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SpraySMART®

Chemical Training

Level 3: CHEMICAL ACCREDITATION

RESOURCE MANUAL - 2021

Name:

Always Read the Label

Enrolment Centre: Free call 1800 872 462

Compiled, written and edited by Dan Austin

Acknowledgements

This manual has been compiled from over 30 years of industry experience working with; FarmCare, ChemCert, SMARTtrain and TAFE as well as from many industry sources and publications.

SpraySMART
Trainer Services Pty Ltd T/A
National Training Resource
Eighth Edition – January 2021
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Trainer Services Pty Ltd

Introduction

Welcome from Trainer Services Pty Ltd. Trainer Services was set up by a group of dedicated industry professionals who felt there was need to provide customised courses for the different industry sectors.

Trainer Services Pty Ltd trades as Sydney Training Services and Rural Training Services providing the **SpraySMART** Course. The course is presented by dedicated industry professionals with their expertise relevant to the area they are training in.

The **SpraySMART** course complies with the relevant national competencies as required by ASQA and as developed after extensive industry consultation. Trainers may supplement this material to customise individual courses to meet local needs.

SpraySMART Full Accreditation: This course in presented to cover the nationally endorsed training standards for all users of pesticides and veterinary products. The units of competency covered are as follows:

- ✓ **AHCCHM307 Prepare and apply chemicals to control pest, weeds and diseases**
- ✓ **AHCCHM304 Transport and store chemicals**

Assessment: This course is presented in two parts: Assessment 1 is an online pre-course theory assessment which covers most of the foundation knowledge required to then undertake the practical component, Assessment 2 is carried out face to face and is the practical component of the course. All assessments are "open book" meaning that you can use all the resources you have i.e., course reference materials and class notes, to complete assessment activities. Calculators are permitted and you **MUST** return all assessment work books to your trainer at the end of the day for marking.

Accreditation: After successfully completing your initial **SpraySMART** training program you will receive a nationally recognised Statement of Attainment and our **SpraySMART** Card which is recognised by your state authorities as a license to apply chemicals. Both the certificate and card will show the units of competency you have successfully completed. The card is valid for 5 years after which you will need to be re-accredited. It will show the course completed, the year accredited, and the year accreditation is due for renewal, your name and accreditation number and the number of the Registered Training Organisation (RTO) who provided accreditation.

Up-Date Training: **SpraySMART** accreditation is valid for 5 years. Up-date training can be gained by, attending a face-to-face course, correspondence and on-line training. Contact your trainer or our enrolment centre for details.

How to use these resources

This manual has been developed to provide you with the latest information available at the time of printing. All resources are updated continuously with information coming from; industry, trainers, trainees and particularly trainee feedback forms so it is particularly important to fill these out honestly.

The manuals have been developed to flow continuously and logically so the need to *"flip back and forth"* when searching for answers has been minimised as much as possible. The assessments have been developed to follow the manuals in the same manner to reduce *"exam confusion"*.

These training materials have been developed with input from relevant state and federal authorities and the industry professionals at Trainer Services. There have been many others who have contributed, and their help has been greatly appreciated.

Chapter 1

LEGISLATION

"You MUST ensure that you are following the Acts/Regulations for the state/territory that you are working in"

Introduction

This chapter is intended to provide an overview of the relevant legislation that governs the use of pesticide in your state/territory. The intent is to provide the basic background knowledge that is required when using pesticides and to prompt the user to investigate further associated legislation that may affect the way in which they handle and apply pesticides in an urban environment in their own specific situation.

This chapter is NOT intended to be a comprehensive guide for the relevant legislation in your state/territory associated with the users work specific situation.

The information in this chapter is an outline only of the most common legal considerations with regard to the application of pesticides in urban environments. For more detailed legal information always contact your relevant local authorities.

Definitions

Legislation

The making of laws by governments. May be either Federal or State/Territory legislation.

Acts

A bill that has passed through the various legislative steps required for it and which has become law, as in "an Act of the Commonwealth of Australia." The same meaning as statute, legislation or law.

Regulations

Rules and administrative codes issued by government agencies at all levels, municipal, county, state and federal. Although they are not laws, Regulations have the force of law, since they are adopted under authority granted by statutes. They often include penalties for violations.

Duty of Care & Common Law

A fundamental principle of our legal system is the concept of "negligence".

Negligence means:

Under common law we have a **Duty of Care. This means we must carry out our activities in a safe, efficient and business-like manner, so as not to cause harm or injury to ourselves, to other people, animals, or the environment.** If we fail in our duty of care, we may be judged to be negligent.

Under common law, negligence means either doing something that a reasonable person would not do or failing to do something a reasonable person would do. (The courts have the task of deciding what a reasonable person would, or would not, do in a particular circumstance).

If as a result of negligence there is injury to another person or damage to property, the court can award damages against the person and/or the organisation that caused the injury or damage.

If a person is involved in an activity that requires special skills or knowledge, (and the use of chemicals clearly comes into this category), then negligence is not decided on how the 'ordinary person in the street' would act.

The common law requirement of a duty of care implies that in handling and using chemicals you must know what you are doing, and do it properly, or you could be sued for negligence.

Guide to Federal Legislation Relating to Registration of AgVet Chemicals

Both Federal and State/Territory governments regulate chemicals in Australia. The Federal government assesses all classes of chemicals and co-ordinates chemical management throughout Australia.

Registration of AgVet chemicals

The Federal body responsible for the assessment and management of agricultural and veterinary chemicals is the **Australian Pesticides and Veterinary Medicines Authority (APVMA)**. The APVMA is responsible for the evaluation, registration and review of agricultural and veterinary chemicals, and their control **up to the point of retail sale**.

Approved chemical labels will bear an APVMA Approval Number. Once the APVMA cancels the registration (de-registration) of an active constituent, there is generally **two years to use up existing stock**.

The major Federal Acts that have an impact on users of agricultural and veterinary chemicals are listed below

The States and Territories generally have responsibility for control-of-use activities after sale. This can include licensing of pest control operators and setting training standards for users of particular chemicals.

Codes of Practice

A 'Code of Practice' gives practical guidance in how to comply with legislation (Acts and Regulations).

Generally, an approved 'Code of Practice' contains various courses of action that are designed to achieve standards required by the Act or Regulations. Codes usually contain a number of options for meeting those standards.

The provisions in a Code are not mandatory. That is, a person may choose to comply with the relevant provision of an Act or Regulations in some other way, provided that the method used also fulfills the requirements of the Act or Regulations. **A person or company cannot be prosecuted simply for failing to comply with an approved Code of Practice.**

However, in legal proceedings, failure to observe a relevant approved Code of Practice can be used as evidence that a person or company has contravened or failed to comply with the provisions of the Act or Regulations.

There are many Codes of Practice that apply to agricultural operations in the various states and territories of Australia.

Examples of some Federal Codes of Practice

- Code of Practice for the Labeling of Workplace Hazardous Chemicals
- National code of practice for the control of workplace hazardous substances (NOHSC2007)
- Code of Conduct on the Distribution and Use of Pesticides
- Code of Practice on Safety in the use of Chemicals at work
- Preparation of Safety Data Sheets for Hazardous Chemicals
- **The Storage and Handling of Pesticides (AS 2507)**

Restricted Chemical Products

The APVMA may declare certain chemical products to be restricted chemical products (RCPs) if special training, and/or other requirements, are needed to be able to handle or use the chemical. Products that are declared to be RCPs can only be used by an "Authorised Person". The relevant State authority determines who may be considered as an "Authorised Person", based on advice from the APVMA following a risk assessment of the chemical product.

The APVMA may declare a product to be a restricted chemical product if:

- **The product may have an effect that is harmful to human beings.**
- **The product may have any unintended effect that is harmful to any animal, plant or thing or to the environment.**
- **Sspecial knowledge, skills/qualifications required in preparation/handling of the product.**
- **Any special equipment is required to use the product with safety.**
- **The APVMA has to certify in writing that it is in the public interest to declare a product. Legislation relating to RCP's is found in Part 4, Div 4 of the Agvet Code Act (1994).**

Currently Restricted Chemical Products

There are 12 chemical products or classes of chemical products which have been declared to be restricted chemical products in Schedule 4 of the *Agricultural and Veterinary Chemicals Code Regulations 1995*.

	Restricted Chemical Products
1	A chemical product containing ethylene dibromide (also known as EDB)
2	A chemical product containing 4-aminopropiophenone (also known as PAPP)
3	**A chemical product containing sodium monofluoroacetate (also known as 1080)**
4	A chemical product containing acrolein
5	A chemical product that is a pre-construction termiticide product containing bifenthrin
6	A chemical product that is a pre-construction termiticide product containing chlorpyrifos
7	A chemical product containing endosulfan
8	**A chemical product containing pindone** that is a concentrate and for which the relevant label instructions require further mixing with carriers before it is ready to use as a bait
9	A chemical product containing mevinphos
10	**A chemical product containing rabbit haemorrhagic disease virus (RHDV) (also known as rabbit calicivirus)** that is in injectable form and requires mixing with carriers such as oats or carrot before it is ready to use as a bait
11	A vertebrate pest control chemical product containing fenthion, alphachloralose or 4 aminopyridine
12	All chemical products with formulations containing, as active constituents, all 3 of the following in various chemical forms:(a) copper, (b) chromium, (c) arsenic

Using Restricted Chemical Products

Restricted chemical products may only be supplied to authorised persons.
A person must not supply a restricted chemical product, or cause or permit a restricted chemical product to be supplied, to a person who is not authorised to use the product under a relevant state or territory law (that is, a person who is not authorised by a relevant state or territory authority).

A restricted chemical product can be identified by the words on the product label:

RESTRICTED CHEMICAL PRODUCT
ONLY TO BE SUPPLIED TO OR USED BY AN AUTHORISED PERSON

Becoming an Authorised Person

The requirements for a person to become authorised to use a RCP may vary across the states and territories. For further information on state and territory control-of-use restrictions for RCPs, contact your relevant state or territory authority.

Jurisdiction	Department	Position
NSW	Environmental Protection Agency	Environment Protection and Regulation Group NSW Environment Protection Authority PO Box A290 SYDNEY SOUTH NSW 1232 P: 02 9995 5793 / 02 9995 5555 E:chemicals.regulation@epa.nsw.gov.au

Permits

The APVMA has a Permits Scheme in place that allows for the legal use of chemicals in ways different to the uses set out on the product label. These are often called 'off-label' permits. In certain circumstances, the limited use of an unregistered chemical may also be allowed by Permit.

In most States, registered products must only be used for those approved purposes that are specified on the label, in practice, situations often arise where chemicals are needed for a use not specified on the label.

Obtaining a permit requires the applicant to satisfy the same criteria as for registration. This requirement is to demonstrate that the chemical product is safe for people and the environment, that it will not affect our international trade through residue problems and is effective.

Types of Permits

Permits are of various types but the three most common are as follows:

- **Minor use permit -** for uses where no relevant registered products or use patterns exist because registering the use pattern would not produce an economic return.
  This is the most common permit for general use.

- **Emergency use permit** - supports primary producers during emergencies or impending emergencies, such as outbreaks of pests and diseases, by allowing the use of a chemical product or an active constituent if there is a genuine belief that the use is required because of the emergency.

- **Research permit** - assists in the development, through experiments, of new uses for products. Note that the APVMA does not issue permits to enable market research.

The permit will specify the exact situation(s) in which product(s) may be used.

Applying for a Permit

Any suitable person or organisation can apply for a permit. In cases where the majority of an industry requires the off-label use of a registered chemical, a representative industry association may be the most suitable permit holder.

The application form and more detailed information on using the Permits Scheme can be found on the APVMA web site: www.apvma.gov.au or by emailing enquiries@apvma..gov.au or obtained by phoning the APVMA on +61 2 6210 4701.

Permits are generally issued for a finite period which commonly ranges from 1 to 5 years. However, where no further data are required for renewal and the use pattern is unlikely to be promulgated to a registered product label the period may be longer.

There is no fee to obtain a permit for emergency use. **Minor use permits cost $350 and allow 3 months for approval**, depending on what modules are assessed (trade and residues, environmental safety, OH&S and efficacy and safety) You can also search existing permits online at: www.apvma.gov.au

Adverse Experience Reporting Program

At the time of registration, the APVMA assesses products for safety to humans, the environment, plants and animals, risks to international trade and for efficacy. Once a product is registered, it can be supplied and used. Occasionally, an unintended or unexpected harmful effect (injury, reaction or crop or environmental damage) occurs when a registered product is used according to label directions.

The APVMA has a program to consider adverse experience reports for registered pesticides and veterinary medicines submitted by product users, registrants and the general community.

Adverse experience reports provide important information for the APVMA to ensure that products used in Australia continue to be safe and effective, are of acceptable quality, are used in the best possible way, and that instructions and warnings on labels are appropriate.

What is an Adverse Experience?

An adverse experience is **"an unintended or unexpected effect on plants, plant products, animals, human beings or the environment, or lack of efficacy associated with the use of an agricultural chemical product when used according to label directions"**.

Examples include:

- **People affected by fumes when exposed to pesticides.**
- **Damage to neighbouring areas.**
- **Environmental damage.**

How do I Report an Adverse Experience?

You can use the form found at: www.aerp@apvma.gov.au or Alternatively, contact the APVMA by:

- Telephone (02) 62104806
- Write to: Adverse Experience Reporting Program
  APVMA PO Box 6182 Kingston ACT 2604

Please provide as much information as possible to help assess the incident.

WORK HEALTH AND SAFETY LAWS – National Harmonisation

Nationally harmonised Work health and Safety laws have been passed in six of the nine jurisdictions, and commenced in the NSW, ACT, Commonwealth, NT and QLD on **January 1, 2012**. Tasmania commenced the new laws in their state on January 2013.

Work Health and Safety Act 2011: Key Concepts

PCBU: A PCBU **(Person conducting a business or undertaking)**, previously known as employer or self-employed, must ensure the health and safety of its workers (or workers whose activities it directs or influences), while they are at work in that business, as far as is reasonably practical (AFARP).

Reasonably practical is defined as what could reasonably be done at the time to ensure health and safety, with respect to:

The likelihood of the hazard or risk occurring and the degree of harm it could cause;
What the business knows or ought to know concerning the workplace hazards and associated risk levels and potential control measures, either to eliminate or minimise the risks AFARP;

PCBU's must ensure the health, safety and welfare of their workers when at work by:

- ✓ Maintaining places of work under their control in a safe condition, and ensuring safe entrances and exits; i.e. implement risk management procedures.
- ✓ Ensuring the safe use, handling, storage and transport of plant and substances; i.e. supply safety equipment.
- ✓ Providing and maintaining safe systems of work and working environments without risks to health; i.e. implement safety programs.
- ✓ Providing the instruction, training and supervision necessary to ensure the health and safety of workers; keep training records that highlight reaccreditation dates.
- ✓ Providing adequate facilities for the welfare of workers.
- ✓ Ongoing consultation with workers, whereby workers can elect a health and safety representative (HSR), request the formation of a Health and Safety Committee (HSC) and cease unsafe work.
- ✓ Reporting accidents to Workcover i.e. Record Keeping (incident reports) especially where there is a fatality, serious injury or dangerous incident.
- ✓ Notify Workcover where hazardous chemicals exceed manifest quantities at a workplace.

Hazardous Substances (transition to Workplace Hazardous Chemicals)

PCBU's - Must:

- ✓ Carry out risk management for each hazardous substance.
- ✓ Keep a register (manifest) of all hazardous substances.
- ✓ Keep the relevant SDS for each hazardous substance.
- ✓ Provide health surveillance for workers exposed to hazardous substances.
- ✓ For Organophosphates (OP's) surveillance should include the workers occupational & medical history, a physical examination and a comparison of red cell and plasma cholinesterase activity at the end of a working day with baseline estimations.

Plant and Machinery

Items of plant and machinery such as mowers also fall under the WHS Act 2011 with a requirement for:

- ✓ Hazard identification, risk management and control.
- ✓ Training.
- ✓ Record keeping, maintenance schedules etc.

Workers - Must not:

- ✓ Interfere with or misuse things provided for the health, safety or welfare of persons at work.
- ✓ Obstruct attempts to give aid prevent a serious risk to the health and safety of others.
- ✓ Refuse a reasonable request to assist in giving aid or preventing a risk to health and safety.
- ✓ Disrupt a workplace by creating health or safety fears.

And must:

- ✓ Use safety equipment and obey safety procedures.
- ✓ Report risks to management.
- ✓ Workers must take reasonable care of the health and safety of themselves and others.
- ✓ Workers must co-operate with PCBU's in their efforts to comply with workplace health and safety health and safety requirements.

Due Diligence

The WHS Act 2011 clearly defines what officers are expected to do in order to exercise due diligence.
S 27 of the Act states: due diligence includes taking reasonable steps:

- ✓ to acquire and keep up-to-date knowledge of work health and safety matters.
- ✓ to gain an understanding of the hazards and risks associated with business operations.
- ✓ to ensure the business or undertaking has available for use, and uses, appropriate resources and processes to eliminate or minimise risks.
- ✓ to ensure that the person conducting the business or undertaking has appropriate processes for receiving and considering information regarding incidents, hazards and risks and responding in a timely way to that information.
- ✓ to ensure the business or undertaking has, and implements, processes for complying with any duty or
- ✓ obligation of the PCBU under the Act, and to verify the provision and use of the above resources and processes.

Worker

A Worker: a broader term that replaces employee and includes contractors or subcontractors, outworkers, employees of labour hire companies and volunteers.

- ✓ Take reasonable care for his/her health and safety persons.
- ✓ Take reasonable care that his or her acts or omissions do not adversely affect the health and safety of other persons as reasonably able comply with the law.
- ✓ Comply, so far as reasonably able, with any reasonable instruction that is given to them by the PCBU to allow the PCBU to comply with the law.

Consultation

A PCBU must so far as is reasonably practical, consult with workers who carry out work for them.
Section 48 of the WHS Act 2011 outlines the following requirements:

- ✓ Relevant information about the matter must be shared with workers; and
- ✓ Workers must be given the opportunity to: express their views and raise work health and safety issues; and contribute to the decision-making process.
- ✓ Views of workers are taken into account by the PCBU; and
- ✓ Workers are advised of the outcomes; and
- ✓ If the workers consulted are represented by a Health and Safety Representative (HSR) that person must be involved in the consultation. Elected Health and Safety Representatives (HSR) can issue Provisional Improvement Notices (PIN)'s under certain conditions.

Reversal of Onus of Proof

The burden of proof (beyond reasonable doubt) rests entirely upon the prosecution in matters relating to non-compliance with duties imposed by the Act.
Prosecutors must prove all matters relating to non-compliance with duties of care, including whether a PCBU failed to do what was 'reasonably practicable' to ensure the health and safety of workers, **therefore a PCBU is innocent until proven guilty of failing in their duty of care.**

Work Health and Safety Regulation 2011 and Codes of Practice

- ✓ Labelling of Workplace Hazardous Chemicals in line with Globally Harmonised System.
- ✓ Preparation of Safety Data Sheets for Hazardous Chemicals.
- ✓ Managing Risks of Hazardous Chemicals.

Rather than mandating risk assessments the act now has a greater focus on putting in place the appropriate risk controls (Hierarchy of controls), as opposed to paperwork requirements. Hazardous Substances and Dangerous Goods enveloped together as **Workplace Hazardous Chemicals.**

NSW LEGISLATION

Pesticides Act 1999 No. 80

The main legislation governing the use of agricultural and veterinary chemicals in New South Wales is the Pesticides Act 1999 No 80. The administration of this Act is the responsibility of the Office of Environment & Heritage (OEH) through the NSW Environment Protection Authority.

The NSW Pesticides Act 1999 regulates and controls the use of pesticides in NSW. It applies to both urban and agricultural situations. The Act aims to reduce the risks to human health, the environment, property, industry and trade associated with the use of pesticides. The Act also aims to promote collaborative and integrated policies for the use of pesticides.

Under the Act, all pesticide users in NSW must:

- ✓ **Read the approved label and/or APVMA permit for the pesticide product (or have the label/permit read to them) and strictly follow the directions on the label.**
- ✓ **Only use pesticides registered or permitted by the APVMA.**
- ✓ **Obtain an APVMA permit if they wish to use a pesticide in a way not covered by the label.**
- ✓ **Only keep registered pesticides in containers bearing an approved label.**
- ✓ **Prevent injury to people, damage to property and harm to non-target plants and animals through the use of a pesticide.**

Pesticide Training

Compulsory training provisions were introduced on 1 September 2003 for anyone who uses pesticides in their business or undertaking. Most users are expected to achieve specific national units of competency in chemical use at AQF Level 3. Separate training requirements apply for aerial applicators of pesticides and pest management technicians (pest controllers) and fumigators licensed by EPA NSW.

Occasional Use Exemption

You can apply pesticides occasionally as part of agricultural or forestry operations without training if you are directly supervised by a person who has been trained. 'Occasional' is defined as pesticide use on no more than 12 days in the previous 12 months.

For this exemption to apply

I. the person supervising you must be trained and hold a relevant qualification under the Pesticides Regulation 2018.
II. the person supervising you must select the pesticide, prepare it for use, calibrate and test the equipment and instruct you on how to apply the pesticide
III. you must only apply the pesticide using hand-held and hand-powered equipment, for example, if you are using a backpack and hand applicator to spot-spray weeds

You must not regularly use pesticides as part of agricultural and forestry operations under this exemption.

Record Keeping

Compulsory record keeping requirements were introduced in July 2002.

Records of pesticide application must be made within 48 hours and be kept for three years.

The penalty notice for failing to make a record of pesticide use, as well as making a false or misleading statement in a record is $750 for individuals and $1500 for corporations, effective September 2009.

Notification of Pesticide Use

Compulsory notification requirements were introduced in February 2007.

Since February 2007 it has been compulsory for the following groups to give notice of pesticide use:

- Public authorities, including NSW Government departments, local councils and county councils need to develop a **Pesticide Notification Use Plan** describing how they will provide the public with notice about their pesticide use in outdoor public places, such as parks and ovals, and near sensitive places, such as schools and nursing homes.

Ways of Notifying the Public can include:

1. **Signs placed at the main entrances to the treatment area.**
2. Advertising in the local paper prior to commencement of the treatment.

Further NSW legislation associated with the use of pesticides:

- **Protection of the Environment Operations Act 1997 (POEO Act)** provides key mechanisms for protecting the environment and improving environmental outcomes in NSW. The POEO Act contains a range of offenses and enforcement powers. It provides a regulatory regime for pollution and waste management including pesticides. For example, fish kills caused by pesticides are investigated under the POEO Act.
- **Dangerous Goods (Road and Rail Transport) Act 2008** allows both OEH and WorkCover NSW to regulate the transport of dangerous goods (other than explosives) by road and rail as part of a national scheme for road transport. Approximately 1 in 20 pesticides are classified as dangerous goods.
- NSW has adopted the nationally harmonised Work Health and Safety Act 2011.

Other NSW legislation includes Acts and Regulations that cover:

The Stock Medicines Act 1989
The Rural Lands Protection Act 1998
The Prevention of Cruelty to Animals Act 1979

NEW SOUTH WALES (NSW) Legislation concerning on farm Fumigation

Phosphine is listed as a fumigant under the NSW Occupational Health and Safety Regulation 2001. Its use in NSW requires appropriate qualifications and a EPA NSW Fumigator Certificate of Competency.

However, EPA NSW issued an exemption from the need for a Fumigator Certificate of Competency to use aluminium-phosphide tablets by hand to control stored grain and vertebrate pests, only for on-farm use within the rural industry and this exemption is subject to the conditions specified below. This exemption has been extended and is still current until rescinded.

