to be identified before treated areas such as ovals can be re-used. The 'withholding period' stated on the label refers to the period before food crops can be marketed after spraying but this can be used to establish the no-entry period. Substances with a short withholding period (1-5 days) can have a short no-entry period. If spraying is necessary, consider using signposting during the spraying and no-entry period. Keep the school community, users of the playing fields and immediate neighbours informed of the intention to spray.

Herbicides commonly used for turf or borders

Dicamba	Selective translocated pre- and post-emergent herbicide for the control of annual and perennial broad-leaf weeds.
MCPA	Selective translocated post-emergent herbicide for annual and perennial weeds.
Bromoxynil	Selective contact post-emergent herbicide for broad-leaf weeds.
Mecoprop	Selective contact post-emergent herbicide for broad-leaf weeds in grass.
Propyzamide	Selective pre- and post-emergent herbicide for broad-leaf and some grass species.
Dithiopyr	Selective pre-emergent broad-leaf herbicide and post-emergent herbicide for some grass species.
Fluazifop	Selective translocated post-emergent herbicide for grasses.
Glyphosate	Non-selective, non-residual, post-emergent herbicide absorbed through non-woody tissue and translocated through a plant.
Amitrole	Selective pre- and post-emergent herbicide for annual weeds.

Dicamba, bromoxynil and MCPA may be present in the same proprietary formulation to produce a mixture which will kill unwanted growth and inhibit seedling development.

Herbicide commonly used for kerbing and footpaths

Glyphosate
Amitrole

6. Code of Conduct for Pest Management Technicians

Most criticism over the use of pesticides has related to concern about the potential hazard to the environment and the general public. While some of this criticism has been ill-founded and emotive, excessive use and misuse of pesticides could endanger people's health and damage the environment.

In accepting the benefits of pesticides, there is a responsibility to use them with care and respect. By incorporating safe practices into daily work habits, much of the risk is removed.

Just as important as safe practices is ensuring that everyone is kept informed. This is particularly relevant in a school community.

Following this Code of Conduct will go a long way in minimising pesticide exposure and ensuring the well-being of staff and students, as well as allaying any fears or concerns about the proposed pesticide application by parents.

6.1 Prior to pesticide application

- Know clearly the purpose of the treatment - that is, the pest to be controlled. 'General sprays' are not recommended.
- Know the habits and biology of the pest concerned.
- Thoroughly inspect the problem areas with the appropriate person.
- Where appropriate, draw up an integrated pest management strategy to control the pest and prevent its re-occurrence.
- Choose only registered pesticides that are appropriate and effective and which have the lowest toxicity rating.
- Check whether the pesticide chosen is controlled by any specific regulation and ensure compliance with the regulations.
- Make sure everyone is informed of the strategy including parents, teachers and administration. When possible, allow plenty of time for groups such as parent organisations to discuss the proposal.

- Make sure that the school and school community have a copy of the MSDS for the chemical you recommend.
- Be available to discuss your proposal and answer any questions or concerns fully and frankly.
- Read the label carefully and be familiar with it.
- Inform the school community whether or not there is likely to be any lingering smell and explain the cause.

6.2 When to treat

- Do not use pesticides during school hours or when school buildings and/or grounds are occupied, other than in exceptional circumstances.
- Ideally, treat with pesticide during school holidays.
- Otherwise, treat on Friday afternoon, when students and staff have left, or on weekends.

6.3 Pesticide application

- Thoroughly survey the area to be treated and implement any necessary safety measures, including signposting, before applying a pesticide.

> *Remember, it may be easier to replace some wooden equipment than to use a pesticide on it.*

- Localise treatment to as small an area as practicable for effective treatment
- If treating food preparation areas, make sure that all food and food utensils are removed or adequately covered.
- Remove any pets from the treatment area. Schools, particularly lower primary, may have fish, guinea pigs or birds. Be very careful to check where they are housed. (Fish are very sensitive to the synthetic pyrethroids)
- Do not treat where children have ready access, such as playground equipment and sandpits unless absolutely necessary (eg for red back spiders, which pose a bigger risk to children than pesticides).
- Read the label and follow the application directions, safety directions and precautions.
- Calculate and mix only the amount of chemical needed for the job.
- Wear protective clothing as indicated on the label.
- All persons not wearing appropriate protective clothing should be excluded from areas being treated.
- Do not spray in windy conditions when spray drift is likely.
- Pesticides should not be applied in ducts or near air-conditioning intakes. If this is unavoidable the air-conditioning must be turned off and all precautions must be taken to prevent solvents or pesticide being disseminated through the system when it is turned on again.
- Only use insecticides on those areas where insect pests shelter.
- Make sure all pesticides are well secured and out of reach of children. Don't leave unsecured pesticides unattended.