The controller of premises where fumigants (aluminum phosphide tablets) are used shall:

1. Ensure that fumigants are only used by persons authorised by him or her and that the authorised person must not be less than eighteen (18) years of age.
2. Meet the requirements of the Pesticides Regulation 1995.
3. Attain competency in the relevant state or territory legislation.
4. Complete additional training in the on-farm safe use and handling of fumigants (aluminum phosphide tablets) where applicable.
5. Instruct those persons in the safe use of fumigants and ensure that any hazards identified with such use have been assessed and adequately controlled and those persons are advised of the controls.
6. Be satisfied those persons can be relied upon to use fumigants without placing the health and safety of themselves or others at risk.
7. Ensure those persons are made aware of the application and limitations of this exemption order.

OTHER STATES LEGISLATION

QUEENSLAND (QLD) - includes but is not limited to the following:

1: **Agricultural Chemicals Distribution Control Act 1966**
The Act controls the application of agricultural chemicals from aircraft and specifically the ground application of herbicides through licensing of businesses and operators.
a) any person who applies agricultural chemicals to land which they do not own (commercial operator) using powered equipment will be required to hold an ACDC license. To obtain this you must complete a level 3 Chemical Safety course plus a Control Weeds course. Take the Statement of Attainment for both to Biosecurity and apply for the ACDC license.
b) There is also a provision for further controls of use of herbicides in designated "hazardous areas". These are: Sunshine Coast, Toowoomba Eastern Darling Downs and Emerald and surrounding areas. In these areas' restrictions nominate the herbicides or forms of them which are prohibited.
c)The Act outlines the types of records you need to make and keep for ground distribution. **All records made under Section 26 of the Act must be kept for at least 2 years.**
2: Chemical Usage (Agricultural and Veterinary) Control Act 1988 (Chemical Usage Act)
3: Stock Act 1915
4: Environment Protection Act 1994
5: Great Barrier Reef Protection Amendment Act 2009
6: Transport Operations (Road Use Management Dangerous Goods) Act 1999

VICTORIA (VIC) - includes but is not limited to the following:

1**: Agricultural and Veterinary Chemicals (Control of Use) Act 1992**
Under this Act users of chemical products must obtain an Agricultural Chemical Users Permit (ACUP) to apply certain Restricted Chemicals. **If you apply these chemicals, you must keep a record of the application for at least 2 years and make the record with 48 hours of application.**

ACUP is a ten-year permit, which is required to use a range of chemical products with endorsements required for each of the following:
a)" restricted use" chemicals, b) gaseous products containing methyl bromide or phosphine, c) pindone concentrate for the preparation of poison bates, d) products containing 1080
2: Road Transport (Dangerous Goods) Act 1995
3: Environment Protection Act 1070

SOUTH AUSTRALIA (SA) - includes but is not limited to the following:

1: Agricultural and Veterinary Products Act 2002 (Control of Use) & Regulations 2004
a) Records must be kept by Pest Management Technicians (contractors) for 7 years.
2: Livestock Act 1997
3: Controlled Substances Act 1984

WESTERN AUSTRALIA (WA) - includes but is not limited to the following:

1: The Health Act 1911 and the Health (Pesticides) Regulations 2011.
The regulations provide for the licensing and operation of commercial pest controllers and crop spraying contractors. **Records must be kept for 3 years.**
2: Dangerous Goods Safety Act 2004 (WA) and Regulations 2007.
3: Aerial Spraying Control Act 1966

NORTHERN TERRITORY (NT) - includes but is not limited to the following:

1: Agricultural and Veterinary Chemicals (Northern Territory) Act 1995
a)If applying chemicals for a fee you must be licensed by the DoR (applicators license) To obtain a license you must complete a Level 3 Chemical safety Course and take the Statement of Attainment to the department of resources to apply for an Applicators License. **Application records must be kept for 2 years.**
2: Poisons Act 2001
3: Dangerous goods Act 2004 and Dangerous Goods (Road & rail Transport) Act 2003

TASMANIA (TAS)- includes but is not limited to the following:

1: Agricultural and Veterinary Chemicals (Control of Use) Act 1995 supported by:
a) Code of Practise for Aerial Spraying and Code of Practise for Ground Spraying
b) If you provide pest, disease or weed control services for a fee or reward, you must hold a Commercial Operator License issued by the Registrar of Chemical Products.
2: Dangerous Substances (Safe Handling) Act 2005 &: Animal Health Act 1995
3. **There are presently no mandatory requirements to keep records other than best practice.**

AUSTRALIAN CAPITAL TERRITORY (ACT) - includes but is not limited to the following:

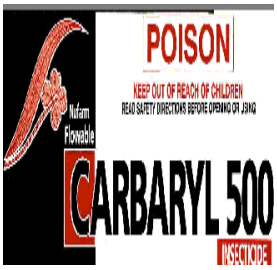
1: Environment Protection Act 1997.
2: Dangerous Goods (Road Transport) Act 2009.
3: There are currently no timeframe requirements for record keeping. The intention is to adopt a few of the national AgVet reforms, including record keeping. It is intended that records will have to be made within 48hours and kept for 2 years. Current advice is to follow best practice and that the ACT copies NSW requirements.

Chapter 2

THE PRODUCT LABEL

&

SAFETY DATA SHEET



"ALWAYS READ THE LABEL"

Introduction

LABELS ARE LEGALLY BINDING DOCUMENTS – ALWAYS READ AND FOLLOW ALL LABEL INSTRUCTIONS BEFORE USING THE PRODUCT.

A LABEL IS YOUR PRIMARY RISK MANAGEMENT DOCUMENT WHEN USING CHEMICALS

Regulations for pesticide use vary between states and territories, therefore pesticide users should follow the instructions on the product label for several important reasons.

The information on pesticide labels is based on rigorous scientific testing and independent assessments and is approved at the national level by the **Australian Pesticides and Veterinary Medicines Authority (APVMA)**. The instructions on the label ensure that the pesticide is effective, safe to use, will not harm the environment and will not pose a risk to trade.

Efficacy

- All pesticide have to be scientifically tested to prove that they control the weeds, pests or diseases in the crops and situations as specified on the label.
- Trials that follow APVMA guidelines are evaluated by relevant government departments as well as by private consultants to determine whether or not the trial evidence supports the use patterns specified on the label
- The application rates that give effective pest control are determined scientifically.

Effects on human health

- All pesticides registered for use in Australia are rigorously tested to ensure they are safe for people, animals, plants and the environment.
- The Therapeutic Goods Administration assesses the toxicity of the concentrate and determines the Poisons Schedule and the First Aid Instructions
- Because people, animals and the environment can be exposed to agricultural chemicals, the risks must be managed, and these are addressed on the product labels.
- **As long as the instructions on the label are followed, pesticides are safe to apply, safe to handle and transport.**

Effects on the environment

- The risk of potential environmental or off-target impacts, such as spray drift or runoff into waterways, is assessed independently before a pesticide can be marketed, and appropriate risk management instructions are included on the label.
- **When applying pesticides, it is important to follow the label instructions to avoid any unintended environmental impacts.**

Effects on trade

- The label includes advice on how to minimize any residues arising from incorrect application of the pesticide. The APVMA determines Withholding Periods (WHPs) in relation to MRLs (maximum residue limits). If an MRL poses a health risk, then the WHP is extended or the use pattern deleted from the label.
- Food is monitored for pesticide residues to ensure it is safe and pesticides have been used correctly, but if unacceptable residues are found, the food could be banned, and the pesticide traced back to the source for corrective action.

To gain registration before a product can be sold, manufacturers must draft and print product labels in accordance with a national code of practice on labeling issued by the Australian Pesticides & Veterinary Medicines Authority (APVMA). This Code incorporates the labeling requirements of all the government agencies that are involved in the registration process.

It is illegal in most states, to use the product other than in the manner as specified on the label for that state.

In some situations, the product can be used other than as specified on the label. In these situations, a **permit** must be obtained from the APVMA. The types of permits that can be obtained are:

1. Minor Use
2. Emergency
3. Trial

The following label example reproduces a typical product label format in accordance with the Ag Labeling Code. All pesticides follow the same basic format.

GREENWAY
TURF SOLUTIONS

ABOUT GREENWAY TURF SOLUTIONS

Greenway Turf Solutions (GTS), is an exciting and innovative agronomic focused supplier of specialty products and services to the professional turf industry.

An agronomic framework is applied to each influencing factor to improve turf health. At GTS we work with our clients to develop management programs to deliver the best results within budgetary constraints.

The GTS Team is made up of qualified agronomists and turfgrass managers providing the highest standard of scientifically based advice in the turf market.

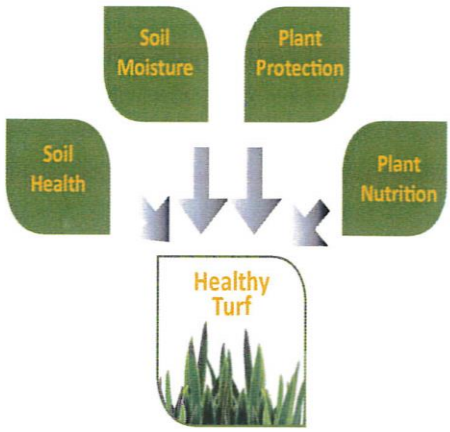
CONTACT DETAILS

NSW Contact
Lee Falappi - Turf Consultant
0466 288 919 | E: leef@greenwayturfsolutions.com

National Office
3/118 Lahrs Road Ormeau, QLD 4208
P 07 5546 6623 | E: admin@greenwayturfsolutions.com

www.greenwayturfsolutions.com

At GTS we believe in a holistic approach to turf management



GTS brings to the market unparalleled service and support of a complete range of turf management products.

CAUTION

KEEP OUT OF REACH OF CHILDREN
READ SAFETY DIRECTIONS BEFORE OPENING OR USING

Pest A Side

Systemic Insecticide

ACTIVE CONSTITUENTS: **350 g/L PIEREEFRUM**
250 g/L ROGORE
(an anti-cholinesterase compound)
SOLVENT: **400 g/L LIQUID HYDROCARBONS**

GROUP	3D	INSECTICIDE

For the control of certain insect pests in pasture and turf areas, commercial and industrial areas and non-crop areas.

READ THE COMPLETE DIRECTIONS BEFORE USING THIS PRODUCT

Contents 20 Litres

Pest Aside is a registered trademark of AKMEE Chemicals Pty Ltd
124 Roadrunner Rd Coyoteville NSW 1234
Emergency Contact No. Phone: 1800 123 456
Web: www.pestasyde.com.au

APVMA Approval No. 12345/20/0813

THIS LABEL IS ONLY INTENDED TO BE USED FOR TRAINING PURPOSES.

DIRECTIONS FOR USE

RESTRAINTS: General

DO NOT spray if rain is expected within 4 hours of application.
DO NOT apply to legume pastures
DO NOT apply when wind speed is less than 3 or more than 20 kms/hr as measured at the application site.
DO NOT apply above 30°C or during temperature inversion conditions at the application site

SPRAY DRIFT RESTRAINTS

Ground application: **DO NOT** apply with spray droplets smaller than a **MEDIUM** spray droplet size category according to nozzle manufacturer specifications that refer to the ASAE S572 Standard or the BCPC Guideline.

MANDATORY NO SPRAY ZONES

DO NOT apply if there are livestock, pasture or any land that is producing feed for livestock downwind from the application area and within **the mandatory no-spray zones** shown in Table 1 below.

Table 1: No-Spray Zones for Protection of the Aquatic Environment	
FOR GROUND APPLICATION: HAND & BOOM APPLICATIONS	
Wind Speed Range at Time of Application	**Downwind Mandatory No-Spray Zone**
3 to 20 kilometres per hour	50 metres
FOR AERIAL APPLICATION	
3 TO 8 kilometres per hour	550 METRES
9 TO 20 kilometres per hour	600 METRES

For additional detailed information on spray drift management refer to the **APVMA's Drift Policy: Operating Procedures in Relation to Spray Drift Risk.** Published 15 July 2008.

SITUATION or CROP	**INSECTS**	**STATE**	**MIXING RATE**			**CRITICAL COMMENTS**
			Backpack	**Tank**	**Boom**	
			Per 15lts	**Per 100lts**	**Per Hectare**	
Pastures Turf Horticulture	Diamondback moth Cabbage white butterfly Caterpillars	All states	100ml	450ml	6.5L	Apply to young active insects and moist soil. DO NOT mow turf for 2 days before or after application or fertilise within 2 weeks of spraying.
Non-Crop Situations	Cluster caterpillar Army worm	NSW, Qld, SA, WA only	80ml	350ml	5L	A repeat spray may be necessary

NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION

WITHHOLDING PERIOD:

DO NOT GRAZE OR CUT FOR STOCK FOOD FOR 7 DAYS AFTER APPLICATION.

GENERAL INSTRUCTIONS

For best results the insect should be active at the time of treatment.

Complete insect death may take up to 2-3 days. Faster results can be expected on younger insects.

INSECTICIDE RESISTANCE WARNING

GROUP	3D	INSECTICIDE

Pest Aside systemic insecticide is a Group 3D insecticide. Some naturally occurring insect biotypes resistant to Pest Aside and other Group 3D insecticides may exist through normal genetic variability in any insect population. The resistant individuals can eventually dominate the insect population if these insecticides are used repeatedly. These resistant insects will not be controlled by Pest Aside or any other Group 3D Insecticides. Since the occurrence of resistant insects is difficult to detect prior to use, AKMEE PTY LTD accepts no liability for any losses that may result from failure of Pest Aside to control resistant insects.

MIXING

Mix and load on a flat area, only mix the required amount of Pest Aside sufficient for each day's work.
Add the label rate of Pest Aside to potable water when the tank is half full tank and hen finish filling the tank, agitate the mix well before application. If allowed to stand for any length of time agitate again thoroughly before use.
Surfactants (if used) should be added after Pest Aside and water are mixed when the spray-tank is almost full.
Tank Mixing different products: DO NOT mix concentrates together prior to adding to tank. Add each to tank separately.

APPLICATION

BACKPACK APPLICATION: A **15lt backpack** will treat approx. **150-250** square metres.
HIGH VOLUME APPLICATION: Handgun application will use 900-1500L per hectare.
BOOM APPLICATION: Apply by a properly calibrated boom spray using not less than 50L per hectare unless otherwise indicated in the critical comment's column.
NOTE: Best results will occur if applied to young wingless insects. A temporary browning off of the treated turf may occur soon after application or if applied to stressed plants.

CLEANING SPRAY EQUIPMENT:

THOROUGHLY CLEAN ALL APPLICATION EQUIPMENT AFTER USE. Rinse water should be discharged onto a designated disposal area or if unavailable onto unused land away from desirable plants and watercourses.

COMPATABILITY

No information is available that indicates physical compatibility with other products. Tank-mixing other products with Pest Aside cannot therefore be recommended. As formulations of other manufacturers' products are beyond the control of AKMEE Pty Ltd, all mixtures should be tested prior to mixing commercial quantities.

GENERAL INSTRUCTIONS (continued)

RE-ENTRY PERIOD

DO NOT allow entry into treated areas for 24 hours after application. If prior entry is necessary, wear PPE as specified on the label.

PROTECTION OF WILDLIFE, FISH, CRUSTACEA AND ENVIRONMENT

Dangerous to fish and other aquatic life.
Toxic to bees, DO NOT apply while bees are actively foraging.
DO NOT contaminate streams, rivers or waterways with the chemical or used containers.

PROTECTION OF CROPS, NATIVE AND OTHER NON-TARGET PLANTS:

DO NOT apply under weather conditions or from spraying equipment that may cause spray to drift onto nearby susceptible plants/crops, cropping lands or pastures. Spray drift from Pest Aside application may cause injury to herbaceous plants, vegetables, fruit crops, vines, ornamentals and trees.

STORAGE AND DISPOSAL:

KEEP OUT OF REACH OF CHILDREN. Store in the closed, original container in a dry, cool, well-ventilated area out of direct sunlight. Do Not store with food or feedstuffs. Triple or preferably pressure rinse containers before disposal. Add rinsing water to the spray tank. Do not dispose of undiluted chemicals on-site. If recycling, replace cap and return clean containers to recycler or designated collection point. If not recycling, break, crush, or puncture and bury empty containers in a local authority landfill. If no landfill is available, bury the empty containers below 500mm in a disposal pit specifically marked and set up for this purpose clear of waterways, desirable vegetation and tree roots. Empty containers and product should not be burnt.

SAFETY DIRECTIONS:

Harmful if swallowed. Will damage eyes. Will irritate skin. Avoid contact with eyes and skin. If product in eyes, wash it out immediately with water. Wash hands after use.

1. **When opening the container and mixing the spray, wear cotton overalls buttoned to the neck and wrist, face mask, elbow-length PVC gloves and goggles.**
2. **When using the mixed spray use elbow length PVC gloves and goggles.**

After each day's use wash gloves, goggles and contaminated clothing.

FIRST AID:

If poisoning occurs, contact a doctor or **Poisons Information Centre 13 11 26**.

SAFETY DATA SHEET:

Additional information is listed in the Safety Data Sheet which can be obtained from the supplier.

SPILL MANAGEMENT:

Minor Spills – Prevent runoff into waterways. Use a Spill Kit or Contain spill with sand or earth, contain collected material in a sealed plastic bag. Contact ChemClear for disposal.

Major Spills – Contact Fire Brigade – Hazmat Unit and the manufacturer for specific emergency procedures.

PESTICIDE, LIQUID, FLAMMABLE, TOXIC, N.O. S	
UN No. **1234**	Packing Group **PG III**
Hazchem **3WE**	
IN EMERGENCY **DIAL 000** **POLICE or FIRE BRIGADE**	

DOM: 14/06/2013 EXP: 14/06/2023 Batch No. ABC12345

1	COARSE SPRAY		
2	FINE SPRAY		
3	FOAM		
4	DRY AGENT		
•	ALCOHOL RESISTANT FOAM		
P	V	LTS	DILUTE
R			
S	V	BA & FIRE KIT	
T			
W	V	LTS	CONTAIN
X			
Y	V	BA & FIRE KIT	
Z			
E	PUBLIC SAFETY HAZARD		

DRY AGENT
Water must not be allowed to come into contact with the substance at risk.

ALCOHOL RESISTANT FOAM .2 OR .3
Alcohol resistant foam is the preferred medium. If not available:
- If .2 – use Fine Spray or Water Fog
- If .3 – use Normal Protein Foam

V
Substance can be violently or even explosively reactive, including combustion.

LTS
Liquid – Tight Chemical Protective Suit with (breathing apparatus). Full **FIRE KIT** should also be worn for thermal protection if the substance is: Liquid Oxygen **OR** Liquified Toxic Gas (Division 2.3), **OR** Toxic Gas with sub-risk 2.1 or 5.1 OR Class or sub-risk 3 **OR** Division 5.1 PGI with sub-risk 6.1 or 8 **OR** carried at temperatures > 100°C.

DILUTE
May be washed to drain with large quantities of water.

E
People should be warned to stay indoors with all doors and windows closed – but evacuation may need to be considered.

Source: WorkCover NSW

Parts of the Label

The product label is the most important source of information about pesticides. It is a legally binding document and your primary risk management document.

The label is made up of several areas which are all important for proper use of the chemical. Following is detailed information on the main parts of the sample pesticide label.

1 - SIGNAL HEADING

The signal heading is the most prominent indicator of hazard on the label. It indicates the level of toxic hazard associated with handling the concentrated product and the potential danger to those exposed to the concentrated product if it is used contrary to label instructions.

The signal heading is based on the Poisons Schedule classification of the product. These schedules are set by the Commonwealth Government and adopted under the State Poisons legislation. Products are placed into a Poisons Schedule based on consideration of a number of complex factors including the toxicity profile, the purpose of use, potential for abuse, safety in use and the need for the substance.

Poison Schedules

The Poisons Standard, previously the SUSDP has been renamed the SUSMP, that is the Standard for the Uniform Scheduling of Medicines and Poisons. The Poisons Schedule classification is determined following extensive review of the toxicology of the active constituent, its concentration, the product formulation type (e.g. emulsifiable concentrate, powder, granule) and any other ingredients, particularly solvents, which may be included in the product.

Other than Schedule 4, which is for prescription animal medicines, the higher the schedule number the greater the potential hazard presented by the product. The signal heading words enable recognition and comparison of products in terms of the level of hazard they present to users.

CAUTION (Warning) (SCHEDULE 5)

- Low to moderate hazard.
- May cause minor injury to humans in normal use.
- Unlikely to cause fatal poisoning
- Take care in handling, storage and use

POISON (SCHEDULE 6)

- Moderate to high hazard
- May cause severe injury if ingested, inhaled or in contact with the skin
- Low risk of fatal poisoning
- Take care in handling, storage or use

DANGEROUS POISONS (SCHEDULE 7)

High to extremely high hazard
Can cause death or severe injury at low exposures

Depending on State/Territory can be purchased and used by people who are trained in chemical use. Take extreme care in handling, storage and use. Personal Protective Equipment required
DO NOT use in the home or garden

Signal Heading	Poison Schedule	Level of toxic hazard	Acute Oral LD_{50} (Rats) mg/kg Bwt	Acute Dermal LD_{50} (Rats) mg/kg Bwt
Not required READ SAFETY DIRECTIONS BEFORE OPENING OR USING	**Unscheduled** (not toxic enough to be scheduled as a poison)	**Very Low**	> 5000	
PHARMACY MEDICINE READ SAFETY DIRECTIONS BEFORE OPENING OR USING	Schedule 2 S2	Various Available off the shelf from pharmacies		
PHARMACIST ONLY MEDICINE READ SAFETY DIRECTIONS BEFORE OPENING OR USING	Schedule 3 S3	Various ONLY available from the pharmacist in person		
PRESCRIPTION ONLY MEDICINE **PRESCRIPTION ANIMAL REMEDY** KEEP OUT OF REACH OF CHILDREN READ SAFETY DIRECTIONS BEFORE OPENING OR USING	**Schedule 4** **S4**	**Various** ONLY available on prescription		
CAUTION KEEP OUT OF REACH OF CHILDREN READ SAFETY DIRECTIONS BEFORE OPENING OR USING	**Schedule 5** **S5**	**Low** Handle with caution	2000 to 5000	> 2000
POISON KEEP OUT OF REACH OF CHILDREN READ SAFETY DIRECTIONS BEFORE OPENING OR USING	**Schedule 6** **S6**	Moderate to **High** Poisonous	50 to 2000	200 to 2000
DANGEROUS POISON KEEP OUT OF REACH OF CHILDREN READ SAFETY DIRECTIONS BEFORE OPENING OR USING	**Schedule 7** **S7**	High to **Very High** Highly Poisonous	50 or less	200 or less
CONTROLLED DRUG	Schedule 8 S8			
PROHIBITED SUBSTANCE	Schedule 9 S9			
Substances of such danger to health as to warrant prohibition of sale, supply and use	Schedule 10 S10 (previously App C)			
The Poisons Standard Oct 2018: This Standard lists poisons in ten Schedules according to the degree of control recommended to be exercised over their availability to the public.				

2 - TRADE NAME / DISTINGUISHING NAME

The trade name is the proprietary or common name under which the product is marketed and may be protected under Patents and Trademark legislation.

There can be many trade names for the same active constituent.

The distinguishing name may include a trade name but includes other words or phrases that distinguish the product from all others and identify its use e.g. Pest Aside® Systemic Insecticide.

3 - PESTICIDE GROUP

The general group of pesticides the product belongs to. All products in the group provide the same type of control.

4 - ACTIVE CONSTITUENT

The active constituent is the biologically active component of the product. It is the only part of the formulation that is active on the targeted pest. All active constituents are listed on the label and the concentrations usually expressed in grams per kilogram (g/kg) or grams per litre (g/L). When the substance present is a scheduled poison, the chemical name must be in capitals and boldface type e.g.

350g/L PIEREEFRUM
250 g/L ROGORE

Certain solvents which are present in the product at prescribed levels designated by Health Authorities are also specified on the label immediately below the active constituent and must be in capitals and bold face type. For example, a combined active constituent/solvent statement could appear on a label as:

ACTIVE CONSTITUENTS:	**350 g/L PIEREEFRUM**
	250 g/kg ROGORE
	(an anti-cholinesterase compound)
SOLVENT:	**400 g/L LIQUID HYDROCARBONS**

5 - MODE OF ACTION CODE

In order to help in the management of resistance, all products sold in Australia are grouped by mode of action. The mode of action for pesticides is indicated by a letter/number code on the product label. The identification symbol allows users to distinguish between similar products with different modes of action. This symbol should be visible at the point of sale and should be on the main (front) panel of all pesticide labels (except home garden products).

The mode of action labeling is based on the resistance risk of each group. Australia was the first country to introduce mode of action labeling and is still the only country where mode of action labeling is compulsory. Herbicides are indicated alphabetically (A-Z), insecticides are indicated numerically with an alphabetic subgroup i.e 1B for organophosphates and fungicides use a numeric code apart from where there is multi-site activity (M to M9)

6 - BROAD CLAIMS FOR USE

This statement provides a general summary for which the product is registered. Unless the distinguishing name is sufficient to describe the product, the label must include a concise statement of the purposes for which the product is to be used

7 - NET CONTENTS

The net contents of the container is specified in metric units e.g. 20 L, 25 kg NET.

8 - NAME AND ADDRESS OF COMPANY

Provides contact information about the company responsible for the product, including emergency details.

9 - APVMA APPROVAL NUMBER

When the **Australian Pesticides and Veterinary Medicines Authority (APVMA)** registers a chemical product or approves a new label, an approval number is placed on the label.

This number is typically found at the base of the rear panel on the main container. The approval number contains the product number, the pack size identifier and the month and year of initial registration. A typical example might be APVMA 12345/20/0813.

This approval number means that the product has been scientifically assessed by the APVMA and is safe when used according to label instructions.

Registration status can be checked from the APVMA web site or by phoning or emailing the product manufacturer.

Chemical products that do not have this approval number have not been assessed and therefore present an unknown risk.

10 - DIRECTIONS FOR USE

This section presents information as a table, the crops or situations where the product may be used, what are the targeted pest(s), any restraints or restrictions on the use of the product, the rate of application, the State(s) in which particular uses are registered, and any comments critical that may help in achieving the desired results, such as timing of application, interval between applications, pre- or post-emergence applications and other pertinent information.

11 – RESTRAINTS

Found on some labels directly under the 'Directions for Use' heading. Indicates situations or conditions in which the product should not be used. Generally, start with the words **DO NOT.**
Remember it is a legal requirement to observe DO NOT STATEMENTS e.g. DO NOT apply when wind speed is less than 3 or more than 20 kilometres per hour as measured at the application site.

12 – SPRAY DRIFT RESTRAINTS

Part of Restraints with specific information relating to spray drift and what you can do to reduce the potential for spray drift.

13 - "NOT TO BE USED" STATEMENTS (RESTRICTIONS)

This statement always appears immediately below the Directions for Use Table on pesticide labels, however is not required on veterinary medicines unless the product is a pesticide.

NOT TO BE USED FOR ANY PURPOSE OR IN ANY MANNER CONTRARY TO THIS LABEL UNLESS AUTHORISED UNDER APPROPRIATE LEGISLATION

14 - WITHHOLDING PERIODS

The purpose of the withholding period (WHP) is to avoid unacceptable residues of chemicals and their metabolites in raw agricultural commodities, and food for humans or animals.

The WHP is the minimum period which must elapse between the last application of the product to any crop, pasture or animal and the commencement of harvesting and grazing of that crop or pasture, collection of the animals produce such as wool or milk, or slaughter of that animal for human consumption. **The Withholding Period is about food safety.**

Situation	Withholding Period
Harvest of a crop	Do NOT apply later than 7 days before harvest
Grazing of treated	Do NOT graze or cut for stock feed for 14 days after application
Slaughter of treated animals for food	Do NOT apply for less than 42 days before slaughter for human consumption
Offering for sale produce such as milk or eggs from treated animals	Do NOT use in birds producing eggs for human consumption

Failure to observe withholding periods may result in unacceptably high residues in agricultural products. The residue could be picked up through monitoring programs, interstate market monitoring, and for some commodities through the National Residue Survey Program.

Consequences may include loss of market, loss of consumer confidence, investigation, prosecution and possibly unacceptable risk to health. It is illegal for growers to sell their produce as food or feed if it exceeds MRLs.

15 - GENERAL INSTRUCTIONS

This section of a pesticide label usually includes general information or instructions not already detailed under 'RESTRAINTS' or 'DIRECTIONS FOR USE' and may include;

16 - RESISTANCE WARNING STATEMENTS

Herbicide, fungicide and insecticide resistance warning statements are included to assist users to manage chemical rotations to reduce the development of chemical resistance.

17 - MIXING INSTRUCTIONS

Provides information for spray preparation or mixing of the product, the order of mixing and additives that may improve result for example:

Add the label rate of Pest Aside to a half full tank and then finish filling the tank, agitate the mix well before application. If allowed to stand for any length of time agitate again thoroughly before use.

18 – APPLICATION INSTRUCTIONS

May provide information on specific application equipment and calibration and how to best achieve the desired results.

19 – CLEANING OF EQUIPMENT

20 - COMPATIBILITY STATEMENT

This part of the label should be checked before mixing with other chemicals.

21 - RE-ENTRY PERIOD

Do not allow entry into treated areas for 24 hours. Where prior entry is required, follow label advice for appropriate PPE and wash contaminated clothing at the end of the day

Where no re-entry period is stated, a minimum of 24 hours should be observed or until the chemical has dried upon the crop, whichever is the later (subject to the risk assessment), unless appropriate PPE is provided and worn as intended.

Caution should be exercised entering wet crops where chemicals have previously been applied, irrespective of the time lapse between application and re-entry.

Even after the re-entry period has been observed, some PPE may be necessary. Appropriate PPE should be indicated by the risk assessment.

22 - PROTECTION STATEMENTS

This section relates to protection of Non-Target organisms such as Wildlife, Fish, Crustacea and Environment, Protection of Livestock, Protection of Crops, Native and other Non-Target Plants.

It lists specific hazards to fish, bees and the aquatic environment as well as spray drift, for example: *'Dangerous to fish. DO NOT contaminate waterways.*

23 - STORAGE AND DISPOSAL

This section of the label provides information on storage of the product, disposal of excess spray solution or product and disposal of containers.

Common storage and disposal statements may include: *"Store in the closed original container in a well-ventilated area, as cool as possible. Do not store for prolonged periods in direct sunlight".*

24 - SAFETY DIRECTIONS

These directions and instructions are specified by the Office of Chemical Safety and Environmental Health (OCSEH) of the Commonwealth Department of Health and Aging following a detailed review of relevant toxicological data.

Particular information is specified for individual chemicals and formulations. These statements relate to safety in handling, use and storage of the product.

For example, the information may include: Hazard warning statements which give specific hazard information e.g. *"Product is poisonous if absorbed by skin contact, inhaled or swallowed. May irritate the eyes, nose and throat".*

Precaution statements: identify risks to human safety and reflect the type of hazard e.g. *"Avoid contact with eyes and skin. DO NOT inhale vapors or spray mist", If product is spilled on skin, immediately wash area with soap and water.*

Protective clothing and equipment e.g. *"When opening the container, preparing spray and using the prepared spray wear cotton overalls buttoned to the neck and wrist, washable hat, elbow-length PVC (non-cotton lined) gloves and face shield".*

25 - FIRST AID

First aid is the practical treatment in case of exposure or poisoning. A typical first aid statement will read: **If poisoning occurs contact a doctor or the Poisons Information Centre (phone 131126)**. It is recommended that all users of pesticides and veterinary medicines complete an accredited First Aid course and maintain their accreditation.

26 - SAFETY DATA SHEETS

An SDS file for all products needs to be maintained in an accessible location at all premises where chemicals are stored, manufactured or handled, and used.

27 - COMPANY WARRANTY

The Company Warranty Statement or Conditions of Sale explain the limit of the manufacturer's responsibility in respect to the product.

28 – SPILL MANAGEMENT

For minor spills refer to the chemical label and/or Safety Data Sheet (SDS). In case of emergency.
Major spills call your local brigade – Hazmat Unit and call the product manufacturer for specific containment, disposal and mitigation procedures.

29 - DANGEROUS GOODS

Emergency telephone contact numbers are usually provided for the fire brigade, police and ambulance, and to obtain specialist emergency advice from the manufacturer. This important information is generally present in a box similar to the following:

In an emergency
DIAL 000 Police or Fire Brigade
SPECIALIST ADVICE IN EMERGENCY ONLY:
MANUFACTURER'S EMERGENCY RESPONSE NUMBER: XXXXXXXX
ALL HOURS - AUSTRALIA WIDE

Dangerous goods are substances that pose an immediate danger such as flammability, toxicity or corrosiveness during transport, storage and handling. They are classified under Dangerous Goods Legislation according to their PREDOMINANT hazard. A description of this classification system can be found in the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code).

BATCH NUMBER

This is the number or letters, or a combination of numbers and letters, by which the manufacturer uniquely identifies each production batch through all stages of manufacture and distribution. The number or letter should be preceded by the words 'Batch number' or the symbol (B) or (BN). Companies often keep a sample of each batch in storage as a reference in case of efficacy complaints.

MANUFACTURE AND EXPIRY DATES. DATE OF MANUFACTURE (DOM)

Some pesticides and veterinary medicine labels contain the date of manufacture (DOM). Some pesticides and all veterinary medicine labels also specify an expiry date. If a label has no expiry date but does have a DOM, then a rule of thumb is to continue usage for two years from the DOM, assuming storage without high temperature and ultra violet exposure.

SAFETY DATA SHEETS – SDS (formerly Material Safety Data Sheets)

WHAT IS AN SDS?

A safety data sheet (SDS), previously called a Material Safety Data Sheet (MSDS), is a document that provides information on the properties of hazardous chemicals and how they affect health and safety in the workplace. For example, it includes information on the identity, health and physicochemical hazards, safe handling and storage, emergency procedures and disposal considerations. An SDS is an important tool for eliminating or minimising the risks associated with the use of hazardous chemicals in workplaces.

Regulation 330, Schedule 7: A safety data sheet must:

- **be in English**
- **contain unit measures expressed in Australian legal units of measurement under the National Measurement Act 1960 (Commonwealth)**
- **state the date it was last reviewed, or if it has not been reviewed, the date it was prepared**
- **state the name, Australian address and business telephone number of: (i) the manufacturer, or (ii) the importer, and**
- **state an Australian business telephone number from which information about the chemical can be obtained in an emergency.**

You should have an SDS for all hazardous substances. A safety data sheet (SDS) is prepared by the manufacturer of the product, or the supplier. They are available from the manufacturer or through the supplier. The SDS will clearly state if a product is a hazardous substance in Section 2.

You should obtain an SDS the first time you purchase or use a hazardous substance. If an SDS is not available, you should ask your employer or supplier. If you have difficulty in getting or using an SDS contact your local Worksafe office. All substances will have an SDS even those that are not classified as hazardous and you should keep an SDS for these substances as well.

They give working people and emergency service personnel essential information on substance identity, correct safety procedures when using, handling, transporting, disposal of substances and for dealing with accidents or emergencies involving these substances.

Just because an SDS has been provided this does not automatically mean that the product is now safe to use. You should always read the SDS carefully prior to using the product and always carry out a risk assessment.

All SDSs are set out in a standard format of 16 sections. You should get to know what information these sections provide as the information provided can help minimize risk in the case of an accident. These are important sources of information on safety and are prepared for each chemical to supplement the information provided on the product label. It is **NOT** a substitute for the product label, because it provides different information to that included on the label.

SDS in your Workplace

- **You MUST keep hard copies of the SDS for each product used and place in a register.**
- **You need to store the SDS in a place that is accessible to everyone but NOT in your chemical storeroom.**
- **Make sure everyone is familiar with the contents of the SDS for products used in their area and trained in the correct use.**
- **You MUST make sure that the SDS is no more than five years old.**

Format for an SDS: In Australia an SDS should follow the National Code of Practice for the Preparation of a Safety Data Sheet, 2nd edition (NOHSC2011-2003) which has a 16-header section format as follows:

SAFETY DATA SHEET - STANDARD SET OUT: showing section headings

Regulation 330, Schedule 7: A safety data sheet for a hazardous chemical must state the following information about the chemical:

Section	Information
SECTION 1	**IDENTIFICATION OF THE MATERIAL AND SUPPLIER**
SECTION 2	**HAZARDS IDENTIFICATION**
SECTION 3	**COMPOSITION/INFORMATION ON INGREDIENTS**
SECTION 4	**FIRST AID MEASURES**
SECTION 5	**FIRE FIGHTING MEASURES**
SECTION 6	**ACCIDENTAL RELEASE MEASURES**
SECTION 7	**HANDLING AND STORAGE**
SECTION 8	**EXPOSURE CONTROLS/PERSONAL PROTECTION**
SECTION 9	**PHYSICAL AND CHEMICAL PROPERTIES**
SECTION 10	**STABILITY AND REACTIVITY**
SECTION 11	**TOXICOLOGICAL INFORMATION**
SECTION 12	**ECOLOGICAL INFORMATION**
SECTION 13	**DISPOSAL CONSIDERATIONS**
SECTION 14	**TRANSPORT INFORMATION**
SECTION 15	**REGULATORY INFORMATION**
SECTION 16	**OTHER INFORMATION**

You can use the SDS to:

- Identify if the product is a hazardous substance or Dangerous Good
- Assist in carrying out risk assessments.
- Check that emergency equipment and procedures are adequate
- Develop on-the-job training

Supervisors, the workplace health and safety committee, the health and safety officer and employees can use the SDS to check on and improve health and safety in the workplace.

Where to get an SDS, SDS are available from:

- The product re-seller
- The product manufacturer (either as hard copy, electronic copy or via the internet)
- Third Party Suppliers e.g. MSDS.com (you may be required to pay a fee to acquire)

SAMPLE SAFETY DATA SHEET – PEST ASIDE

THIS SDS IS INTENDED FOR TRAINING PURPOSES ONLY

SECTION 1: IDENTIFICATION OF THE MATERIAL AND SUPPLIER

- **Pest A Side Systemic Insecticide**
- Systemic insecticide for the control of certain insects in pastures and turf areas, commercial and industrial areas and non-crop areas.
- AKMEE Chemicals Pty Ltd, 124 Roadrunner Rd Coyoteville NSW 1234
  Emergency Contact number: 1800 123 456 Web: www.pestasyde.com.au

SECTION 2: HAZARDS IDENTIFICATION

Classified as hazardous according to criteria of Safe Work Australia
Classified as a Dangerous Good according to the ADG Code

GHS Classification.

Acute Toxicity – Oral: Category 3

Signal Word: DANGER

Hazard Statements

H301 Toxic if swallowed

Precautionary statements:

Prevention

P264 Wash hands, arms and face thoroughly after handling

P270 Do not eat, drink or smoke when using this product

Response

P301 + P310If If SWALLOWED: Immediately call a POISON CENTRE or doctor/physician

P321 Specific treatment (see Safety Directions on the product label)

Storage and disposal

P405 Store locked up

P501 Dispose of contents/container in accordance with national regulations

Pictograms:

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient(s)		CAS Number	Concentration %
CHEMICAL:	PIEREEFRUM	123-45-6	35
CHEMICAL:	ROGORE	234-56-7	25
OTHER:	LIQUID HYDROCARBON	345-67-8	40

SECTION 4: FIRST AID MEASURES

Ingestion: Seek immediate medical attention. Contact the Poisons Information Centre (131126). If vomiting occurs, clear the mouth of vomitus, tilt the head back and bring the jaw forward to ensure a clear airway. DO NOT induce vomiting.

Eye: Irrigate with copious quantities of water for 15 minutes. Hold eyelids open. Seek immediate medical attention. Contact the Poisons Information Centre (131126).

Skin: Remove all contaminated clothing and wash skin thoroughly with soapy water. Seek immediate medical attention. Contact the Poisons Information Centre (131126).

Inhalation: Remove victim from further exposure. Remove contaminated clothing and loosen remaining clothing. Contact the Poisons Information Centre (131126). Allow patient to assume most comfortable position and keep warm. Keep at rest. If breathing has stopped, apply artificial respiration. If breathing is labored and victim cyanotic (blue), ensure airways are clear and have a qualified person administer oxygen through face mask.

Advice to Doctor: If ingestion has occurred, empty stomach. Save sample of emesis or initial gastric washings for chemical analysis. Instill 50gms of activated charcoal.

SECTION 5: FIRE FIGHTING MEASURES

- Combustible liquid. Use foam to extinguish.
- May release smoke and hazardous decomposition products.
- Wear self-contained breathing apparatus when fighting fire.
- Hazchem Code – 3WE

SECTION 6: ACCIDENTAL RELEASE MEASURES

- In the event of a spill, clear area of unprotected personnel. Wear PPE as per label instructions for mixing the concentrate.
- Contain spill/leak using a Spill Kit or if unavailable use sand or earth. Prevent run-off into drains or waterways. Decontaminate area with hydrated lime and wash down excess with water. To dispose of contact your local land waste management authorities.

SECTION 7: HANDLING AND STORAGE

- Precautions for safe handling: Keep out of reach of children, unauthorized persons and animals. Keep containers tightly closed at all times. Poisonous if swallowed. Avoid contact with skin.
- Conditions for storage: This product should be stored as a Dangerous Good Class 3. DO NOT store (or allow to contact) fertilizers and feedstuffs. Store in a cool place out of direct sunlight. Store in a well-ventilated area away from sources of heat and ignition.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

- Cholinesterase inhibitor: exposure levels should not exceed 20% of pre-exposure baseline for RBC, 40% for plasma.
- Natural ventilation should be adequate under normal conditions of use.
- Avoid skin contact. Wear rubber boots, impervious gloves, protective waterproof clothing and full-face respirator with combined dust and gas canister. Always wash hands before eating, drinking, smoking or using the toilet. After each day's use, wash respirator and PPE. Ensure PPE complies with Australian Standards.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

- Appearance: Murky brown liquid.
- Odour: Mild odour.
- pH: 4-6
- Specific Gravity: 1.0g/ml
- Boiling point: 37.5°C.
- Solubility in Water: Product emulsifies in water
- Flash point (ºC): 63°C.
- Flammability Limits (%): 7% to 2%.
- Poisons Schedule: Product is a Schedule 5 (S5) poison.

SECTION 10: STABILITY AND REACTIVITY

- Chemical Stability: Product is considered stable in ambient conditions for a period of at least 2 years after manufacture.
- Conditions to avoid: Do not store for prolonged periods in direct sunlight
- Incompatible materials: Can react with oxidising agents.
- Hazardous decomposition products: Produce is likely to decompose after heating to dryness and continued strong heating and will emit; carbon monoxide, sulphur dioxide and other sulphur compounds.
- Hazardous reactions: Will not polymerise

SECTION 11: TOXICOLOGICAL INFORMATION

Acute

Swallowed: **Toxic if swallowed acute oral LD_{50} (rat) 500mg/kg**. Anticholinesterase effects. Ingestion can result in nausea and vomiting followed by headaches, dizziness, weakness and exhaustion. **Severe cases may result in blurred vision, muscular twitching and slurred speech.**

Eye: A mild eye irritant.

Skin: This product has a low dermal toxicity. **The dermal LD_{50} in the rat is 2000-2500 mg/kg**. It is non- irritating and non-sensitising to the skin

Inhalation: Low inhalation toxicity. Acute inhalation $LC_{50} \geq 1.05$ mg/L/4 hrs which was the highest attainable concentration.

Chronic: Unlikely to pose adverse reproductive or development risks under normal exposure conditions. Not mutagenic. In studies with laboratory animals the active constituents did not cause reproductive toxicity, teratogenicity or carcinogenicity. An overall absence of genotoxicity has been demonstrated in tests of mutagenicity, DNA damage and chromosome aberrations.

SECTION 12: ECOLOGICAL INFORMATION

Environmental toxicity data are based on the active constituents Piereefrum and Rogore. The physical and environmental properties as well the environmental toxicology of both products is very similar therefore unless indicated the information below pertains to Piereefrum.

Environmental Toxicology: The actives are highly toxic to bees, fish and aquatic arthropods.

- Birds – acute oral LD50 for mallard ducks 2000-2600 mg/kg; moderately toxic.
- Fish – LC_{50} (96 hr) for rainbow trout ranges from 0.065 to 2.8 mg/L.
- Bees – LC_{50} (96 hr) 0.085 mg/L.
- Low mobility in soils. Rapidly degrades in soil and water by chemical, photolytic and biological processes.

Environmental Properties: Piereefrum degrades at a moderate rate in agricultural soils (half-life = 50-110 days) and more rapidly on surface soils or bare soils (half-life = 10 - 35 days). Piereefrum is tightly bound in most soils and has a very low water solubility.

SECTION 13: DISPOSAL CONSIDERATIONS

- Triple rinse containers. Add rinsate to spray tank. **Do Not** dispose of undiluted concentrate on site. Take cleaned container to a drumMUSTER® collection site.
- If not recycling, break, crush or puncture and bury empty containers in a local authority landfill. If landfill is not available, bury the container below 500mm in a disposal pit specially marked and set up for that purpose, clear of waterways, desirable vegetation and tree roots. Empty containers and/or product should **NOT** be burnt.
- DO NOT contaminate sewers, drains, dams, creeks

SECTION 14: TRANSPORT INFORMATION

- UN (United Nations) Number – 1234
- UN Proper shipping Name – organophosphorous pesticide, liquid, toxic.
- Dangerous Goods Class 3 and subsidiary risk 6.1
- Packing Group – III, Hazchem Code – 3WE.

SECTION 15: REGULATORY INFORMATION

- Poison Schedule S5

SECTION 16: OTHER INFORMATION

- Issue Date: 2 January 2020. Valid for 5 years from this date. (Included APVMA registration).

Chapter 3

HUMAN HEALTH

&

PERSONAL

SAFETY

"Personal Safety Comes First when using chemicals"

Introduction

PERSONAL SAFETY COMES FIRST WHEN USING PESTICIDES. Products can only be used with confidence if ALL label instructions are followed, including those relating to personal safety. Your health is unlikely to be compromised if you use products, according to the label and SDS

The most likely problems to human health are caused by accidental exposure, or misuse by not following the label and SDS instructions and not following good pesticide safety practice such as Manual Handling procedures.

The greatest risk occurs when handling the concentrated product during measuring and mixing.

Toxicity of Pesticides: "Toxicity is the degree to which a substance can cause harm"

All pesticides are toxic to some degree and, if not used correctly, may adversely affect people and other non-target organisms as well as the targets for which they are intended.

You cannot alter the toxicity of a pesticide. The formulation and the active constituents in the container have already determined this. The level of toxicity can be determined from the signal heading on the label.

There are two types of poisoning: acute and chronic.

Acute Poisoning

Acute poisoning results from a single exposure, which may occur when a person is splashed or sprayed with a large amount of concentrated pesticide. It may also occur if someone ingests or inhales a chemical and soon after has immediate symptoms of poisoning.