6.4 After the treatment

- Ensure that adequate time has elapsed before allowing people to re-occupy a treated area. Post warning signs and give instructions about ventilating the area before re-occupation.
- To ventilate the area, open all doors and windows and allow fresh air in for at least two hours, or turn on the air conditioning with maximum fresh air intake for at least two hours. (Ensure that the airconditioning system does not distribute affected air to other occupied areas during this time.)

> *Adequate ventilation is particularly important as the building will be securely locked after you leave and chemicals may not dissipate as you might normally expect.*

- Make sure there is adequate ventilation beneath floor boards when an organophosphate termiticide has been used to treat stumps.

APPENDIX 1 ~ How toxic are pesticides?

Safety assessment

Before a pesticide can be marketed in Australia, it must pass an extensive assessment process. Each pesticide is evaluated for its effectiveness against the pest species, and its safety for the environment and the human population. Special studies are carried out by the manufacturer and results are evaluated by agriculturalists and scientists employed by the government.

Safety assessment of pesticides is carried out using animals in toxicology studies. These studies examine how acutely and chronically toxic the pesticide is.

Some older chemicals did not undergo the same stringent and extensive testing procedures to which new chemicals are subjected. Consequently, the National Registration Authority is undertaking an extensive review of these chemicals and, where safety information is found lacking, the sponsor company is asked to provide it.

Acute toxicity

Hazards to health associated with short term exposure to high concentrations of pesticide are indicated by the results of studies on animals which measure the lethal dose, and which assess skin and eye irritation, and skin sensitisation.

Although the potential for skin and eye irritation is important when considering the acute toxicity of chemicals, pesticides are usually classed according to the results of the lethal dose studies. These studies identify the dose likely to kill half of the animals given the chemical. This dose is called the LD_{50} (LD_{50} stands for **L**ethal **D**ose in **50**% of animals). The classification and corresponding LD_{50} is given below. The higher the LD_{50} the lower the toxicity.

Warning on label	*Toxicity class*	*LD_{50} (mg/kg body weight)*
DANGEROUS POISON*	High toxicity	less than 50
POISON	Moderate toxicity	50 - 2000
WARNING or CAUTION	Low toxicity	2000 - 5000
No warning necessary	Very low toxicity	more than 5000

** In New Zealand, this is split into "Deadly" (less than 10) and "Dangerous" (10-50)*

Chronic toxicity

In chronic or long term studies, animals are given doses of the chemical every day for periods from a few months to their whole life. These studies examine effects on specific organs, on life expectancy, birth and fertility, and on offspring.

Other studies are also performed to identify any effects of the pesticide may have on DNA and genes, and to measure how much is absorbed and retained in the body.

The studies are designed to detect toxic effects, hence very high doses are used, usually referred to as the Maximally Tolerated Dose (MTD). The concentration of a pesticide in the body after a MTD is many times higher than the concentration that would be expected to occur in people if exposure occurred during pesticide application.

A complete toxicological profile of a chemical will identify the type of adverse effect, the target organs of toxicity, the extent of the adverse effects and the time at which they occur, and the consequences of the observed effects.

The studies also identify a dose level which does not cause any observed adverse effects to the test animal. A safe level for humans can then be estimated by using this No-Observed-Adverse-Effect-Level (NOAEL) and dividing it by a safety factor.

The safety factor is usually 100 and is included because it is assumed that humans are ten times more sensitive than animals, and that there is a tenfold variation in human sensitivity.

The safe level for humans, based on the NOAEL divided by 100 is called the Acceptable Daily Intake (ADI). This is the amount which, when taken into the body every day for a lifetime, is not expected to cause adverse health effects.

The ADI is usually only set for pesticides which are used on food producing crops or crops used for stock feed.

Chemicals which are not used in this way but for which there may be the potential for substantial human exposure are assigned a Tolerable Daily Intake (TDI) or Tolerable Weekly Intake (TWI) above which people should not be exposed. These are calculated in the same way as the ADI, but the different terms are used to avoid the implication that intake of non-food crop pesticides is 'acceptable'.

For example, arsenic trioxide is a pesticide used against termites but is not used on food crops. Arsenic is also a naturally occurring substance found widely in the environment. No ADI is set for arsenic but the World Health Organisation has set a TDI of 0.002 mg/kg body weight/day.

When pesticides are used properly, human exposure should be minimal. Exposure is not expected to exceed the ADI, and would normally be much lower.

If, through misapplication or accidental spillage, the ADI is exceeded, this does not mean that exposed people will necessarily be at risk. Each incident would need to be assessed on a case-by-case basis by considering the toxicity of the pesticide and the degree of exposure. In the majority of cases, it is expected that greater amounts than the ADI can be taken in without causing harm - provided this occurs only for a short time and the amounts are not high enough to cause acute effects.

The ADI values provide a simple way of comparing the safety of pesticides. Pesticides with low ADI values may be considered more dangerous or more likely to accumulate in the body than those with higher ADI values.

Since comparison by ADI values is based on long term exposure and since for most members of the public or school community, any exposure to pesticides will be only of short duration, acute toxicity provides a better indicator of the potential for harm.