Chronic Poisoning

Chronic poisoning can result from repeated exposure to small doses of a pesticide over a period of time (e.g. weeks or a spraying season) by not following label safety directions. The greatest problems occur when an operator, who is suffering chronic poisoning, absorbs sufficient chemical (may be a small amount) to exceed the toxic level, thus leading to an acute poisoning.

Evaluating Toxicity

The acute toxicity of a chemical can be expressed by its LD_{50} rating (Lethal Dose 50%).

This is an estimate of the amount of poison generally (pure active constituent) required in one dose to kill 50% of a batch of test animals, usually rats.
The LD_{50} is expressed in milligrams of the active constituent per kilogram of body weight of the test animals. The poison may be administered orally (through the mouth), dermally (through the skin) or by inhalation, (through breathing it in).

A low LD_{50} rating indicates that the active constituent of a pesticide is HIGHLY TOXIC. It should be noted that the label does not contain LD_{50} values. LD_{50} values are found on the SDS (section 11 under the heading Toxicology Information)

Ideally, users should select a Schedule 5 product in preference to a Schedule 6 product and a Schedule 6 product in preference to a Schedule 7. However, given there may be other reasons for selecting an S6 or S7 product, such as resistance management, users should pay particular attention to label safety directions in order to minimise potential exposure to the product and therefore minimise risk.

Risk is a combination of hazard and exposure i.e. (Risk = Hazard x Exposure)

Safety directions are based on the risks associated with using a product in accordance with the label directions

No matter how severe the hazards presented by a product if exposure is low or negligible, then the risks will also be low. Equally even a low hazard product can present significant risk if the exposure is high or frequent (chronic health effects from frequent exposure) e.g. inhaling a dust.

Poisoning from Anti-cholinesterase Compounds

The organophosphate (OP) and carbamate classes of chemicals cause the greatest number of poisonings in Australia, associated with pesticide use.

Organophosphates and carbamates inhibit the enzyme acetylcholinesterase (AChE). This enzyme is essential for normal nerve function. These chemicals can poison all living creatures with cholinesterase in the nervous system, such as humans, insects, fish, birds and other mammals.

All pesticides that contain anti-cholinesterase compounds have a specific statement on the label:

(an anticholinesterase compound)

The effects of organophosphate or carbamate poisoning can be local or general.

Early symptoms depend on the route of absorption and the level of exposure.

Cholinesterase is an enzyme that is needed for the proper function of the human body's nervous system. Organophosphates and carbamates limit/inhibit this enzyme.

The enzyme acts as a stop switch for nerves. The brain sends out a function request between nerves. The lack of this enzyme means the body will repeatedly send the same function command; therefore the enzyme isn't stopping the request from being repeated between nerves.

The nervous system "jams up" with active unnecessary commands, and this is why a common symptom of cholinesterase poisoning is shaking, trembling or anxiety.

Antidotes

Antidotes for organophosphate or carbamate poisoning should be prescribed and administered only by a doctor. Doctors and hospitals should be advised which pesticides and veterinary medicines are used locally and encouraged to have appropriate antidotes available for treating poisonings.

Minimising Exposure

The best way to avoid or minimise the risk of exposure to pesticides is to read the label carefully and follow instructions. Users must be aware of their legal and moral obligations when using pesticides and veterinary medicines. By reading the label and practising good management, there should be very few (if any) health problems resulting from the use of chemicals.

Times of Great Risk

Experience has shown that the greatest likelihood of exposure occurs:

- When a new pesticide is being introduced or when handling concentrates

Sensitisation

With continued use and exposure some people may become sensitive to and react to a particular pesticide. This sensitisation process may speed up the more the particular pesticide is used.

Absorption

There are **four main routes** by which chemicals are absorbed by the human body:

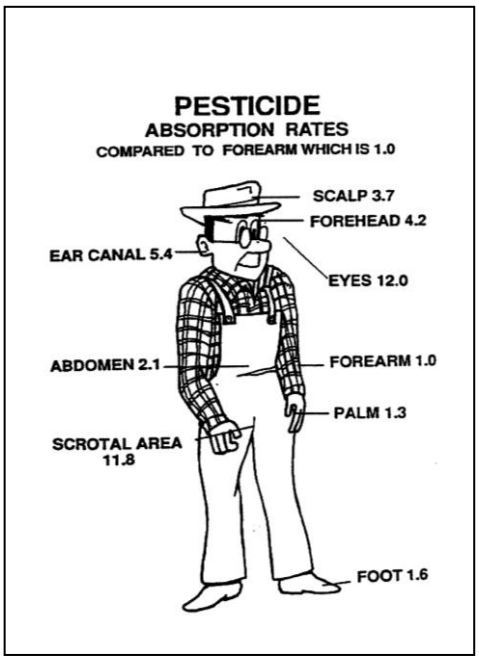
1. **Skin**
2. **Injection**
3. **Inhalation (breathed in)**
4. **Ingested/Swallowed**

Accidental injection is an additional lesser recognised route.

Skin Absorption (dermal)

Skin absorption is the most likely route by which poisoning may occur for users of pesticides and veterinary medicines. The absorption through skin of the face, forearms and hands can be greater than absorption resulting from inhalation. The danger of skin absorption is always greatest when the temperature is high, and the skin is wet with perspiration. Dermatitis may also increase the risk of absorption, and indeed dermal exposure to some chemicals may cause dermatitis. This is because the skin is already inflamed and the protective layer of the stratum corneus is damaged.

Rates of absorption through the skin are different for different parts of the body.



For example:

The sensitive eye area will absorb and react to chemicals much easier than the forearm area.

If clothing becomes contaminated it should be changed immediately.

Absorption through the skin continues as long as the chemical remains in contact with it. Do not allow contaminated protective or other clothing to remain in contact with the skin.

The ability for chemical skin absorption to occur is greatly increased by the subsequent working time, sweating, and continued absorption of chemical into the body from contaminated clothing. The majority of poisoning cases are the result of skin absorption.

Eyes

Chemical contamination of the eyes can result from a splash or spill of concentrate, from drift and by rubbing the eyes with contaminated hands or clothing. Eyes are particularly sensitive to many chemicals and great care must be taken at all times to prevent exposure by wearing eye protection. **Irrigation of the eye with clean water may be required for at least 15 minutes if contamination occurs.**

Inhalation Exposure

Inhalation exposure results from breathing in chemical vapours, dusts or spray particles, where the chemical may be absorbed through the mucous membrane of the nose, throat, the mouth and through the lungs.

The greatest risk of inhalation exposure exists when mixing pesticide concentrates in confined areas, in windy conditions or when using fumigants. The use of sprays in closed situations such as a machinery shed, or grain silo is also hazardous. In such a situation wearing a suitable respirator will provide vital protection.

Ingestion

Ingestion of chemicals may occur accidentally but more frequently occurs due to carelessness.

For example:

> Clearing 'blocked' nozzles by blowing with the mouth
> Smoking or eating after using pesticides without first washing **e.g. the primary source of poisoning when handling sodium fluoroacetate (1080) is via the oral route (swallowed).**

These examples must not be followed, because they can lead to ingestion exposure. Good hygienic practices such as frequent washing of hands, face and other exposed skin areas are always essential when handling or applying chemicals.

Putting pesticides into drink bottles is a common cause of ingesting poison by children and adults.

THIS IS HIGHLY ILLEGAL

Poisoning Symptoms

Not all symptoms will be experienced as the severity of the poisoning depends on the area of the body contaminated, type of poisoning and the toxicity of the pesticide.

Inhalation Exposure

If you have been exposed to pesticides, then you should contact the Poisons Information Centre.

The Poisons Information Centre provides emergency information 24 hours a day, 7 days a week. The services are offered free and deal with inquiries from the public as well as from medical personnel.

It will help if you have access to the product label and the SDS when contacting the centre.

Poisons Information Centre
Ph: 13 11 26
(Australia Wide)

https://www.health.gov.au/contacts/poisons-information-centre

Precautions to Avoid Poisoning

The misuse of pesticides and veterinary medicines can have immediate, as well as long term effects upon humans, pets, wildlife and the environment. Misapplication can also waste time and resources, and may lead to crop damage, injury to livestock, or failure to control the pest.

Most importantly, make sure ready access is available to clean water and first aid supplies at all times

Safety Principles - 'Good Practice' Tips

- ✓ **Always read the label. Use the correct dosage and time of application**
- ✓ **Do not allow children to play near application equipment or the mixing, storage and disposal areas**
- ✓ Use pesticides and veterinary medicines only when necessary and as part of an integrated pest management program
- ✓ Be familiar with the laws relating to pesticides and veterinary medicines use
- ✓ Secure pesticides and veterinary medicines, in their original labelled containers, inside a properly marked cabinet or storeroom, away from food and feedstuffs
- ✓ Work in pairs when applying the more hazardous pesticides and veterinary medicines
- ✓ Wear appropriate protective clothing and equipment
- ✓ Never eat, drink or smoke when handling pesticides and veterinary medicines
- ✓ Avoid drift to non- target areas. Dusts drift more than sprays and air blast sprayers usually create more drift than boom sprayers
- ✓ Avoid spills on skin or clothing and wash immediately with soap and water. If poisoning is suspected, contact the Poisons Information Centre. Take the chemical label with you to the hospital or doctor
- ✓ Observe re-entry periods specified on the label
- ✓ Dispose of empty containers according to the label
- ✓ Wash or shower after handling pesticides and veterinary medicines or contaminated equipment. Wash clothing after application, keeping in mind that, until laundered, clothing must be handled with the same caution as the chemicals themselves.
  Keep chemical contaminated clothing separate from the family wash.

Personal Protective Equipment (PPE)

NEVER STORE YOUR PPE INSIDE A CHEMICAL STOREROOM

YOU ARE LEGALLY REQUIRED TO WEAR THE PPE AS STATED ON THE LABEL OF THE CHEMICAL YOU ARE ABOUT TO USE.
THIS IS THE LEGAL SAFE MINIMUM PPE THAT IS REQUIRED.

The greatest risks arise in handling chemical concentrates, especially when mixing, loading or applying undiluted or neat chemicals.

Although a dilute chemical is generally less hazardous than a concentrate, the risk increases:

- When there is significant drift
- When appropriate safety and application procedures are not followed
- When there is repeated exposure
- When cleaning up spills or repairing equipment
- If people enter treated areas before the period of re-entry has elapsed.

Even though appropriate protective clothing and/or equipment can be uncomfortable and cumbersome to wear, particularly in hot weather, it must be used for your own personal safety.

The type of protective clothing and/or equipment needed depends on the job being done and the type of chemical being used. Some pesticides and veterinary medicines require full protection, including a respirator during mixing, application and disposal. Some fumigants require special equipment to be worn such as a self-contained breathing apparatus.

Always read the label to find out the level of personal protective equipment required for the type of chemical being used and always have a container of clean water (tank) on your sprayer / ute. Also refer to section 8 of the product's SDS for further information on exposure controls and PPE.

Even if protective clothing is not specifically mentioned on the label, protection may be needed to reduce the risk of chemical contact. Similarly, a statement specifying only one piece of safety equipment does not rule out the need for additional protection. It should be stated that "extra" PPE is optional depending on the situation and what you are comfortable wearing.

Clothing

Protective clothing can consist of long-sleeved shirt and long trousers made of a tightly woven fabric or a water repellent material. A cotton T-shirt and shorts is not suitable.

Alternatively, overalls, whether disposable or reusable, may be worn. A waterproof apron (from chest to boots), raincoat or rain-suit should be worn when pouring and mixing concentrates and when using the more toxic products. Overalls usually do not provide adequate protection against spills and splashes. Hang the apron when not being used i.e. when returning to the vehicle.

Waterproof gear should be worn whenever mist or spray drift could substantially wet your work clothes. Waterproof gear should be made of rubber or a synthetic material resistant to the solvents in chemicals.

Gloves

Unlined, waterproof gloves should be elbow length and made of waterproof material (e.g. PVC or nitrile) that is not affected by the product being handled. Only use gloves approved for use with chemicals as some rubber products can react with solvents and dissolve. Folding 25mm of the edge of the glove over itself will prevent chemical running up your arms when raised.

Latex medical type gloves allow access of organic vapours and are entirely unsuited to work with pesticides. Check gloves carefully to ensure there are no holes by filling them with water and squeezing them.

Wash chemicals off the gloves with soap and water before removing them to avoid contaminating your hands during removal.

Repeated re-use of gloves should be avoided as some chemicals are not removed by washing and can gradually permeate through the glove material.

Hat

A head covering should be worn when handling chemicals. A waterproof hat or hood is required if the operator gets wet with spray i.e. when using an air blast sprayer or spraying above head height.

Such a hat should be either disposable or easy to clean with soap and water. Where the operator does not get wet with spray, a washable cotton hat should be worn. A hat that cannot be washed such as an Akubra or felt hat is not suitable.

Shoes/Boots

Boots should be unlined and made of rubber. Because of their absorbency, leather, canvas or cloth boots should never be worn when handling chemicals. Trouser bottoms should be worn outside of boots to prevent any chemical from running down the legs and into the boot. Two-star pickets can be used to hang boots when not being used.

Goggles/Face shields

Tight fitting, non-fogging goggles or a full-face shield should be worn when there is any chance of eye contamination. This is especially important when pouring or mixing concentrates or handling dusts or toxic sprays.

It is extremely important to avoid contact with eye. Contact lenses can trap material underneath presenting greater risk of poisoning. If contact lenses are worn, consult a doctor prior to using chemicals.

Goggles and face shields should be kept clean at all times. Goggles should be washed with soap and water and cleaned by soaking the equipment for two minutes in a mixture of 30 mL of chlorine bleach in 4 L of water. They should then be rinsed thoroughly with clean water to remove soap and bleach, wiped with a clean cloth and allowed to air- dry. Attention should be given to goggle headbands as they are often made of absorbent material that requires regular replacement.

Respirators

For many chemicals, the respiratory (breathing) system can be the most direct route of entry into the circulatory system.

Respiratory protective devices vary in design, use and protective capability. In selecting a respiratory protective device, the user must consider the degree of hazard associated with breathing the substance and understand the specific use and limitations of the available equipment.

Select a respirator that is designed for the intended use, and always follow the manufacturer's instructions concerning the use and maintenance of the respirator.

Types of respirators

Respiratory protective devices can be categorised into three classes: negative pressure air-purifying, supplied-air and self-contained. Most chemical contaminants can be removed from the atmosphere by air-purifying devices.

Air-purifying devices include chemical cartridge respirators (also referred to as canister filter respirators), disposable masks and powered air purifying respirators (PAPR). They can be used only in atmospheres containing sufficient oxygen to sustain life.

Disposable masks (dust masks)

Only provide respiratory protection against particulate matter such as mist, smoke, metal fumes and non-volatile dust. Some contain small amounts of activated carbon to remove low levels of organic vapours or acid gasses. These masks only cover the nose and mouth. Dust masks should never be used when mixing or applying liquids that contain significant amounts of organic vapours as these will not be collected in the filter and the wearer will not be protected.

Chemical Cartridge Respirators

Provide respiratory protection against certain gases and vapours present in concentrations not greater than 0.1 % by volume. They are available either as half-masks, covering only the nose and mouth, or as a full-face shield for both respiratory and eye protection.

Powered Air-Purifying Respirators (PAPR)

Can also effectively filter out particles and gaseous vapours. They are available as half-masks, full-face masks, hoods and protective helmets, and are connected by an air supply hose to a battery powered filtration system worn at the waist. This type of system has the additional advantage of cooling the person wearing it. But it does not provide a supplementary oxygen supply and must be worn only when the external oxygen supply is adequate.

Cartridges and canisters

Protect against organic vapours differ chemically from those that protect against ammonia gases. Be sure the cartridge or canister complies with the relevant Australian Standards and is approved for use with the particular product.

They are especially recommended for wearers with facial hair or other conditions where it is not possible to obtain adequate fit with Disposable masks or Chemical cartridge respirators.

A different type of chemical cartridge or canister must be used for different contaminants

Cartridge respirators

These are not recommended for use against chemicals that possess poor warning properties. The user's senses (smell, taste) must be able to detect the substance at a safe level for cartridge respirators to be used correctly.

Remember cartridges and filters do not supply oxygen. They must not be used where oxygen may be limited

The effective life of a respirator cartridge or canister depends on the conditions associated with its use such as the type and concentration of the contaminants, the user's breathing rate, and the humidity. When the cartridge becomes saturated, a contaminant can pass through the cartridge. At this point, the cartridge must be changed immediately. Most respirator manufacturers can provide guidance on the service life of their filters if the wearer has some basic information such as the types of chemicals used exposure levels, work rate and temperature.
Chemical cartridge respirators cannot provide protection against all types of gases and vapours. Masks with a self- contained air supply are necessary for these purposes. When using fumigants, full-face canister respirators are required where exposure is minimal; otherwise a self- contained air supply is required at all other times.

Use and care of respirators prior to using a respirator, read and understand the instructions on the cartridge or canister and all supplementary information about its proper use and care. Be sure the filter is approved for protection against the chemical to be used.
All respirators must be inspected for wear and deterioration of their components before and after each use. Special attention should be given to rubber or plastic parts that can deteriorate. The face piece, valves, connecting tubes or hoses, fittings and filters must be maintained in good condition.

Dispose of all spent cartridges carefully because they cannot be reconditioned and inadvertently be used by another applicator

All valves, mechanical filters and chemical filters (cartridges or canisters) should be properly positioned and sealed. Fit the respirator to ensure a tight but comfortable seal on your face. Facial hair or other conditions will prevent an adequate seal on the negative pressure respirator.

Testing Cartridge Respirators Effectiveness

Two tests can be done to check the fit of most chemical cartridge respirators.

The first test requires placing your hands tightly over the outside exhaust valve - if there is a good seal, exhalation should cause slight pressure inside the face-piece. If air escapes, re-adjust the headbands until a tight seal is obtained.

The second test involves covering the inhalation valve(s) by placing your hands over the cartridge(s) - if there is a good seal, inhalation should cause the face-piece to collapse. If air enters, adjust the headbands for a tighter fit until a good seal is obtained.

A simple test to check if a cartridge is working effectively is to spray a strong perfume when the respirator is fitted. If perfume can be detected, it is time to change the cartridge.

DANGER SIGNALS:
Smell or taste contaminants
Eyes, nose or throat become irritated
Breathing becomes difficult
Nausea or dizziness

When using a respirator, if you sense any of the specific danger signals, get to fresh air immediately. Your cartridges or filters may be used up or abnormal conditions may be creating concentrations that exceed the capacity of the respirator.

Respirator filters are continuously absorbing vapours, therefore it is extremely important to store the respirator face-piece, cartridges, canisters and mechanical filters in a clean, dry place, in a tightly sealed container or plastic bag. Do not store your respirator with any chemicals.

Handle your respirator with the same care that you give your other protective equipment and clothing.

What is a Fit Test?

Because everyone's face is different, a fit test is used to determine an adequate match between the face piece of a respirator and the face of the wearer. Ideally this should be done before the respirator is first issued and then at regular intervals.

Can I wear a respirator with a beard?

Any facial hair has the potential to break the face seal of a respirator. We recommend that people wearing respiratory protection be clean-shaven, to enable the respirator to achieve a good seal against the face.

Spray vehicle cabins

Charcoal filter systems are available which can be fitted to tractors or utilities to prevent chemical fumes coming in through the intake ducts. But tractor cabins fitted with charcoal filters will not protect you against dermal or skin absorption if your clothes, boots or the inside of the cabin have been contaminated with chemicals.

Normal air-conditioned cabins do not give you adequate protection.

When you are handling concentrated chemicals, you are at the greatest risk of being poisoned.

You can minimise the risk by taking the following precautions:

- **Read the label before you open a drum or package.**
- Wear your protective gear and wear it correctly. This means a full outfit of protective clothing, including face shield and respirator.
- Be careful opening containers of concentrate. Pressure may build up inside, causing them to spurt. If there are seals to be broken, remove them carefully.
- Pouring concentrated liquid into measuring jugs, buckets or spray tanks is probably the most hazardous procedure. It is too easy for chemicals to splash, or to be blown by the wind onto your skin or into your eyes.
- There are a number of self-filling devices on the market that minimise direct handling of concentrates by the operator. Take care when coupling and uncoupling these devices. Poor connections may cause the concentrate to splash. Remember that the hose may still contain chemical even though the container is empty.
- When mixing wettable powders, stir carefully. Add powder to water and allow the powder to settle to minimise dust blowing about. Dust can easily settle on exposed skin. This is a particular problem if you are sweating.

Gloves should be worn when cleaning blocked nozzles, or handling parts of sprayers or pumps when spraying. Use a toothbrush or special brush to clean nozzles.

Care and Cleaning of Personal Protective Equipment

All protective clothing and equipment should be washed at the end of each day of use. Contaminated clothing must be stored and washed separately from the family wash. Ideally, a separate washing machine should be used and located away from the household laundry.

Remember gloves should be worn during handling and laundering and be sure to check the product label for any specific laundering instructions.

Clothing that has become saturated with a product concentrate should be discarded.

Some residues may be removed by hosing the contaminated clothing with water or presoaking in an appropriate container.

NEVER STORE YOUR PPE INSIDE A CHEMICAL STOREROOM

Washing in hot water removes more chemicals from clothing than washing in cold water temperatures. The hotter the better. Cold water might save energy, but it is relatively ineffective in removing chemicals from clothing.

Most laundry detergents are effective in removing most pesticides and veterinary medicines from fabric. However, heavy-duty liquid detergents typically have better oil removing ability and, therefore, are more effective than other detergents in removing emulsifiable concentrates.

The ease of chemical removal through laundering depends not on toxicity, but on the product formulation. Bleach or ammonia (not used together) may help in the removal or breakdown of certain chemicals.
Bleach and ammonia should never be mixed because they react to form chlorine gas which can be fatal.

A washing machine with a full water level should be used when washing contaminated clothing.
After washing it is important to rinse the washing machine with an empty load using hot water and the same detergent.

Line drying of clothing is recommended because:

- It eliminates the possibility of residues collecting in the dryer, and
- Residues of many products will breakdown when exposed to sunlight.

Finally, ensure that hands and arms are washed after the laundering procedure. After washing and drying protective clothing, store it away from the chemical storage area.

Tractor safety

Between 2010 – 2011 figures show that 43% of traumatic deaths on Australian farms were associated with vehicles. TWith 26% of farm deaths being tractor related. Tractor deaths and injury occurs from tractor runovers, rollovers and entanglement in power take-off shafts (PTOs).

Design features for tractors, such as roll bars, neutral start switches and safe operator access have improved the situation, but injury events continue to occur.

Tractor rollover

Tractor rollovers are the leading cause of tractor-related deaths, responsible for around 37% of fatal tractor injuries. Older farmers are at greater risk of tractor rollover. Incidents are often associated with maintenance, jump-starting, checking or operating implements and alighting moving tractors. Some rollovers involve children.

- Keep tractor steps and handrails in good repair or replace old tractor steps with safer tractor access
- Fit steps which enable access outside the line of the rear wheel of the tractor. A diagram and free guide is available at www.farmsafe.org.au
- Do not get on or off a moving tractor
- Do not jump start the tractor while standing on the ground or in front of the tyres
- Maintain the hand brake in good repair. Engage the handbrake or place the transmission in Park before getting on or off the tractor

First Aid for Pesticides and Veterinary Medicines Poisoning

Immediate and appropriate action may be necessary to prevent serious injury to a victim of chemical poisoning. In a chemical exposure emergency look at the label first. Also check the Safety Data Sheet (SDS) for information on the effects (symptoms) of over exposure and emergency and first aid procedures.

Poisons Information Centre
Ph: 13 11 26
(Australia Wide)

OR

Call an Ambulance
Ph: 000 or 112 (mobiles)

First aid is only the first response and is not a substitute for professional medical help

General First Aid Instructions

1. **ALWAYS READ THE LABEL**
2. Remove the victim from the source of contamination, making sure to protect yourself from contact with the pesticide
3. If oral or skin exposure occurs, dilute the chemical and prevent its absorption.
4. If inhalation exposure occurs, immediately get the victim to fresh air.
5. Always have a source of clean water available. In an extreme emergency, even water from a farm dam, irrigation system, or watering trough could be used to dilute the chemical.
6. If there is a likelihood of direct exposure to a chemical while a person is administering first aid, or removing the victim from an enclosed area, they should wear appropriate protective equipment.
7. Become familiar with the proper techniques of artificial respiration; it may be necessary if a person's breathing stops or becomes impaired.
8. Never try to give anything by mouth to an unconscious person.
9. Never give alcohol to a poisoned person.
10. Purchase an appropriate first aid kit for the chemicals you are storing or transporting.

Specific First Aid Instructions

If you are trained in first aid you will be able to assess the situation and may be able to do the following. If you are not a trained in first aid the best course of action would be to follow the label first aid instructions and contact the emergency services as soon as possible):

- See if the victim is breathing, if not administer artificial respiration (CPR), **ensuring you are not contaminated.**
- Decontaminate the victim immediately by washing thoroughly. Speed is essential.
- Call the ambulance (phone 000) or the closest hospital.

If more than one person is available to help the victim, do the following:

One person should check that the victim is breathing. If not give artificial respiration, then begin washing the victim.

Another person should call the hospital or doctor immediately, then assist with the decontamination of the victim. Ambulance officers will need information from the label and/or SDS i.e. active ingredients, UN number.

If the chemical has been spilled on the skin or clothing:

1. **Remove clothing immediately if it is contaminated and thoroughly wash the skin with soap and water. Avoid harsh scrubbing as this enhances chemical absorption.**
2. **Rinse the affected area with water, wash again and rinse.**
3. **Gently dry the affected area and wrap in a loose cloth or a blanket if necessary.**

If there are chemical burns of the skin, cover the area loosely with a clean, soft cloth. Avoid the use of ointments, greases, powders and other medications unless instructed by a medical authority.

It may be best to dispose of contaminated clothes. However, if you decide to keep the clothing, store and wash it separately from any other laundry.

If the chemical has been inhaled

- Get the victim to fresh air immediately; carry the victim (don't let the victim walk)
- Have the victim lie down and loosen clothing
- Keep the victim warm and quiet
- If the victim is convulsing, watch the breathing and protect the victim's head
- If breathing stops or is irregular, give artificial respiration.

Do not attempt to rescue someone who is in a closed, contaminated area unless you are wearing appropriate protective equipment

If the chemical has entered the eye

- Hold the eyelid open and immediately begin gently washing the eye with clean running water
- Do not use chemicals or drugs in the wash water unless instructed by a doctor or the Poisons Information Centre
- **Continue washing for 15 minutes**
- Avoid contamination of the other eye by flushing the affected eye downwards
- Flush under the eyelids with water to remove debris
- Cover the eye with a clean piece of cloth and seek medical attention immediately.

If the chemical has been swallowed

- **DO NOT INDUCE VOMITING unless specifically stated on the label.**
- Contact the Poisons Information Centre (Ph 13 11 26)
- Always Read the Label
- Get the victim to a doctor or hospital as soon as possible and take the label with you.

Some old labels specify the use of Ipecac syrup to induce vomiting. This practice is no longer recommended. If in doubt, contact the Poisons Information Centre.

Artificial Respiration Procedure

Ensure the victim's facial skin is free of chemical contamination, which may poison the person administering resuscitation. (Always use a face mask or shield)

Expired Air Respiration (rescue breathing) either Mouth to Nose or Mouth to Mouth is the accepted artificial respiration method. Learn the method well. A few minutes of practice to develop coordination and know-how is an investment that may someday save a life. Always refer to label first aid advice.

Do not waste time.
Start immediately and don't stop.
Seconds, and perseverance may be the difference between life and death.
Basic First Aid Kit: First aid kits can be purchased from various outlets.

Chapter 4

TRANSPORT

STORAGE

&

HANDLING

"Chemicals must NEVER be carried in the passenger compartment"

Introduction

Misuse of pesticides can adversely affect the health of people who unknowingly use water, soil, or air that is polluted by accidental or irresponsible storage, transport, and handling of pesticides.
Misuse of pesticides can cause environmental damage through injury to wildlife, or contamination of water, soil and air. With good practices and appropriate care, pesticides can be used with minimal impact on the environment.

Safe Transport General Guidelines

Pesticides, other than for bulk quantities, should be transported according to their label and SDS instructions and the **National Transport Commission (NTC) Load Restraint Guide for Light Vehicles 2018** as well as any specific transport codes and State/Territory laws.

They can be safely transported by following these basic rules:

- **Make sure all loads are secure and all lids are on tight.**
- **Carrying the correct documents.**
- **Segregation of Dangerous Goods correctly.**
- **Warning signs on the vehicle if required.**

NOTE: The responsibility for the safe transport of chemicals is shared between the retail store manager and the user who receives the chemicals for transport.

Faulty packaging can lead to leakage during transport and a potentially significant safety hazard. **DO NOT** accept packages that are damaged or that have damaged labels from the supplier.

Any vehicle used to transport chemicals must be free from any defect that might affect its safety or any feature that may damage the load e.g. sharp objects on the back of the truck that could puncture containers.

Chemicals MUST NEVER be transported in the passenger compartment of any vehicle, or the boot of a car as it is the same airspace as used by vehicle occupants.

Remember the Slogan "Ute it, don't Boot It"

The following principles should be applied when transporting pesticides:

- Vehicles should be locked and supervised when they are parked.
- Transport pesticides separately from food, stock feed, seed, fertiliser, plants and veterinary products.
- Any spills occurring during transport must be correctly cleaned up immediately.

Assuming the vehicle is suitable for carrying chemicals, attention needs to be paid to the following:

- **DO NOT** stack heavy containers on top of light ones.
- Load the least dangerous material on top.
- **DO NOT** stack the load too high or wide and make sure it is secured by approved containment devices (gates/hurdles/straps).
- Load liquid chemicals with the container opening facing up.
- Observe any special loading instructions listed on the labels or SDS.

Rules on load restraint

You must restrain any load you are carrying on a light vehicle so that it:

- Stays on the vehicle during normal driving conditions – this includes heavy braking, cornering, acceleration and even minor collisions.
- Doesn't negatively affect the stability of the vehicle, making it difficult or unsafe to drive.
- Doesn't protrude from the vehicle in a way that could injure people, damage property or obstruct others.

You must pick up any fallen load if it is safe to do so or arrange for someone to retrieve it.

The law sets out Performance Standards for load restraint

The National Transport Commission (NTC) provides Performance Standards that set out the minimum amount of force a restraint system must be able to withstand in each direction. These are:

- 80% of the weight of the load forwards
- 50% of the weight of the load sideways and rearwards
- 20% of the weight of the load upwards (if the load isn't fully contained).

If a load is restrained to meet the Performance Standards, it will not fall off or affect the stability of the vehicle under expected driving conditions. This includes emergency braking and minor collisions.

You can find a copy of the Load Restraint Guide 2018 on: www.spraysmart.com.au under Learner Login.

Dangerous Goods: How they are classified?

Australia's system for the classification of Dangerous Goods is based on the system developed by the United Nations and is the same as used in many other countries. It is designed to quickly help people recognize Dangerous Goods, their properties and potential dangers.

The Dangerous Goods classification system should never be confused with systems for classifying hazardous substances or poison schedules. Classification systems are independent of each other, but can be interdependent, and covered by separate laws. Any substance can fall into different categories in these classification systems.

Dangerous Goods (DG'S) are chemicals, substances or articles that can cause immediate risk at ALL times to human health, animal health and the environment when transported, handled or stored. They are determined by their immediate hazards rather than any potential health effects for people that work with these substances.

Dangerous Goods are defined under the Australian Dangerous Goods (ADG) code and includes goods too dangerous to be transported or C1 combustible liquids. Licensing is required for specific substances in some Dangerous Goods classes.

Some common Dangerous Goods are petrol, LP gas, oxygen and acetylene cylinders, pool chlorine, some pesticides, flammable solvents (i.e. methylated spirits, acetone and turps), kerosene, some paints and glues, combustible liquids (diesel) acids and caustic soda, explosives, including fireworks and security sensitive ammonium nitrate.

Labeling: Dangerous Goods are divided into nine classes according to their risk.

HINT: if it has a DIAMOND on the label it is a Dangerous Good

You can determine from the product label whether that particular product is classified as a Dangerous Good. See the figure below for class labels that will appear on the product label if that product is a dangerous good.

All these label symbols and codes relate to transport, storage or handling of that product. It is important that pesticide users are able to determine from this information what their responsibilities are.

DANGEROUS GOODS CLASSES

Main classification	
1. Explosives	
2. Gases	   
3. Flammable liquids	
4. Flammable solids	  
5. Oxidizing substances and organic peroxides	 
6. Poisonous and infectious substances	 
7. Radioactive substances	
8. Corrosives	
9. Miscellaneous dangerous substances	 Environmentally hazardous 

Source: WorkCover NSW

Packing Groups: show the potential level of danger to people who are exposed when an accident occurs. Only class 3, 4, 5, 6 & 8 are assigned a packing group.

I = Great Danger	II = Medium Danger	III = Minor Danger

UN Numbers: The United Nations have allocated a four-digit UN Number to substances and articles to assist in their identification and to assist emergency services around the world. A Code has been developed which is a first response instruction providing advice on dealing with issues such as a fire or an environmental contamination situation involving Dangerous Goods.

Storing and Transporting Dangerous Goods in New South Wales (NSW)

The Dangerous Goods Storage and Handling Regulations are defined in the Dangerous Goods Act 1985 and are classified in the Australian Code for the Transport of Dangerous Goods by Road and Rail ADG 7.6, 2018 Code) according to their common hazardous properties. **The code is given legal force in each Australian state and territory by each jurisdiction's dangerous goods transport laws.** It is important that the code is read in conjunction with these laws. A summary of these can be found on our web site at:

www.spraysmart.com.au under your Learner Login

The storage of pesticides is regulated by four pieces of legislation:

1. Protection of the Environmental Operations Act 1997
2. Work Health and Safety Act 2011
3. Pesticides Act 1999 & Pesticides Regulation 2017
4. National Standard for the Storage and Handling of Dangerous Goods

When quantities exceed 1000kg or Litres combined, there are additional specifications which must be met and complied with, such as:

1. **Dangerous Goods (Road & Rail Transport) Act 2008**
2. **Dangerous Goods (Road and Rail)) Regulations 2014.**

What is a placard load: A placard load is any load containing any individual receptacle greater than 500L/kg, or loads consisting only of receptacles each with a capacity 500 lts or less **and** containing 500 kilograms or less of dangerous goods, the load is a placard load if it contains?

- ✓ **any** category A, division 6.2 dangerous goods (infectious substances)
- ✓ **10 litres/kilograms or more**, of category B, division 6.2 dangerous goods (infectious substances)
- ✓ **any** division 2.1 (flammable gases except aerosols), div 2.3 (toxic gases) packing group I substances in the load & total quantity of all dangerous goods is 250 lts/kgs or more
- ✓ domestic/consumer products, total of **2,000 lts/kg of dangerous goods or more**
- ✓ where none of the above apply, a total of **1,000 lt/kgs of dangerous goods or more**

When carrying a placard load on your vehicle you are legally obligated to be compliant with the relevant legislation and you **MUST** carry **emergency information and a first aid kit** in your vehicle at all times.

Dangerous Goods (Road and Rail Transport) Act 2008

This Act commenced on 1 May 2009 and appoints the EPA and SafeWork NSW (formerly WorkCover) as competent authorities to administer the legislation. The EPA regulates the on-road transport of dangerous goods while SafeWork NSW regulates activities prior to transport, including correct classification, packaging and labelling. The transport of dangerous goods by rail is regulated by the Independent Transport Safety Regulator on behalf of the EPA.

Exemptions under the Dangerous Goods (Road and Rail Transport) Act 2008 for:

- ✓ Small quantities transported for private use
- ✓ **DG's transported under Tools of Trade provisions**

- ✓ Certain single consignments
- ✓ Goods intended to be used by a person for a commercial use.
- ✓ Applies if aggregate qty <500 L and no Class 2.1, 2.3 or PG 1 in the load.
- ✓ Applies if aggregate qty <250 L and any Class 2.1, 2.3 or PG 1 is in the load provided that 2.3 and PG 1 together is <100 L/kg
- ✓ And the aggregate quantity of DG's must be in a space separate to passenger compartment.

Amount of Dangerous Goods	Transport Documents
Less than 25% of Placard load	Exempt
Category 1 - less than Placard load	Transport Documents
Category 2 - Placard Load (receptacles up to 500 L/500 kg net mass)	Placards (Class labels), transport documents, emergency info/holder-reflectors - 30B fire extinguisher - PPE - stowed correctly & segregated
Category 3 - Placard Load - Receptacles > 500L capacity /500 kg net mass	Placards (EIPs & Class Labels) - Transport documents - Emergency info c/w holder - Reflectors - additional fire extinguishers - PPE - Stowed correctly - segregated - Licenses unless only IBC up to 3000L

Segregation of Dangerous Goods for Transport and Storage

Segregation means keeping incompatible goods apart from one another. Chemicals must be segregated when either stored or shipped to ensure they do not mix in case of spillage.

Placarding Requirements for Storage of Dangerous Goods

To assist emergency personnel, placards provide useful information about the Dangerous Goods at your premises. If the quantity of Dangerous Goods on the premises is above the "placarding quantity" threshold you must display a **HAZCHEM** placard at the entrances to the premises. Other types of placards may also be required at locations within your premises, where Dangerous Goods are stored and handled.

Placards (signs) indicating the hazard are required for storage areas or tanks containing Dangerous Goods in notifiable quantities. These are based on the Dangerous Goods "diamond" symbol on the label (or the transport placard).

Store packaged Dangerous Goods in a securely marked area with the appropriate Class diamond sign - e.g. the skull and cross bones for Class 6 on or near the door. If the goods are kept in only one part of the building, put another diamond sign next to or above the actual storage area.

Above placard quantities, consult the **Code of Practice for the storage and handling of Dangerous Goods** for further advice.

Manifests, Emergency Plans and Notification

You must have emergency arrangements in place regardless of the size of the premises or the quantity of chemicals. Where the quantity exceeds the 'manifest quantity' threshold, controllers of premises must also:

- Prepare a written emergency plan, which is reviewed at least every five years.
- Prepare a 'manifest', which includes a list of the chemicals, their location on the premises and a site plan.
- Notify the Government Regulatory body in your State or Territory responsible for WHS, e.g. Workcover in NSW.

WorkCover NSW
Locked Bag 2906
Lisarow NSW 2252

What is the GHS, Globally Harmonised System of Classification and Labelling of Chemicals?

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) is a single internationally agreed system of chemical classification and hazard communication through labeling and Safety Data Sheets (SDS). The GHS is published by the United Nations and is sometimes referred to as 'the purple book'.

It includes harmonised criteria for the classification of physical hazards, health hazards and environmental hazards and **became effective in Australia on January 1, 2017.**

Safe Work Australia has advised that chemicals **manufactured or imported before January 1 2017** will not need to be re-labelled to meet GHS requirements.

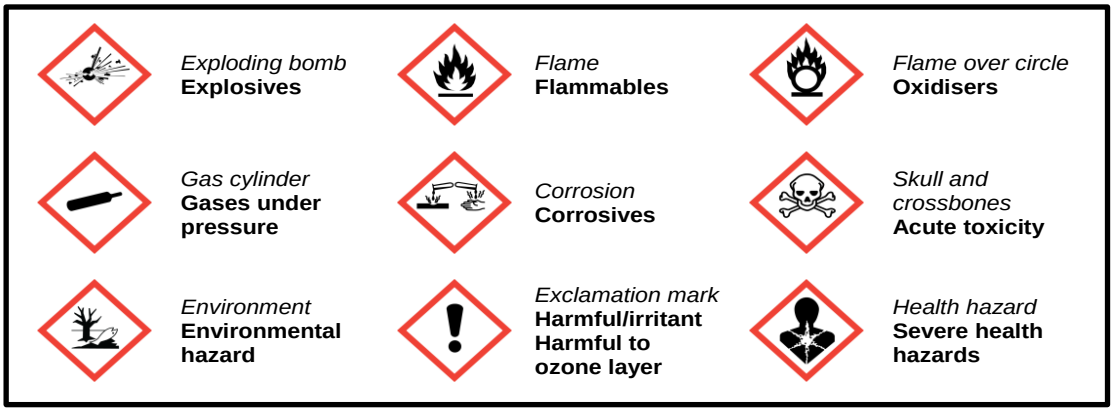
It is expected that the GHS will provide trade benefits to industry as well as improved health and safety outcomes through use of internationally consistent hazard communication elements.

What is Hazard Communication?

Hazard communication is a term used to describe how critical information about the hazards of chemicals and any precautions necessary to ensure safe storage, handling and disposal, are conveyed to users of chemicals. In the GHS, hazards are communicated to chemical users through a combination of symbols as well as words, in the form of signal words, hazard statements and precautionary statements. These are intended to appear on labels and in SDS.

Pictograms

There are nine hazard pictograms in the GHS which represent the physical, health and environmental hazards.



Safe handling of Pesticides and Veterinary Medicines

Use of unsuitable equipment or poor handling techniques can damage packaging and increase the risks of spillage. Consequently, attention should be given to the following:

- The use of adequate protective clothing and safety equipment.
- Workers engaged in loading or unloading must be trained for the job.
- Tools that can damage packaging, such as baggage hooks, must not be used.
- Pallets/truck beds must be free from protruding obstructions that could damage containers.

- Suitable mechanical handling equipment must be used to reduce the risk of container damage.
- Consider in your risk assessment: the lifting of heavy containers, pouring and mixing chemical concentrates, ventilation in the mixing area, appropriate equipment and PPE.

If pesticide application is a regular job, consideration should be given to the purchase and use of equipment designed for handling chemical concentrates. Correct storage helps prolong chemical shelf life while protecting the health of people, animals and the environment. Consult the product label for specific storage information.

Small Chemical Storage - Risk Prevention Measures

When storing chemicals consider the following risk assessments for the storage facility:

- The quantity of chemical to be stored and the type of container (package or bulk)
- Location well away from other workplace activities and/or accommodation, and separate from food, feeds, veterinary supplies, and seeds.
- Fireproof construction, well away from potential ignition and heat sources, or flammable materials such as fuels and oils.
- **Crossflow ventilation** should be provided with vents in opposite walls, **above bund height**.
- Concrete floors and door sills.
- Provide for **drainage of spills** and clean up water **into a sump or pit that can contain** the chemical, clean-up materials and the wash water.
- Insulation to ensure that substances are stored at a cool temperature to prevent deterioration.
- Adequate floorspace and shelving for the separation of chemicals, especially Dangerous Goods from other classes of Dangerous Goods. For example, Class 5 oxidising agents (i.e., solid pool chlorine), are incompatible with many substances.
- **Appropriate signage** especially for Dangerous Goods classes, PG (packing group) and other characteristics with respect to toxicity, stability and compatibility (SDS)
- A supply of wash water and soap should be readily available in cases of splashes or contamination of skin.
- Impervious shelving or spill control trays on shelving. **Appropriate Spill Kit.**
- Out of flood zones – waterproof – **NOT** near a stormwater drain.
- A **lockable door** to keep Dangerous Goods secure, and child-proof latch even if no Dangerous Goods are stored.
- Emergency procedures and equipment needed in the store such as clean-up kit for spills (consult the SDS for information on fires, spills and other emergencies). Provision for the containment of spills **(bunding)**, especially of those chemicals classified as Dangerous Goods, (i.e.: a drum with sand and a shovel).
- **The bunding (or walls) and door sill should be high enough to contain a spill of 100 per cent of the largest package plus 25 per cent of the total volume of remaining packaged liquid chemicals.**
- **Lighting that is adequate to easily read chemical labels.**
- A fire extinguisher approved for chemical fires, first aid equipment and emergency telephone numbers should all be readily available.
- Clean safety equipment readily accessible, but not stored inside the chemical storage shed.
- An up-to-date storage record sheet, and SDS for each hazardous substance, readily accessible in the event of an emergency (but not located in the storage shed).
- Products should be protected from moisture so that packing, and labelling does not deteriorate (especially cardboard containers).

ALWAYS observe **Australian Standard AS 2507 The storage and handling of agricultural and veterinary chemicals** if you have more than 1,000 kg or 1,000L of agricultural chemicals that are Dangerous Goods.

Check the SDS and labels for information on chemical compatibilities and other advice in relation to storage. In some cases, specific Australian Standards provide advice on the location, design and separation distances.

Storing containers

Store pesticides in their original containers; **NEVER** use soft drink bottles, fruit jars, or other types of food containers.

Under the AgVet Code THIS IS HIGHLY ILLEGAL.

Children are the number one group who are poisoned by chemicals. Poisoning can result from using the wrong container because small children associate the shape of a container with its contents.

Other important rules for storing chemical containers include:

- Keep the original label attached to the container. Remember, the information on the label is essential in the safe use of pesticides and veterinary medicines.
- Never lend or give away any product in an unmarked or unlabeled container.
- Close containers securely when not in use. Dry formulations tend to cake when wet or subjected to high humidity.
- Store liquid formulations and small containers of dry formulations on metal shelving. Metal shelving will not absorb spills and is easier to clean than other surfaces.
- Store temperature sensitive products as per label advice, or in cool locations on lower shelves. Too much heat can cause the container to break or burst open.
- Containers should not be put where they could be bumped or knocked off shelving.
- Containers of liquids should be stored below powders, so any leaks do not affect the powdered products.
- Check shelving materials will not damage containers.
- Store chemicals in their separate chemical groups e.g. insecticides away from herbicides.
- Some animal health products like vaccines and antibiotics will need to be refrigerated.
- Transferal via decanter from a larger container to a smaller container of the same product is allowed if it has the same APVMA approval number on both containers.

Shelf Life of Pesticides

A product cannot be legally used beyond its Use by or Expiry date. Keep an inventory of all products in storage and mark each container with the purchase date.
If a product has an effective shelf life recorded on the label, you will know how long the product should remain usable. If there are doubts concerning the shelf life of a product, call the retailer or manufacturer **- two years is regarded as a reasonable shelf life for pesticides**, although many products will retain their quality for a number of years if stored according to label instructions.

The best way to determine whether old pesticide products can be used, is to conduct a small trial by spraying a small amount of product on the targeted pest at the recommended rate. It may be old but if it still works, and you can use it you are better to use it than to dispose of it.

Safe disposal

It is the responsibility of the user to ensure that wastes such as unused chemicals and empty chemical containers are disposed of in an appropriate manner. Empty chemical containers can be a hazard to people, animals and the environment.

Under State Legislation incorrect disposal of chemical waste and other waste products are prohibited.

See extract below from the NSW Protection of the Environment Operations Act 1997.

Use of land as waste facility without lawful authority

A person who is the owner or occupier of any land and who uses the land, or causes or permits the land to be used, as a waste facility without lawful authority is guilty of an offence.

There are substantial penalties for breaches of the Act.

It makes good business sense to deal with chemical wastes properly and safely.