APPENDIX 2 ~ Synthetic pyrethroid insecticide

Synthetic pyrethroid insecticides are similar in chemical structure to pyrethrins which are natural insecticides produced by Chrysanthemum flowers.

Pyrethrins extracted from Chrysanthemums have been used as insecticides for many years. Features of pyrethrins are lack of persistence in the environment, and a rapid "knock down" activity which kills insects quickly.

In the past, pyrethrins were expensive to produce and had poor stability in light, resulting in loss of activity during storage. Synthetic versions of the pyrethrins have now been made and these have the advantages of being more stable, cheaper to produce, and have stronger activity against insects. In modern products it is common for synthetic pyrethroids formulations to contain other chemicals which increase their activity. Such chemicals, for example piperonyl butoxide, are called synergists.

There are a number of different but related chemicals in the synthetic pyrethroid class. All act in the same way by interfering with nerve impulses. Many of the synthetic pyrethroids have been made to have particular properties. For example, some are intended to act particularly quickly to knock down flying insects; others are intended to be sprayed on to surfaces on which insects crawl, killing them some time after spraying.

Synthetic pyrethroids commonly used include:

Allethrin	α-Cypermethrin	Permethrin
Bifenthrin	Deltamethrin	Phenothrin
Bioallethrin	Esfenvalerate	Pyrethrin I
Bioresmethrin	Fenfluthrin	Pyrethrin Ii
Cismethrin	Fenvalerate	Resmethrin
Cyfluthrin	Fluvalinate	Tetramethrin
Cyhalothrin		

Like all pesticides, pyrethroids are toxic to humans and other mammals. However, they are far more toxic to insects (and fish). This is because mammals have particular enzymes which break down the synthetic pyrethroids into less toxic chemicals. Insects lack these enzymes and so the pyrethroids persist longer in their bodies and have greater effects on their nerves and other tissue. Because of this, these chemicals tend to have a large safety margin although this varies from pyrethroid to pyrethroid.

The safety margin is the ratio of the toxic dose in mammals compared to the toxic dose in insects. Some synthetic pyrethroids have very large safety margins. For example, the synthetic pyrethroid deltamethrin is 2500 - 5500 times more toxic to flies than it is to rats, and natural pyrethrum is 60 - 90 times more toxic to flies than rats. In comparison, the organochlorine insecticide DDT, which is no longer used in Australia, is only 11 time more toxic to flies than to rats.

Because synthetic pyrethroids are so much more toxic to insects, the amounts needed to control pests are generally too low to have any particular health risks for humans (provided they are used according to instructions on the label). This makes this class of pesticide the first choice in many situations, particularly in the home and in school buildings.

Although these chemicals are often the pesticides of choice for many pests, they are not always the most appropriate. Under some circumstances and against some pests, other types of pesticide may be preferred. It is therefore important to use the chemicals against only those pests included on the label. For large infestation or for infestations which are proving difficult to control, consult your pest management technician who will be able to advise on the most appropriate pesticide for the job.

APPENDIX 3 ~ Addresses and contact numbers (March 1997)

Poisons Information Centre

This is a national service and the Australia-wide 24-hour telephone number is **131126**.

Public Health Units

New South Wales

Environmental Health Unit, New South Wales Health Department,
PO Box 798, Gladesville. NSW 2111.
Phone: (02) 9816 0373 Facsimile: (02) 9816 0345

Victoria

Environmental Health Unit, Department of Human Services
GPO Box 4057, Melbourne. 3001
Phone: (03) 9616 7777 (switchboard)

Queensland

Drugs and Poisons Services, Environmental Health Unit, Queensland Health,
GPO Box 48, Brisbane. QLD 4001
Phone: (07) 3234 0938 Facsimile: (07) 3234 1480

Tasmania

Public and Environmental Health Branch, Department of Community and Health Services,
GPO Box 125B, Hobart. TAS 7001.
Phone: (03) 6233 3762 Facsimile: (03) 6233 6620

South Australia

Environmental Health Branch, Department of Human Services,
PO Box 6 Rundle Mall, Adelaide. SA 5000.
Phone: (08) 8226 7100 Facsimile: (08) 226 7102

Western Australia

Environmental Health Service, Health Department of Western Australia
PO Box 8172, Stirling Street, Perth. WA 6849.
Phone: (09) 388 4997 Facsimile: (09) 388 4975

Northern Territory

Environmental Health Branch, Territory Health Services,
PO Box 40596, Casuarina. NT 0811
Phone: (08) 8922 7340 Facsimile: (08) 8922 7200

ACT

Health Protection Service, ACT Department of Health & Community Care,
Frewin Place, Scullin. ACT 2614.
Phone: (06) 205 1700 Facsimile: (06) 205 1705

National Registration Authority - who licence the use of pesticides in Australia.

PO Box E240, Kingston. ACT 2604
Phone: (06) 272 5158 Facsimile: (06) 272 4753