Plan carefully and observe the following guidelines:

- **Always read the label for disposal instructions.**
- Only mix sufficient chemical for the job.
- Decontaminate spray rigs at the site of application.
- Avoid disposal problems by purchasing only the amount you will need for one season.
- **Do not stockpile chemicals.** Recommendations may change and new chemicals may be better than old ones. The storage period may also exceed the effective shelf life of the product.
- Avoid always decontaminating spray equipment at the same site.
- During disposal of any unwanted pesticides, wear appropriate protective clothing.
- Clothing and protective equipment to be decontaminated, and decontaminated soils and materials used to clean up spills should be treated in the same manner as waste chemical.

Waste Management Programs

The **drumMUSTER** and **ChemClear®** programs are widely recognised programs that manage risks associated with Agvet chemicals. They provide an effective and convenient path for users to safely dispose of empty Agvet chemical containers and unwanted Agvet chemicals in accordance with the regulatory requirements of the States and Territories. The **drumMUSTER** and **ChemClear®** programs are well established programs and are an excellent example of industry self-regulation through extended producer responsibility and product stewardship in action.

Overall the benefits to the wider community from achieving the safe disposal of empty Agvet chemical containers and unwanted chemicals through the **drumMUSTER and ChemClear®** programs are considered significantly greater than if disposal was though licensed landfills.

Disposal of containers

Proper rinsing and cleaning are the first steps in the safe disposal and recycling of empty chemical containers. Clean containers are essential for meeting occupational health and safety standards in the recycling process.

Rinsing not only saves money by using rinsate in the spray tank but also renders the containers non-hazardous waste.

Never use pesticide containers for any other purpose than their original use.

Once you have used the entire chemical in a container you should immediately clean the container and store it in a safe location with the cap removed until you are able to deliver it to a **drumMUSTER®** collection.

AgSafe standards for container cleanliness

The container must be cleaned to meet the Agsafe Cleanliness Standards, which effectively means it:

1. Must be free of chemical residue.
2. Stains may be permissible if they cannot be removed with a gloved hand.
3. There must be no product residue on the inside or the outside of the container, including the thread.
4. The container should be dry.

Rinsing and Flushing

Rinsing should be carried out immediately after emptying the container, as residues are more difficult to remove when dry. Under current regulations in most states, containers that have not been properly rinsed can be classified as hazardous waste.

Triple rinsing

To triple rinse, follow these procedures:

1. **Rinse the container immediately after emptying.**
2. **Quarter fill the container with clean water and replace the lid.**
3. **Shake, invert and roll the container.**
4. **Drain rinsate into the spray tank.**
5. **Repeat two more times or until the container is clean.**

Flushing

In all cases follow the manufacturer's recommendations. Generally, the rinse cycle should last up to 30 seconds unless otherwise stated.

Whatever method of cleaning is used container lids should be rinsed separately in a bucket of clean water and this rinsate ultimately added to the solution in the spray tank. The containers should be cleaned on the outside to ensure they are free of chemical residue. All rinsate should be added to the spray solution.

For information on procedures for draining and cleaning oil based, ultra-low volume (ULV) and low volume (LV) insecticide sprays follow the manufacturer guidelines on the product label.

drumMUSTER - For disposal and recycling of eligible empty chemical containers.

Product eligibility is indicated by a **drumMUSTER®** eligible containers logo.

This logo may be applied to the container either as a sticker, printed as part of the product label or embossed into the container material.

The drumMUSTER® program provides an avenue for chemical users to dispose of their eligible unwanted 1 litre up to 205lt containers with the knowledge that they will be turned into valuable resources.

Since 1st February 1999, farm chemical users have paid a 4 cents per litre or kilogram levy on crop production and on-farm animal health products sold in non-returnable chemical containers over 1 litre or kilogram in content by participating manufacturers. This levy funds the **drumMUSTER®** program and is available to reimburse participating councils and other collection agencies for all agreed costs incurred in running a **drumMUSTER®** collection.

drum Muster® Preparation Process

In addition to meeting the Agsafe Cleanliness Standards detailed in Standards for Container Cleanliness the participation in the drumMUSTER® program requires:

- ✓ A signed statement by the chemical user, which provides evidence that the container has been and is cleaned free of chemical residue (but this must be backed up by other evidence of rinsing).
- ✓ The thread and neck of the container must be free of chemical residue.
- ✓ That the container should have the labels intact to provide inspectors with positive identification of the materials being handled.
- ✓ That the containers should be presented without the lids however the lids may be taken separately to the collection.

The container must have been cleaned and left to dry with the cap off after rinsing. The presence of any liquid in the container will result in rejection at a **drumMUSTER®** collection.
If a container is rejected, you should rinse the container again and use the rinsate to make up an application of the same chemical according to label recommendations.
Liaise with your re-seller to find out when and where your drums can be dropped off at your nearest drumMUSTER receival depots. You can also contact drumMUSTER on:

www.drummuster.org.au or 02 6230 6710

ChemClear - For the disposal of unwanted chemicals

ChemClear collects obsolete currently registered for use Agvet chemicals manufactured by signatories to the Industry Waste Reduction Scheme.

The program provides a safe and easy collection and disposal service for Agvet chemical users across Australia.

When does a chemical become a waste?

An Agvet chemical product becomes a waste when it is unwanted as a result of:

- Having served its purpose and is no longer of use
- Being left over or surplus to requirements
- Reaching its expiration date
- De-registration
- Severe restrictions on a product use
- Change in farming practices to newer and safer chemicals
- Sale of properties (deceased estates)

How do ChemClear® and drumMUSTER® differ?

Group 1 chemical being registered with the ChemClear program must have a level of 1 % or above in its original container to be accepted into the program as a waste.

If the container has less than 1 % of its mass the container should be rinsed free of residue and returned under the drumMuster chemical container recycling program. Any volume of Group 2 chemical which is commonly de-registered, expired, unknown or unlabeled is eligible for collection and disposal.

DrumMuster® is for the provision of correctly cleaned containers into the recycling chain.

ChemClear® collects and disposes of two different classifications of Agvet chemicals. Different criteria are applicable under each classification:

Below is a guide to Group 1 and Group 2 classifications:

'Scope of eligible products:

All crop protection and animal health products, including granules and powder formulations used for:

Agricultural and commercial livestock production
Pest or weed control on public, industrial and recreational land
Forestry

Similar activities conducted by local, state and federal government authorities (including Plague Locust Commission and transport departments)
Aerial spray operators.

Group 1 Chemicals - collected free of charge are:

Sold only by member companies of the Industry Waste Reduction Scheme (IWRS);

- ✓ Are registered agricultural and veterinary products[111] or products whose registration or permit ceased in a two-year period.
- ✓ Are in the original non-returnable rigid metal, plastic or cardboard container.
- ✓ Are identifiably labelled with the original manufacturer's label, or other permanent and clear identification (which includes the product and manufacturer's name and an indication of the date of manufacture/expiry date).
- ✓ Are not the subject of any other practical routine return program operated by the manufacturer and/or distributors for the product in its original container.
- ✓ Are not part of a special regulatory or voluntary phase-out campaign agreed to between the APVMA and the manufacturers.
- ✓ Are not the subject of any recall or phase-out as a requirement of the APVMA, where the deadline has expired and are not held by Distributors as unwanted inventory

Group 2 Chemicals – a fee applies for disposal for:

- ✓ Agricultural and veterinary chemicals whose registration has expired more than two years ago, including organochlorine and arsenical insecticides
- ✓ Farm chemical products of non-IWRS members companies that are either currently registered or whose registration or permit ceased since the last collection.

Registering to use the ChemClear® Program

There are six simple steps to using the program:

1. Make an inventory of any unwanted ag vet chemicals. The inventory should include all identifiable details of the container including product name, manufacturer, expiry date, size of container and the containers integrity, an estimate of the remaining quantity of chemical left in the container.
2. Register your Inventory for the next collection in your area. Book on free call 1800 008 182 or at www.chemclear.com.au.
3. Continue to store your registered chemicals safely and securely.
4. ChemClear® will contact you direct to advise the location for retrieval.
5. Prepare chemicals for delivery to collection site.
6. Deliver chemicals to pre-nominated site.

You can register at: www.chemclear.org.au

Meeting your Quality Assurance requirements

Both programs provide receipts for delivery/collection of containers and chemical product to the user of the programs as evidence of correct disposal which can be used for Quality Assurance purposes.
The drumMUSTER® and ChemClear® programs are widely recognised programs that manage risks associated with Agvet chemicals. They provide an effective and convenient path for users to dispose of safely empty Agvet chemical containers and unwanted Agvet chemicals in accordance with the regulatory requirements of the States and Territories.

The drumMUSTER® and ChemClear® programs are well established programs and are an excellent example of industry self-regulation through extended producer responsibility and product stewardship in action.

Cleaning Up Spills

No matter how carefully chemicals are handled, there will always be the chance of a spill, even if it is only a minor one. It is important to know the correct procedures and the equipment required. To deal with minor spills, keep a "spill kit" with the equipment necessary to clean up spills at the mixing and storage sites.

Suitable equipment for cleaning up spills:

- ✓ Absorbent material to form a bund around the spill and soak up liquids, eg sand, lime, vermiculite, or a commercially available absorbent.
- ✓ Square mouthed shovel.
- ✓ Open headed drums to put waste in.
- ✓ Brush and spade.
- ✓ Stiff bristled broom.
- ✓ Household bleach or washing soda, and/or hydrated lime.
- ✓ Protective clothing.

Dealing with Chemical Spills "**EMERGENCY SPILL RESPONSE**"

In the event of a liquid chemical spill remember the following 5 processes

- ✓ **Isolate:** The spill area from other people
- ✓ **Contain:** The spill from getting worse
- ✓ **Decontaminate:** The spill area using a neutralising substance
- ✓ **Dispose:** Of the neutralised substance safely
- ✓ **Notify:** Authorities

Steps to consider in the event of a spill are:

1. Keep unnecessary people, children, livestock and pets away.
2. Wear appropriate protective clothing.
3. Avoid direct contact with the chemical or fumes.
4. Keep naked flames away from the area, as well as unsafe equipment that may generate sparks.
5. Notify supervisor, call for assistance, and/or raise the alarm if necessary. Notify the Fire Brigade (000) if the spill is beyond your response capacity. **IN MOST CASES**, **A large spill is considered to be one where more than 200 litres/kgs of concentrate is spilled.**
6. Take immediate steps to control the flow of chemical from the spillage source.
7. Form a dam with absorbent material to prevent liquid spreading further.
8. Consult store records and follow the label and SDS instructions.
9. Absorb liquid by covering the spill with an absorbent material.
10. If powder or granules, recover any uncontaminated product and place the product into an appropriately labelled container for reuse.
11. Powder or granule pesticide residues (but not fumigants) can easily become airborne. The dust hazard can be controlled by slightly wetting the material with a fine water spray (unless incompatible) and decontaminating with hydrated lime or bleach.
12. Sweep the area carefully and shovel the absorbed chemical into open headed drums for disposal. Mark the drums 'Waste for Disposal' and the product name and attach an SDS to the container.
13. Dispose of waste product, contaminated cleaning solution and any contaminated PPE by following SDS guidelines.
14. On completion of clean-up operations remove and wash PPE, and contaminated clothing immediately. Launder as soon as possible. Shower, using liberal quantities of soap and water.
15. If soil is contaminated, remove the top layer of soil (5 to 10 cm) and dispose of it in the same manner as waste chemicals. Cover the ground area with hydrated lime and cover the lime with a layer of clean soil. (In some soil types the contamination may run deeper than 10 cms)
16. Record the spill and clean-up procedures.
17. Either you or your supervisor should notify the appropriate authorities in your State/Territory, usually the Fire Brigade.

Some formulations such as solid fumigants or other class 4.3 Dangerous Goods are incompatible with water so check the SDS for water compatibility.

Reporting Incidents

A system for workers to report storage and transport incidents as required should be established within the workplace too:

1. Determine the cause or likely cause of the incident
2. Review the risk assessment
3. Check the results of the investigation
4. Revise risk control measures accordingly

5. Be prepared in consultation with workers
6. Documented so that it is readily understood
7. Be able to inform supervisors, workers and other persons of the results of the investigation.

Records of incident investigations

Consider including the following:

1. Were on-site or off-site emergency plans activated?
2. Did the leak or spill have the potential to cause fire, explosion or release of toxic or corrosive materials?
3. Did the leak or spill have the potential to cause:
   - Acute or chronic human health effects?
   - Environmental harm?
   - Damage to plant or equipment?
   - Would the leak or spill affect the quantity or quality of effluent discharged into the sewers?
   - Did the leak or spill need to be reported to Worksafe and/or the Department of Environment and Conservation?

Pesticide Incident Report

Nature of incident:

Have you experienced similar incidents: **Yes / No (if Yes, when?)**

Farm Contact: Position: Ph/ Mob:

Agronomist/ Consultant: Ph/ Mob:

Site name: Location:

Non target area exposed: Growth stage:

Date/ time of incident or when effect first noticed: By who:

Reported to: ☐ **Grower/ Owner** ☐ **Site Manager** ☐ **Neighbour/s**
☐ **State Regulatory Officer** ☐ **APVMA**
☐ **Other (please specify):**

Approx.' size of area (ha) impacted: What % of total area does this represent?

Location/ description of area: (e.g. site map attached, field numbers or name, GPS coordinates)-

Initial assessment of incident: including observed adverse effect on area (circle): **Low / Med** / **High**

Describe any relevant events or effects prior to and following exposure. Include estimate of potential property damage or environmental damage. Attach any reports, comments etc, from investigating agencies, and other information where applicable such as site history, suspected drift source, meteorological data, etc.

What chemical/s are suspected to have been involved? _____

Supporting information attached: ☐ **Photos of affected plants** ☐ **Other: (specify)**

Note: A copy of this report may need to be provided to the APVMA 'Adverse Experience Reporting Program' for the purposes of assisting in monitoring incidents of off-target spray drift and for determining future spray application and drift management preventative strategies.

NOTES

Chapter 5

RISK MANAGEMENT

"The chemical label is your best risk management document"

Introduction

Pesticides must always be used strictly as directed on the label. The labels warnings and safety precautions must always be observed when using the product.

Under state legislation, a person must not use a product in a manner that results in any injury to another person, their property, or the environment.

Risk Management is the process by which users of pesticides implement measures to help them minimise risks in their workplace.

Risk Management

The Principles of Risk Management can be applied to all aspects of the workplace to minimise risks to human health, property and the environment.

Whether you resolve risk management situations on the go or you undertake a more formal approach, the type of risk assessment you are applying are the **"SAFER" principles of risk management:**

- **"See it"** → Identify the hazard
- **"Assess"** → Assess the nature and degree of risk associated with the hazard
- **"Fix It"** → Take appropriate action to manage and control the risk
- **"Evaluate"** → Evaluate the action you have taken to manage the hazard and control the associated risk
- **"Record"** → Record the action you have taken or plan to take

In summary the four components of a risk management process are:

- Hazard identification
- Assessing risks
- Eliminating or managing the risks
- Develop a plan and record actions.

Hazard Identification

A hazard is the term used to describe something with the potential to cause harm and can be health hazards, physical hazards, hazards to property and environment.

Assessing Risks

A risk can be described as: **RISK = HAZARD x EXPOSURE.**

The following chart can help you assess risk level and prioritise actions to manage the risk.

When you use the matrix to assess hazards as being low risk, this doesn't mean that no action (control) is required but rather that there are other higher priority risks that require attention first. Once these higher priority risks are controlled then you can attend to the lower priority risks with the objective of maintaining a safe workplace for everyone.

Using table 10a you could see that using a highly toxic (S7) pesticide could kill or cause permanent illness. If there are no safe handling procedures or personal protective equipment used, then injury is very likely and will almost certainly happen. Therefore, the risk rating is extreme and immediate control (action) is required, considering the "Hierarchy of Control" principles in section 1.3.

Likelihood	Major (eg death/disability)	Serious (eg serious injury/lost time)	Minor (eg first aid injury)	Insignificant (eg incident but no injury)
Very likely	Extreme	High	High	Medium
Likely	High	High	Medium	Medium
Unlikely	High	Medium	Medium	Low
Very Unlikely	Medium	Medium	Low	Low

Eliminating or Managing Risks

Once a hazard has been identified and the risk assessed, it is important to put processes in place to manage the risks.

The **hierarchy of control** is a list of control measures, in priority order, that can be used to eliminate or minimise exposure to hazardous substances.

The steps in the hierarchy control in priority order are:

- **Elimination**
- **Substitution**
- **Isolation**
- **Engineering controls**
- **Administrative controls**
- **Personal protective equipment.**

Which of these controls you use depends on a number of factors, however you should note that effectiveness of these control measures is generally improved when more than one measure is used?

Example, removing the hazardous substance from your workplace may eliminate exposure. This may be achieved by the adoption of an Integrated Pest Management program.

Substitution

Using a pesticide with a lower toxicity can still offer satisfactory control of the targeted pest, i.e **switching from an S6 to S5 chemical**.

Engineering controls / Isolation

Engineering controls include guarding, shielding, design of equipment and systems, and can be used in the following ways:

- ✓ **Lock your chemical shed at all times when unattended**
- ✓ Changing nozzles to increase droplet size can result in less risk from drift exposure.
- ✓ Using an air extraction ventilation system in your chemical storage room will remove vapour from the workplace
- ✓ Using a Canid Pest Ejector (CPE) for 1080 in wild dog baiting reduces the chance of non-target species taking up the baits.

- ✓ Changing the design of a spray applicator i.e. adding a cover will help lower the risk of exposure to the operator and environment.
- ✓ Reducing manual handling requirements by switching from 20 litre drums to 5 litre drums.
- ✓ Notify your neighbours by the use appropriate signage.

Administrative Controls

Administrative controls are "policy" or behavioural controls and relate to designing safer working procedures or practices. Often these controls are referred to as 'Safer Work Methods Statements' (SWMS) or 'Standard Operating Procedures (SOPs)'. Training, instruction and supervision are critical components of administrative controls.

Examples include:

- Ensuring that all users of pesticides have received proper training and instruction and are assessed as competent.
- Enforcing a policy requiring the wearing of appropriate PPE as per the label directions.
- Reducing the number of persons exposed and excluding access of nonessential personnel to chemicals especially the mixing area.
- Ensuring that chemical application activities are carried out at the most appropriate time of the day.
- Providing and ensuring the use of adequate facilities for effective decontamination, and also ensuring that emergency first-aid procedures are in place.
- Ensuring that re-entry periods are strictly observed, and all people are removed before a spray application commences.
- Ensuring used containers are disposed of in accordance with label directions and hazardous substances are stored in an approved manner.

Personal Protective Equipment (PPE)

The label requirements for use of PPE must always be complied with but, in cases where the risk of exposure to a hazardous substance cannot be adequately reduced by other higher control measures, the operator must be issued with good quality and well-maintained PPE and instructed in the appropriate use and maintenance of the equipment.

Workplace Health and Safety (WHS) Act 2011

All states other than Victoria, Western Australia and South Australia have endorsed the new harmonised Workplace Health and Safety legislation. These states remain under their existing OH&S legislation. The new WHS Act 2011, became effective on January 1, 2012 with Tasmania deferring until January 2013.

Employers (PCBUs) must ensure the health, safety and welfare of employees (workers) by providing and maintaining equipment and safe systems of work and working conditions. Employers must also make information that affects worker safety available to employees, and to provide training.

The health and safety of visitors to the workplace must also be ensured.

Employees must take reasonable care for the health and safety of themselves and others and cooperate with employers in their efforts to comply with occupational health and safety requirements.

(Note under the WHS legislation an employee is referred to as a worker and an employer as a PCBU, a person conducting a business or undertaking, alone or with others, whether or not for profit).

Guide to OH&S / WHS Regulations

OH&S regulations may vary from state to state, which is why there has been the push for, and majority acceptance of, nationally harmonised workplace health and safety legislation. Following are some of the principles that are usually incorporated in OH&S regulations. You should also check the specific requirements in your state.

WHS legislation generally requires risk assessments only for high risk activities. It involves a more practical approach to making work safer, with a greater focus on ensuring the appropriate risk controls are in place, rather than on paperwork.

Hazard Identification:

- Identify hazards that could harm
- Have procedures in place to identify hazards at specific times e.g. before new chemicals are introduced.

Risk Assessment

If a hazard is identified an employer must assess the risk.

Risk Assessment consists of the following steps:

- Evaluate how likely it is that someone will be hurt or become ill and how serious any injury or illness could be.
- Review available information about the hazard.
- Identify the actions need to be taken to eliminate or minimise the risk, as far as is reasonably practical. If the risk is extreme with the likely potential for a fatality or major injury then the activity should be ceased.
- Identify the records that need to be kept.
- Risk assessment must be reviewed if no longer valid e.g. when someone is hurt or work practices change.

Risk Control

If the risk cannot be eliminated it must be controlled.

Instruction and training help to control risk factors i.e induction training for new employees before they commence work.

Any person exposed to a risk must be informed of that risk and given information about the risk.

Supervision

Provide supervision by an appropriate competent person/s if necessary.

Personal Protective Equipment (PPE)

Provide appropriate PPE.

First Aid facilities

Must be appropriate for the particular workplace and any common medical emergencies that may occur at the workplace.

Consultation

State legislation may specify the requirement for consultative processes eg OH&S committees. WHS legislation allows for workers to express their views concerning health and safety and contribute to the decision-making process. A Health and Safety Representative (HSR) can be appointed by the PCBU/workers to represent a work group and form a Health and Safety Committee (HSC) if requested by the work group.

Reporting Accidents

Record accidents and notify authorities.

Remember PPE is your last line of defense, start at elimination and then work down towards PPE. When using chemical control measures and having considered all potential controls always follow the label safety directions and wear the prescribed protection equipment, for both preparing and using the chemical.

Chapter 6

INTEGRATED PEST MANAGEMENT

"Identify your pest"

Introduction

Integrated Pest Management (IPM) uses various tactics in an integrated manner to keep pests from reaching harmful levels. IPM encourages pest managers to explore and use all practical means of pest control and, if that includes pesticides and veterinary medicines, to use those products sparingly and effectively.

What are pests?

Pests are living organisms that cause loss, damage or injury to crops, livestock, stored produce or the environment. Pests may also be a nuisance and interfere with our way of life and standard of living.

The majority of organisms are **NOT** pests. Most organisms are in fact beneficial. Correct identification of the pest and monitoring of pest numbers is essential for effective management.

For effective pest management, we need to understand how pests grow and reproduce (life cycles), how populations and individuals behave, and we need to recognize the damage that they cause. We need to know the numbers of pests that can be tolerated before management measures become necessary.

This will enable us to select management techniques that are effective and select the correct timing for treatment (e.g. at what stage of the pest's life cycle is it most vulnerable and therefore most easily managed.)

Pest Groups

There are six types of pest groups found in Australia. Each cause their own complications to farmers and landowners in Australia

1. **Weeds**
2. **Insects**
3. **Plant Diseases**
4. **Animal Diseases**
5. **Snails & Slugs**
6. **Vertebrate Pests**

(Potential New Pests)

There are many pests that are present overseas but have not reached Australia. These include:

- Animal diseases e.g. rabies
- Insects e.g. Veroa destructor (bees)
- Animals e.g. Squirrels
- Plant diseases

Maintaining Biosecurity

'Biosecurity' is a general term for a number of measures designed to protect people, farming systems and ecological systems from the entry and spread of unwanted animals, pests, diseases and weeds.

National biosecurity is the responsibility of the Commonwealth Government through Biosecurity Australia and the Australian Quarantine and Inspection Service (AQIS). Relevant State and Territory Government Departments are responsible for the protocols for interstate biosecurity. Landowners and managers can implement biosecurity measures for individual properties.

Defining IPM

Pest management can be brought about most effectively by focusing on the 'whole' system and using appropriate methods. This long-term approach of using all appropriate control techniques together in a planned and systematic way is called Integrated Pest Management (IPM). The first step of an Integrated Pest Management (IPM) approach is to prevent the pest, weed or disease from occurring. If the problem does arise, then the next stage is to determine if control is necessary.

Is Management Necessary?

If a living organism is not causing damage or being a nuisance, it is not a pest and management is not required. If damage is being caused, the level may not be enough to justify control measures.

The Economic Threshold (ET) is the pest density at which damage caused is equal to the cost of control.

Control is not warranted below the ET.

Above the ET, the gains from controlling the pest are greater than the cost of control.

In most cases, all we need to do is apply enough controls to reduce the pest population to a level where it is no longer a problem.

Generally speaking, we need to manage the pests to prevent significant economic loss, not try to eradicate them.

An important part of pest management is monitoring to correctly identify pests, beneficial organisms and the population of each.

Pest Management Options

There are many tools that can be used alone or integrated to minimise the damage caused by pests and keep populations at a level where the damage they cause is not economically significant.
Pest management techniques can be grouped under the following techniques:

- **Exclusion**
- **Managerial/cultural**
- **Physical**
- **Genetic**
- **Biological**
- **Chemical**

These measures can be implemented to prevent the pest building up to damaging levels, or curatively to control the pest once it reaches the economic threshold.

Exclusion

Quarantine restrictions are part of a management system to prevent the introduction of pests, weeds and diseases. By setting standards and only allowing entry of machinery between work sites that meet those standards, many pest problems can be avoided. The benefits of exclusion are enormous, but the technique is often under-valued and under-utilised.

Managerial/Cultural

These are generally preventative techniques. They allow us to manage the system to make it unsuitable for pests. Examples:

- Using pest-free planting material
- Maintaining a healthy stand of turf.

Physical Techniques

These are the simplest, most basic, and most often used management techniques. In some cases, they are only effective for a short time, so they have to be repeated. Labour requirements may be high, consequently restricting their use to small areas. In spite of the problems, physical controls play a very important part in pest management.

Physical techniques are adaptable, specific, can be used by relatively unskilled labour and the necessary equipment is usually readily available. Examples: slashing and cultivation.

Genetic Techniques

These techniques include genetic engineering, traditional breeding and selection for species/varieties resistant or tolerant to attacks by pests or disease. Some individuals within a species or breed population may have natural resistance to a pest or disease. These individuals are identified, and their specific qualities are deliberately bred into populations of plants or animals.

Biological Techniques

Biological techniques traditionally use living organisms, either local or introduced, to minimise pest activity through disease, predation or parasitism. The release of sterile males to reduce fruit fly and blowfly populations is another biological technique. Examples:

- Ladybirds, lacewings, hoverflies & earwigs managing aphids
- Myxomatosis and calicivirus in rabbits
- Parasitic wasps to manage scale insects on citrus
- *Bacillus thuringiensis* or BT (more of a 'biopesticide') to manage caterpillars, "GreenGaurd®"

There have been many outstanding successes with biological techniques. Successful biological control has many advantages. It is selective and has few side effects. The agents are natural, are already available, are generally free, and they actively seek out pests. There are generally few problems with resistance and management is usually ongoing. Naturally occurring populations can be encouraged or conserved to maximise their impact.

Biological agents can take time to build up. The timing of a BT application is critical to successful control of caterpillars. Because BT's are stomach poisons, they must be eaten by the insect in order for it to work. Therefore, it is important that BT be sprayed on leaves of trees when caterpillars are actively feeding. BT's are most effective against young, actively feeding caterpillars. It is best to make two applications of the spray over the course of 2 weeks to ensure that susceptible caterpillars are treated. Apply the first spray on the foliage immediately you see caterpillars and apply again 2 weeks later or after rain.

When transporting biological agents such as the calicivirus always be aware that there may be special requirements that differ from those when transporting chemicals. Biological agents can be living organisms and you may need to transport them in a darkened, cool environment out of direct sunlight e.g. in an esky. Ask the supplier if there are any special transport requirements.

Chemical Techniques

Some pesticides are target-specific whereas others are broad-spectrum and kill not only the target pest but other species as well. Some are persistent and give residual control. Pesticides can sometimes be applied in situations where it is impractical to use other methods. The use of pesticides is important for continued production of most crops, but they should be used with discretion. Examples:

- Herbicides
- Insecticides
- Fungicides

Integrated Pest Management Strategies

An Integrated Pest Management (IPM) system incorporates various pest management techniques in an integrated multi-pronged approach to manage one or more pests in a production system. IPM is a management approach rather than an eradication program.

The methods in an IPM system complement each other to maximise effectiveness and minimise problems resulting from reliance on one management method. An IPM strategy must be individual, practical, economically sound and flexible because it will need to be adapted from year to year, and farm to farm, as pest problems change, new management techniques become available, value of produce and cost of controls changes.

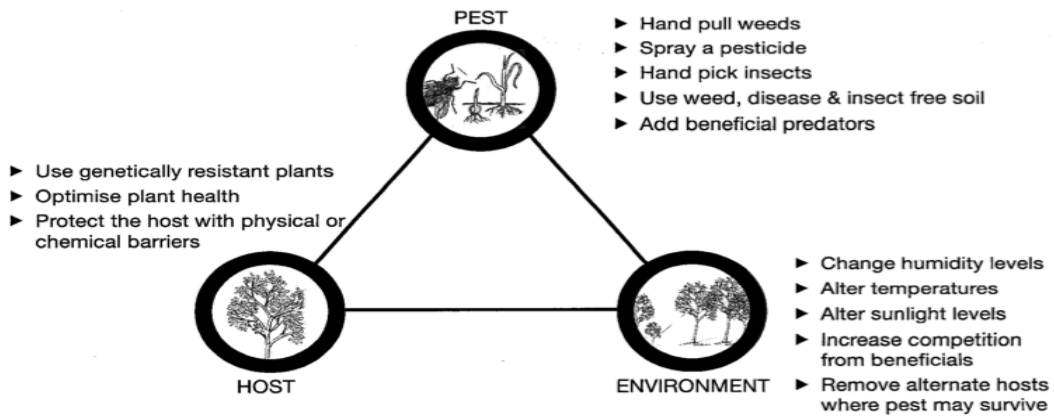
The Pest Triangle

Getting Started

INDENTIFY YOUR PEST. The heart of effective, efficient and environmentally conscious pest control is knowledge of the pest, its host(s) and the environment in which it lives whether you are dealing with insects, weeds or diseases. There is usually some stage in a pest's life cycle in which we can intervene. This might be by acting on the pest directly, its host(s) or changing the environment in which both live, or all three. How, when and where we do this is based on what is known as the "pest triangle."

The Triangle Relationship

There is always a relationship between the pest you are seeking to control, the host it is attacking and its environment. Eliminate or alter any of these three parts of the triangle and you limit the ability of the pest to cause economic damage.



Integrated Pest Management Plan

Your objectives in assessing a pest are to:

- **Identify the pest.**
- Identify the current stage of the pest's life cycle.
- Map the pest's location (sketch or GPS.)
- Determine the number of insects, weeds or disease infected plants/animals.
- Analyse the environment surrounding the pest, as well as the entire area that might be affected by your control actions. Do a risk assessment on each control option as to their effect on neighbouring people and beneficial and non-target plants, insects and animals.
- Identify key hosts. These are plants or other hosts that have a history of problems or in some other way indicate the presence of the pest.
- Identify what damage the pest is causing
- Keep accurate records as you may find that the same problems appear on the same hosts year after year. The Pest Triangle is dynamic and always changes over time. Environments change with the seasons; weeds and insects mature. Your pest control methods will change as the relationships between the pest, its host, and the environment in which they live change.
- Find out how many pests attacking a host at any given time constitutes Economic Injury.
- Ask yourself how much damage you are willing to accept before taking action. This is called the Control Threshold.
- When you believe the economic damage to the host is greater than the cost of control you have reached the Economic Threshold and it's time to take action.

Benefits of IPM

IPM offers the prospect of successful, long-term management of pests with minimal off- target effects. The benefits include:

- Maintenance of a better balance between the pests and their natural enemies
- More efficient and effective pest management
- Reduction in the quantity of pesticides and veterinary medicines used
- Delayed development of resistance
- Improved safety for the environment and the community
- Greater customer confidence.

Implementing IPM

Regardless of what pest you are dealing with, there are a number of steps that need to be taken when deciding if and how to control pests.

- **Identify the pest** - what is it? You can use illustrated guides to identify most pests or contact your local consultant or government agency.
- Gather information about the pest - damage potential and economic threshold, symptoms caused by the pest.
- **Monitor the pest and other species in the system** - record information - how many, what impact is it having, is the population changing overtime?
- **Make a decision about whether the pest needs to be controlled** - compare and check information with the recommended economic threshold and consider the impact of control on other potential pests.
- **Select and implement a control option** - record details of control action - consider options with the least impact on other species first.
- **Assess and modify** - determine if the control was effective.

Review and improve IPM program

- Review how successful each pest control action was, and how well they worked in combination - review written records of pest populations
- Experiment with other available options to see whether they are suitable for your system
- Discuss with other farmers what control or management they have used and how it worked
- Review goals for IPM.

Monitoring

Monitoring is a key activity to ensure successful IPM in the long term. Effective monitoring requires:

- Knowledge of when and where to look - soil, leaves, fruit, buds, shoots, etc. Use of nets, traps, etc can aid detection of pests.
- Ability to identify pests and predators, knowledge of their life cycles. Aids include collection bags, hand lens, pen and notebook, identification guides.
- Recording of environmental conditions, understanding of environmental influences on host/pest relationships.

Resistance to Pesticides

Pesticide resistance is the natural ability of a target species to survive an application rate that would normally kill it.

Pesticide resistance is a serious problem and has had an impact on the effectiveness of herbicides, insecticides and fungicides.

In any pest population there is likely to be a small number of individuals that are naturally resistant to particular pesticides, even if they have not been exposed to them. When pesticides are used, these resistant individuals survive and reproduce, whereas the majority of susceptible individuals are killed. Continued use of a pesticide or pesticide group will eventually result in a significant fraction of the pest population with resistance.

All herbicides, insecticides and fungicides sold in Australia have either a letter code, numeric or alpha-numeric code on the product label that indicates the mode of action i.e. how it works.

Example of a Mode of Action (MOA) mode i.e. group M herbicide, on a Roundup Biactive label

Resistance can be minimised by rotating the use of pesticides with different MOA's

If you continue to use products with the same mode of action and do not follow an anti-resistance strategy you are creating future problems for yourself. Mode of action matters.

The main reason resistance has developed is because of the repeated and often uninterrupted use of herbicides with the same mode of action. Selection of resistant strains can occur in as little as 3 - 4 years if no attention is paid to resistance management. Remember that the resistance risk is the same for products having the same mode of action.

NOTES

Chapter 7

ENVIRONMENTAL SAFETY

"Droplet size is the single most important factor affecting spray drift"

Introduction

If handled and used correctly, pesticides and veterinary medicines can control pests with minimal impact on the environment. But misuse can cause environmental damage through injury to non-target organisms, or contamination of water, soil and air. We all have a duty of care to ensure that pesticides and veterinary medicines are used responsibly to ensure that access to products and environmental safety are maintained.

Chemical Movement in the Environment

There are many pathways for a pesticide to enter the environment.

Not all factors will operate at the same time, nor do they operate discretely to the exclusion of other processes. For example, photodegradation may render compounds suitable for chemical decomposition to begin.

So, it makes sense that if we get the 'application' part right, unwanted chemical movement into the environment will be minimised. This will ensure maximum environmental safety.

Get application right, and environmental safety should follow.

Spray Drift

Spray drift is the airborne movement of pesticide particles onto a non-target area at, or shortly after, application (either by air or at ground level) with the potential of risk for injury or damage to humans, plants, animals, environment or property. It does not address the movement of agricultural chemicals to non-target areas through erosion, migration, volatility or windblown soil particles.

If application is not correctly managed, spray drift can be a major problem confronting those who apply agricultural chemicals and the surrounding community.

Hazards Associated with Spray Drift

Potential Hazards from drift include:

- Community health concerns in populated areas
- Contamination of water tanks from aerial crop sprayers and ground rigs
- Damage to crops in neighbouring paddocks
- Contamination of neighbouring crops resulting in illegal residues in produce
- Adverse publicity
- Loss of expensive chemical and reduced efficacy on target pests
- Death of beneficial organisms such as bees, predators and parasites of pest organisms
- Environmental contamination resulting in adverse effects on soil organisms, wildlife, water supplies, etc.
- Possible exposure of field workers and other occupiers adjacent to the treatment area.

The issue of spray drift is serious enough to be considered by relevant state authorities as an environmental nuisance in cases where a complaint has been logged ('chemical trespass'). Where spray drift has resulted from poor application practices or negligence, regulatory agencies will investigate, and may fine the applicator.

The issue of spray drift has prompted the APVMA to issue Spray Drift Restraints on many product labels. It is considered serious enough to be considered by relevant state authorities as an environmental nuisance in cases where a complaint has been logged ('chemical trespass'). Where spray drift has resulted from poor application practices or negligence, regulatory agencies will investigate, and may fine the applicator.

In instances where a state-based authority seeks to prosecute an individual or company for 'chemical trespass' the burden of proof must be beyond reasonable doubt, hence there are often fewer prosecutions than spray drift instances.

In the majority of situations, the affected party seeks compensation for a perceived loss through civil procedures, where the burden of proof is based on the balance of probability. The only real defense in civil cases requires that the person/s alleged to have caused the loss must show that they acted in a reasonable manner, that is they demonstrated their 'due diligence' and 'duty of care.'

A part of the applicators 'duty of care' is to follow the label instructions and keep accurate records. For many products, the label will contain statements about the requirement to minimise the potential for spray drift. These statements may include specified wind speeds, mandatory spray qualities and no spray zones from sensitive areas.

Applicators have a dilemma. Some movement of droplets is necessary for good target coverage. There is often a balance between drift and maximising target coverage. This balance will depend on the situation.

Management of Spray Drift

There are things that you can do to manage drift:

- Put systems in place
- Use best practices
- Apply chemicals when the weather is suitable
- Use the safest application technique that will produce efficacy
- Adhere to Regulations.

Awareness Zones

The chemical user should be responsible for establishing a spray drift awareness zone around the property. The zone should be used to aid the survey of areas or buildings outside a field to be sprayed that may be potentially sensitive to spray drift, e.g. dwellings, wetland areas, travelling stock routes, organic farms, etc. Websites such as the cottonmap.com.au are a useful tool.

The concept and use of awareness zones should not be confused with the use and implementation of buffer zones.

Buffers (NO SPRAY ZONES)

If it is necessary to apply chemicals when sensitive areas or environmentally sensitive organisms are downwind, buffer zones should be established on the downwind side of sprayed areas to reduce the impact of spray drift.

Buffer zones are usually located on the downwind side of a sprayed area and are used to protect an area susceptible to off-target spray movement.

The distance required for a buffer will depend upon factors such as the type of buffer zone, weather, application method and toxicity of the chemical to the sensitive area concerned.

Communication

Communication with neighbours and stakeholders about proposed spraying activities promotes the development of cooperative spray management strategies and helps avoid future conflicts. Many spray drift incidents can be avoided, or their impact reduced if neighbours, contractors and sometimes the local community are advised and consulted prior to application.

PPE/Safe Practice

Those responsible for the selection, purchase, transport, storage and application of pesticides and veterinary medicines all have a responsibility under legislation to minimise any potential risk to other people, livestock and the environment. Where hazardous chemicals are to be used, chemical users have responsibilities under current Commonwealth and State/Territory legislation. The pesticide label and corresponding SDS contain detailed information on the use of the pesticide and these directions must be understood and followed.

These aspects are covered elsewhere in the manual but do also contribute to drift management.

Training

Training of chemical users can improve the efficiency of their spray applications and reduce the likelihood of off-target spray drift. Evidence of training also helps operators demonstrate their due diligence.

Agricultural chemical users should be qualified and licensed according to relevant State/Territory regulatory, training and accreditation requirements.

Record Keeping

The chemical user should maintain up-to-date records of chemical usage and spray operations on the property. Information on awareness zones, buffers, weather, etc should be kept. Chemical users should retain records in accordance with relevant legislative requirements. This may include federal requirements contained within the label and state-based requirements.

Factors that determine spray drift risk

Wind Speed Is Critical for Good Application

Applicators must ensure that the air is moving and mixing to minimise the likelihood of spray drift.

Weather conditions should be within acceptable limits for the safe and effective application of pesticides.

Wind

Wind speed must be within acceptable limits for the safe and effective application of pesticides. Measure wind speed and direction prior to and during spray application. Sprays should be applied when the wind direction is away from sensitive areas. Spraying should not take place if the wind is light and variable in strength or direction. Chemical users should be alerted to changes in wind direction and modify or cancel a spray program as necessary.

Wind speed should be between 3 and 15 km/hr for most spraying operations.

Always refer to the label for specific advice (windspeed limits may differ for different application methods, e.g. ground versus aerial application).

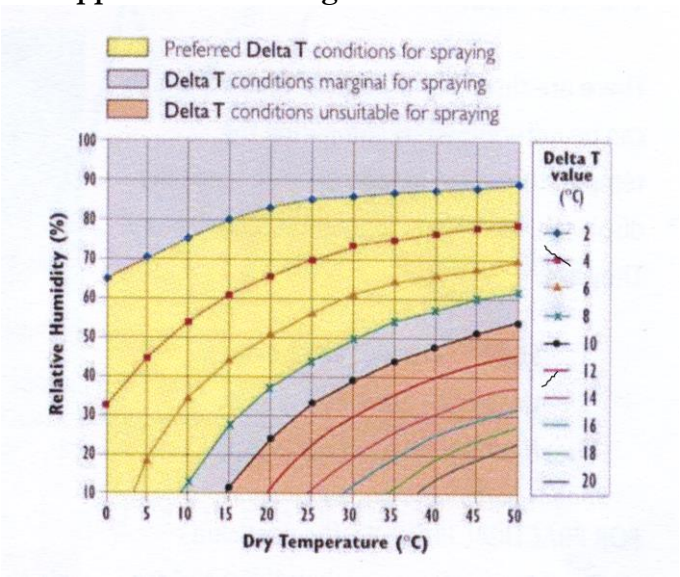
Temperature/humidity

Measure temperature and humidity prior to during and after spray application. Spraying should ideally take place when temperatures are at their most favourable (in a 24-hour cycle). High temperatures and low humidity result in spray droplets evaporating (especially small ones) that, in turn may lead to increased spray drift. Also, high humidity can lead to increased life of the spray droplets, again leading to increased spray drift.

Application should occur when temperature and humidity are optimal. This frequently occurs when conditions are not too hot or too dry.

Spraying of water-based sprays should not take place under conditions of high temperature and low humidity, e.g. when the wet bulb depression (a measure of evaporation potential) is less than 2 or greater than about 10°C. These conditions can increase the rate of evaporation of water-based sprays and may subsequently increase spray drift. Volatile products may also release damaging vapour in these conditions.

Delta T (Δ T)
See Appendix III for larger chart.



Delta ΔT is becoming one of the standard indicators for acceptable spray conditions. It is indicative of humidity, evaporation rate and droplet lifetime. **When applying chemicals, ΔT should ideally be between 2 and 8 (except under inversion conditions)** but may be up to 10 if coarse or larger spray qualities are selected.

What are surface inversions?

Surface inversions are layers of the atmosphere at the earth's surface in which temperature increases with height. This is the inverse of the normal temperature decrease with height that occurs due to the decrease of pressure with height.

The Hazards of Surface Inversions

Surface inversions strongly suppress the dispersion of airborne pesticides and the like.

Thus, surface inversions can cause airborne pesticides to remain at high concentrations for long periods over and close to the target, travel close to the surface for many kilometres in light breezes, move downslope and concentrate into low lying regions, and be transported often in unpredictable directions, particularly during the morning transition periods when airborne pesticides can be lifted above the surface and into the capping inversion. The daytime temperature decreases with height. The nighttime temperature increases with height until it approaches the daytime profile and begins to cool with height. The top of the inversion is shown.

Common Causes of surface inversions

Advection of cool air: Surface inversions can form when cool air moves into and undercuts a warmer air mass. Such movement typically occurs with sea breezes and cold fronts. It may also occur when cool air drains downslopes and into warmer air at lower elevation.

Advection of warm air:

Surface inversions occur when warm air flowing over cool surfaces has its lowest layers cooled more rapidly than those immediately above.

Shading by crops and forests:

This causes a hold in temperatures lower at the surface than immediately above.

Radiation cooling:

Surface inversions usually begin to occur near sunset after the ground cools rapidly by losing heat energy through infrared radiation upward into space. That radiation passes through clear air with little effect.

As the ground cools, the air in contact with the ground begins to cool directly by conduction leading to the lowest layer of air being cooler than higher layers. In shorthand, this is referred N to as "radiation cooling".

Radiation Inversions - the most hazardous

Inversions caused by radiation cooling - called 'radiation inversions'- are the most hazardous to pesticide applications because they are the most likely to severely restrict dispersion and promote transport at high concentrations of the airborne pesticides.

Occurrence of Radiation Inversions

Radiation inversions occur most nights. Only when winds are strong enough to completely mix the lowest layers of the atmosphere and/or cloud cover severely restricts surface heating and cooling is there a chance that surface radiation inversions won't form overnight.

Transport of airborne pesticides

To understand the transport of airborne pesticides within inversions, a distinction needs to be made between radiation inversions forming over flat terrain and radiation inversions occurring over slopes.

Radiation inversions over flat terrain:

These form when air in contact with the ground is cooled by terrestrial radiation. The inversion gradually intensifies and deepens as the surface cools. Air within the 'radiation inversion' does not tend to flow out of the region but remains in place. Thus, airborne pesticides tend to float over the immediate area of application.

Radiation inversions over sloping terrain:

These also form when air in contact with the ground is cooled by terrestrial radiation. The cooled layer remains quite shallow over the slope and is typically only 2m to 10m deep because gravity continually pulls it downward; causing drainage winds. Drainage-wind advection of cool air away from the slope and over or into lower lying regions may initiate a 'drainage inversion' or intensify an existing radiation inversion. Drainage inversions, once formed, have similar attributes to radiation inversions. Airborne pesticides can be transported long distances downhill, over flat terrain toward the lowest lying regions and into valleys by drainage winds.

The Typical Lifecycle of Radiation Inversions Initiation

Radiation and drainage inversions typically begin in the evening at about sunset as the ground surface cools and the air in contact with the surface loses sufficient heat by conduction to become colder than the air immediately above. With continued overnight cooling, inversions usually intensify and deepen up to the time of the overnight minimum temperature.

Cessation

Decay of radiation inversions typically begins just after sunrise as the sun begins to heat the surface. Ground surface heating begins to warm the air immediately above and erodes the inversion from the surface upward. The burning off process is aided by thermal currents lifting and mixing into the inversion layer.

The Remnant Capping inversion

The process of erosion from the surface upwards leaves the upper layers of the inversion intact for some time after sunrise. The intact layers cap thermals that transport heat upward. During this period, airborne pesticides can be lofted into the cap by the thermal activity where they may concentrate before drifting long distances in directions that are possibly contrary to observed surface wind conditions.

Variations of Lifecycle

There are many variations to this idealised life cycle of radiation inversions. Onset may be delayed, and overnight occurrence may be intermittent. Cessation may occur earlier than sunrise due to varying cloud cover, varying wind speed and intermittent turbulence.

Inversion Weather

An inversion can be likened to a dome of colder air next to the ground cut off and largely insulated from the surrounding atmosphere. Being isolated, the inversion weather can be significantly different from what might be expected from the broader weather patterns.

Of significance:

- The inversion onset leads to the often-observed significant drop in wind speed as sunset approaches, signaling the decoupling of the general winds from the surface.
- Drainage winds can flow downslope and/or around obstacles with directions dictated by topographic features rather than the overriding general weather pattern.
- Inversions can lead to an anticlockwise (in the southern hemisphere) turning of nighttime winds.
- Inversions are prerequisites to fog and frost development.
- Inversion break up can be accompanied by winds stronger and gustier than the winds experienced throughout the day.

What Should Chemical Applicators Do to Anticipate and Recognise Radiation Inversions

It is essential that an applicator anticipate and recognize the radiation inversion potential and occurrence for any spray application made between sunset and an hour or so after sunrise.

While it is reasonable to expect surface inversions on most nights, it is not a simple task to forecast exactly the onset and cessation times of surface inversions. The difficulty arises because of the periodic influence of transient cloud cover, varying wind speeds, occurrence of intermittent turbulence and the varying potential of different surfaces to cool the air. See more guidance below.

Anticipation of an inversion

The potential for inversions to occur and to adversely hold high concentrations of airborne pesticides near the surface should always be anticipated between sunset and up to an hour or two after sunrise.

This is unless one or more of the following conditions occur:

1. There is continuous overcast, low and heavy cloud.
2. There is continuous rain.
3. Wind speed remains above 11 km/h for the whole period between sunset and sunrise. Be mindful that established inversions can sometimes still occur when winds are in excess of 11 km/h (based on Pasquill Stability Classes 1961).

The occurrence of any of the three conditions does not wholly exclude surface inversion existence but they do indicate conditions not normally conducive to the drift of high concentrations of airborne pesticides.

To assist applicators, determine the likelihood of inversion conditions and to avoid them, it would be helpful if landowners developed climate data bases for target areas, with a focus on:

- The frequency of radiation inversions and intensity for the time of year and location, e.g. for many Australian locations the weakest inversions occur in winter - the most intense in late Spring and Summer.
- The frequency of drainage winds over the target fields in relation to different wind regimes.

Recognition of an inversion

The most reliable scientific method of detecting inversion conditions is to measure and determine if temperatures are warmer above the surface than at the surface. However, since applicators rarely have access to suitable instrumentation, simpler methods of inversion recognition must be employed.

Surface inversions may exist overnight without visual clues, but some useful visual indicators are:

- Cumulus clouds that have built up during the day tend to collapse toward evening.
- Mist, fog, dew and frost occur.
- Smoke or dust hangs in the air and/or moves laterally in a concentrated package.

Other clues include:

- There is a large difference between the observed maximum temperature and the nighttime temperature.
- Wind speed in the evening and overnight are considerably less than during the day.
- Cool off-slope breezes develop in the evening.
- The clarity of remotely generated sounds increases at night.
- Aromas become more distinct at night than during the day.

Inversions information and diagrams sourced from the APVMA. For more visit www.apvma.gov.au

Meteograms

The Australian Government Bureau of Meteorology provides a wide range of weather information that can be helpful when planning for spraying activities. For details go to: www.bom.gov.au
Forecasting Websites

There are commercially available services that provide forecasts for suitable spraying conditions which allow the applicator to better plan operations according to the likely conditions, such as Syngentas Agricast and Nufarms Spraywise programs

Droplet size

Droplet size is probably the single most important factor affecting pesticide spray drift. Because large droplets fall towards the ground significantly faster than small droplets, the airborne transport of droplets is significantly reduced if small droplet production is kept low.
Any spray is made up of a range of different sized droplets - this is referred to as the spray quality Viscosity, elasticity, specific gravity, surface tension and volatility ail interact to determine the evaporation rates and behaviour patterns of the droplets in the spectrum produced.
The formulation of the product, and any additives to the spray mix, also determine the size of droplets in the spectrum.

Use the coarsest spray quality that will provide efficacy

Chemical users should select nozzles to give the required spray quality, according to the correct BCPC/ASAE droplet size classification, as indicated by nozzle manufacturers.

Release height

The higher droplets are released, the greater the potential for drift. Release height of the spray should be as low as possible, consistent with nozzle specifications and coverage requirements and any label direction. Boom height should not exceed, or be lower than, optimum heights specified by the nozzle manufacturer, and adequate boom stabilisation is essential - especially on uneven ground. Boom height may be lowered to produce less spray drift, although modification to nozzle number, type and orientation is usually required to maintain an even spray pattern.

Spray pressure

When spray pressure is increased finer droplets are produced, which can result in increased potential for drift. To reduce drift potential, applicators should select nozzles that produce the coarsest spray quality required or recommended to obtain efficacy.

Spray pressure should be consistent with nozzle specifications and coverage requirements. Spray volume should be controlled by changing nozzles, not by changing pressure, (i.e. to increase flow rates select nozzles with larger orifices).

Equipment

The most appropriate spray application equipment for a particular task will deliver droplets of the appropriate size in a way that maximises their deposition on the target. Particular types of spray application equipment are designed for specific purposes, e.g. hand-held equipment, orchard sprayers, aerial applicators are all task specific. Spray application equipment should be properly maintained, calibrated and operated to maximise efficiency and avoid excessive spray drift. Shielded sprayers may also be used in certain situations to prevent off-target drift.

Cleaning and decontamination

After each day's use, or when changing products, the boom line and the sprayers should be flushed with water inside and out to prevent buildup of chemicals, and to prevent contamination for the next spray job. When chemicals are changed or spraying is completed for the season, clean the sprayer thoroughly with a cleansing agent. Choose the washing area carefully to avoid contamination of water supplies and injury to plants or animals. Do not create standing puddles that might be accessible to children, pets, farm animals or wildlife.

Cleaning spray equipment used for liquids

The following steps are suggested for cleaning a sprayer:

- ✓ Hose down the inside of the tank and partially fill it with water. Flush the cleaning water through the nozzles by operating the sprayer for 10-15 minutes.
- ✓ Repeat this procedure.
- ✓ Remove nozzle tips and screens (filters). Clean them in mild detergent solution or kerosene, using a soft brush such as a soft bristled toothbrush. Avoid wire, knives or other hard objects that might damage the nozzle orifice.
- ✓ Partially fill the tank with water and add any cleaning agents that are recommended on the product label or recommended by the product manufacturer.
- ✓ Particular care should be taken where spray equipment is used for both herbicides and insecticides/fungicides. Some herbicides such as the phenoxy herbicides are very difficult to remove from equipment and minute quantities remaining can be sufficient to contaminate a subsequent spray of insecticide resulting in crop damage.

Adhere to Regulations

APVMA makes registration decisions using scientifically valid methods regarding the potentially harmful consequences associated with spray drift. Spray drift risk assessment is applied to all agricultural products labelled for use outdoors that can be applied as sprays or dusts and includes both aerial and ground application methods.

Some labels have specific instructions concerning drift. So, if you follow the instructions on the product label (i.e. adhere to regulation), then you are less likely to have a problem with spray drift.

Summary of Drift Management

It has been proven there are many interacting factors impact on spray drift. You need to understand these factors so that you can effectively manage drift when applying chemical.

The APVMA Policy on Spray Drift: Operating Procedures in Relation to Spray Drift Risk was published in July 2008 to assist in the understanding and management of spray drift

While spray drift is widely recognised as the biggest contributing factor to unwanted environmental impacts, there are other application issues that also impact on environmental safety. The following sections deal with managing these other issues so that environmental safety is upheld.

Groundwater Contamination

In most areas of Australia groundwater is a crucial natural resource. An abundant and uncontaminated groundwater supply is vital to the environment and to the economic interests of Australia.

Groundwater is water that lies below the soil surface and fills the pore spaces in and around rock, sand, gravel, and other materials. Groundwater moves through water-saturated zones called aquifers.

The upper level of an aquifer is called the water table. The level of the water table fluctuates, lowering as water is removed from bores or discharged at streams and springs, and rising through recharge from rain that seeps through soil into the aquifer.

For years it was believed that the slow movement of water through soil, sand, gravel and rock formations, filtered out contaminants before they reached groundwater. Studies have shown that recharge, contaminated by human activity, can carry pollutants down to aquifers.

Not all groundwater is equally vulnerable to contamination by pesticides and veterinary medicines. The deeper the water table is below the soil surface, the less likelihood that chemicals will reach groundwater since there is greater potential for absorption, degradation and other processes to occur.

The permeability of the geologic layers between the soil surface and the groundwater is also important. If the materials above the water table are very coarse, such as sand or gravel or highly fractured rocks, water can move through to the groundwater more readily than if less permeable layers of clay or solid rock are present.

The processes that influence the movement of chemical into groundwater are the chemical and physical properties of the product, the soil and geologic characteristics, climatic conditions and chemical handling practices. Each of these factors must be considered when determining the susceptibility of ground waters to farm chemical contamination.

Be mindful of how your activities, including the handling and use of pesticides and veterinary medicines, could affect the groundwater resources. Seek advice from the relevant government departments, environmental agencies or other organisations if you have concerns.

Surface Water Contamination

Surface run-off water picks up soil particles and pesticides from treated fields or spills, and carries these into streams, ditches, ponds and wells. This normally occurs when heavy rains follow within a few days of a spray operation, although it can also happen any time of the year with pesticides that persist in soil year-round.

The greatest loss occurs when rains fall within 24 hours of application. Removal of pesticides from the soil surface decreases with time following application and is usually negligible one week after spraying.

Runoff is normally more severe on clay soils and less of a problem on sandy soils.

To control pesticide losses to surface waters, you should control erosion and reduce the volume of runoff water that leaves the field or farm. Practices such as conservation tillage, terraces, strip-cropping, and contouring reduce runoff and control erosion.

To protect surface water use erosion control practices and less persistent chemicals.

Soil Contamination

The soil is the largest, most important reservoir for the accumulation of pesticide residues. Some portion of practically every pesticide used, including foliar applied chemicals, eventually reaches the soil. Mostly these residues break down rapidly, but where the residues become persistent in the soil, environmental safety can be compromised.

Persistence defines the 'lasting-power' of a pesticide. Most pesticides break down or 'degrade' over time as a result of several chemical and microbiological reactions in soils. Sunlight breaks down some pesticides. Generally, chemical pathways result in only partial deactivation of pesticides, whereas soil microorganisms can completely break down many pesticides to carbon dioxide, water and other inorganic constituents.

Some pesticides produce intermediate substances, called 'metabolites' as they degrade. The biological activity of these substances may also have environmental significance. Because populations of microbes decrease rapidly below the root zone, pesticides leached beyond this depth are less likely to be degraded. However, some pesticides will continue to degrade by chemical reactions after they have left the root zone.

Degradation time is measured in 'half-life.' Each half-life unit measures the amount of time it takes for one-half the original amount of a pesticide in soil to be deactivated. Half-life is sometimes defined as the time required for half the amount of applied pesticide to be completely degraded and released as carbon dioxide. Usually, the half-life of a pesticide measured by the latter basis is longer than that based on deactivation only. This is especially true if toxic or non-toxic metabolites accumulate in the soil during the degradation.

Carbamates, synthetic pyrethroids and growth regulators have little or no residual activity (that is, they are highly biodegradable) and their use in agriculture has been limited in the past largely because of this.

While a number of organophosphates have been identified as causing acute but relatively short-lived toxic residue problems, much more extensive problems have been encountered in Australia with organochlorine pesticides and arsenical pesticides because they are very slow to break down.

The chemicals most likely to cause contamination problems today are arsenic and organochlorines, followed by organophosphates, and sometimes mercurial and lead pesticides.

To identify potentially contaminated agricultural land, start with a historical review, followed by soil testing if necessary. Call in an expert consultant and investigate options for remediation.

Soil testing can tell you if the soil contains any persistent contaminating residues. Any such contamination may require remedial measures, for example:

- Removing the contamination (e.g. excavation of soil, pumping-up of groundwater)
- Containing the contamination (e.g. covering contaminated soil with asphalt or another impermeable layer, and preventing contaminated groundwater from flowing downstream)
- Preventing human contact with the contamination (e.g. covering the contamination with clean soil, fencing-off contaminated areas, closing contaminated wells).

Effect of Chemicals on Non-target Organisms

The use of pesticides and veterinary medicines may affect some non-target organisms i.e. plants, bees and other beneficial insects, fish and other wildlife. The product label provides directions to minimise or avoid these effects. The label should be studied before use and the directions for protection of non-target organisms carefully followed.

Fish and Wildlife

The most recognisable effect on fish and wildlife is the direct impact of acute poisoning.

Fish kills can occur as a direct result of water pollution by a farm chemical. The products can enter via drift, surface run-off, soil erosion, leaching and in some cases deliberate or careless release directly into the water. Fish kills are most often caused by insecticide contamination of small dams or streams with low water volume or flow.

It is possible for bird kills to occur as a result of exposure to pesticides and veterinary medicines. Birds (in particular, wild ducks) can ingest a poison by grazing on treated grass or ingest granules, baits, or treated seed; they may be exposed directly to the spray or they may feed on chemical contaminated prey.

Birds and other animals often mistake granules or pellets for food. Pets, birds and other wildlife can be killed when baits are left unattended or improperly placed.

The following practices can minimise any effects upon wildlife from the use of pesticides and veterinary medicines.

- Determine whether or not wildlife graze on the land to be sprayed or treated.
- Use pesticides and veterinary medicines only when necessary; select the least toxic and least persistent product, where possible.
- Observe the environmental precautions on the label.
- Check the label to see if no spray zones are required
- Only treat the areas needed and avoid aquatic areas. In the absence of label instructions regarding no spray zones - If possible, leave a buffer zone of at least 15 metres (ground spraying only) between bodies of water and the treated area. Avoid spraying trees that overhang streams and dams.
- Exercise caution when placing baits or granules.
- Users must be aware of their legal responsibilities when using pesticides and veterinary medicines. Strict laws have been enacted to protect public health, the environment and wildlife, especially endangered species.

When misused, all the benefits associated with pesticides and veterinary medicines can be quickly outweighed by the risks they present and the harm they may cause.

Plants

Many kinds of pesticides and veterinary medicines can injure or kill plants if used incorrectly. Herbicides, however, are the primary cause of non-target plant injury.

A chemical that injures plants is said to be phytotoxic. The symptoms of herbicide phytotoxicity are frequently difficult to diagnose. Symptoms often do not appear for several days or sometimes weeks and, even then, are often confused with pest damage, nutritional deficiencies, cultural practices, or adverse weather conditions. Sometimes no symptoms develop, but instead a crop is rendered unsaleable due to illegal residue levels.

Bees and Pollinators

Bees and other pollinating insects are essential for the successful production of many crops including deciduous tree fruits, small fruits, most seed crops and certain vegetables. Many pesticides and veterinary medicines, particularly insecticides are toxic to pollinating honeybees and wild bees.

Applicators should be aware of how bee poisoning may occur, and how this can be prevented. Product labels usually provide directions for use to avoid injury to bees and other pollinating insects.

Poisoning of bees can occur when flowering plants are treated with insecticides. The residual toxicity of a chemical is a key factor in the assessment of hazard to bees.

An insecticide that becomes unavailable to bees (e.g. it tightly adheres to the foliage) within a few hours of application can be used with reasonable safety as long as bees are not actively foraging during the actual application period.

By taking the following precautions users can reduce the chances of bee poisoning:

- ✓ Do not apply products that are toxic to bees during flowering. Even shade trees and weeds should not be sprayed during bloom. Mow cover crops and weeds to remove the flowers prior to spraying.
- ✓ Select the product that is least harmful to foraging bees. Check product labels for specific bee hazards.

- ✓ Select the safest formulation. Dusts are more hazardous to bees than are sprays. Wettable powders are usually more hazardous to bees than water-soluble formulations. Granular insecticide formulations are generally the least hazardous to bees. The hazard increases, however, when insecticides are microencapsulated as the minute capsules can be carried back to the hive in much the same manner as pollen.
- ✓ Reduce drift during application. Applications made by aircraft are usually more hazardous to bees than ground applications.
- ✓ Try to time the application carefully. Evening applications are less hazardous than early morning or midday applications.
- ✓ Do not treat near hives. Bees may need to be moved or covered before using insecticides near colonies.
- ✓ Co-operate with beekeepers. Bee poisonings can be reduced by fostering cooperation among beekeepers, growers and farm chemical users.

Beneficials

Many insects and other arthropods can also serve a useful function, either as predators or parasites of pests. Unfortunately, when controlling the target pest with chemicals, populations of these beneficial organisms can be reduced as well.

Pesticides and veterinary medicines also have the potential to alter populations of beneficial bacteria, fungi and other microorganisms in the soil.
Many of the microorganisms degrade organic matter to basic nutrients that can be used by plants and other organisms. Others are involved in the natural control of soil-borne pests. Fortunately, the effect of soil microbes from the use of chemicals is usually minimal or short lived.

The best way to avoid injury to beneficial insects and microorganisms is by careful and correct use of pesticides and veterinary medicines. Selective products should be used where possible and applied only when necessary as part of an integrated pest management program.

Managing environmental safety can be complex. The solution is to develop an environmental management system.

Environmental Management Systems.

Environmental safety is a complex task, so it makes sense to have a tool to manage environmental safety.

Environmental safety should be actively considered as part of a broader environmental management system (EMS) for your enterprise.

What is an EMS?

An ‘environmental management system’ (EMS) is a systematic approach to assist any enterprise to identify and manage its impacts on the environment, while providing opportunities for improved business performance.

As an integrated business management tool, an EMS can effectively complement and build on other existing activities such as property management planning, best management practices, codes of practice and quality assurance schemes. EMS provides a management framework based on a simple 'plan, do, check, act’ cycle that achieves continuous improvement.

A manager uses the system to identify their environmental impacts and legal responsibilities, then implements and reviews changes and improvements in a structured way. To provide credibility for external stakeholders, managers may decide to have their EMS externally audited and may become certified to the international standard, ISO 14001.

How do I benefit from an EMS?

EMS is a valuable tool because it provides a voluntary, flexible approach to business management and because it encourages activity beyond compliance. An EMS will help prepare landholders to meet current and future challenges, whether imposed by government regulation, by consumer market preferences, or by communities concerned about their local environment.

Adopting EMS principles will ensure all your obligations with regard to environmental safety are met.

NOTES

Chapter 8

CHEMICAL FORMULATIONS & RESIDUES

"Residue is what remains of the chemical at a particular time and can occur as the chemical itself or as breakdown products"

Introduction

The principal component of a pesticide that manages the target pest or disease is called the 'Active Constituent' (AC) or 'Active Ingredient' (AI). It is mixed with liquid or dry inert materials (or additives which themselves are not active against the pest or disease) to create the formulation. There can be more than one active constituent in a pesticide or veterinary medicine.

Formulations

Pesticides are available in a wide variety of formulations. It is not uncommon to find active constituents formulated in different ways to satisfy different use patterns.

Common formulations include:

- Emulsifiable concentrates (EC)
- Solutions (S)
- Soluble powders (SP)
- Wettable powders (WP)
- Suspension concentrates (SC) (flowables)
- Water dispersible granules (WG) (dry flowables)
- Baits
- Granules
- Fumigants
- Injectables
- Pour-ons/Spot-ons
- Non-aqueous concentrates (oils)

Formulations may vary in their:

- Hazard to the user and/or the environment
- Preferred application methods
- Phytotoxicity (damage to plants)
- Efficacy of pest control
- Cost

Emulsifiable Concentrates (EC)

These are liquid formulations where the active constituent is dissolved in a hydrocarbon solvent. An emulsifier is added so that the formulation will mix readily with water. ECs usually form a milky-white emulsion when added to water.

Solutions

S**olutions are formulations with the active constituent dissolved in water.** Some are ready-to-use while others need to be diluted further.

Soluble Powders

These are dry formulations that dissolve in water to form solutions.

Wettable Powders

These are also dry, finely ground formulations. Unlike soluble powders, wettable powders do not dissolve in water but are mixed with water and applied as a suspension requiring continual agitation.

Suspension Concentrates or Flowables

These are finely ground solid particles of active constituent suspended in a liquid carrier as a slurry. Flowables often contain a high percentage of active constituents, along with surfactants and stabilisers.

Water Dispersible Granules or Dry Flowables

Water dispersible granules or dry flowables are similar to wettable powders but the active constituent is in a granular form rather than a powder. The small granules readily disperse when in contact with water, and the resultant spray mix has all the characteristics of a flowable or a wettable powder.

Baits

Bait formulation is an active constituent mixed with an edible substance or some other attractant and comes in many different forms. Baits are used to control certain insects, snails, slugs, rodents and other pests.

Granules

Granule formulations are dry, ready to use material. Granules are often used to control soil borne pests. Because many of the active constituents possess volatile properties, granule formulations are applied to the soil where the active constituent is absorbed by the roots and translocated through the plants.

Tablets/Pellets

These are similar to granules but are much larger in size, making them easier to handle in some cases. Tablets/pellets have similar properties to granules but can contain a greater amount of the active constituent.

Fumigants

Fumigants are active as gases. Some are compressed gases. Some are formulated as liquids under pressure and become gases only when released. Others are solids that release gases under conditions of high humidity. Fumigants are non-selective in their action and must be handled with care to avoid breathing the vapour.

Injectables, Pour-ons and Spot-ons

These formulations are used to treat animals. Injectables, including vaccines, are for treating internal animal health problems. The pour-on/spot-on formulations treat both external and internal animal pests and are applied in a concentrated form using a special applicator.

Biological Formulations

Some biological agents such as Bacillus thuringiensis spores are also prepared commercially in a manner similar to chemical formulations. They are commonly produced by grinding dead insects containing pathogens into a fine dust.

Primary Solvents or Carriers Introduction

Liquid solvents are used to dissolve the active constituent to form a liquid formulation. The carrier may be water where the active constituent is water-soluble or, more commonly, it is a solvent like xylene or toluene that forms an oil-based product.

Where dry formulations are to be produced, the active constituent is mixed with an inert carrier like talc or finely ground clay.

Additives

Additives, adjuvants or spray supplements are included in most formulations.

Their purpose may be to:

- Assist in the initial formulation of the product
- Maintain long term stability of the product
- Increase or decrease toxicity and activity of the product
- Aid in the product's application to, and uptake by, target organisms.

Usually these additives are included during the formulation process. Some situations, however, may require the addition of adjuvants, (e.g. wetters, anti-evaporants) just prior to spraying. These should only be used if directed by the label.

Examples of additives include emulsifiers, dispersing agents, wetting agents, spreaders, stickers, anti-caking agents, crop oils, penetrating agents and anti-foaming agents. Other additives like odours and dyes may be added to improve safety. Some of these additives can be grouped under the classification of surfactants.

Surfactants

Surfactants (surface active agents) are chemicals that reduce or modify the surface tensions that exist between two or more incompatible substances, e.g. water and oil.

Ionic and Non-ionic Surfactants

In chemical terms there are three major classes of surfactants:

Anionic Non-ionic Cationic

Non-ionic surfactants are the most commonly used for pesticides, but they can cause 'rewetting' and may wash off the target if rain, irrigation or heavy dew occurs after spraying. There are many different brands of non-ionic surfactants on the market. They may have different concentrations so, when selecting one, look at the concentrations of each and mixing instructions and not just the price per litre.

The surfactant label indicates what type it is. If a surfactant is required during application, it will be indicated on the product label. The label will also state the type of surfactant required for that particular product. It is unwise to use a surfactant if it is not recommended because the selectivity of the product can be changed, and crop injury can result.

Non-ionic surfactants generally increase the number of droplets in the fine spectrum and thereby increase the risk of spray drift. However independent studies have shown that Nufarms' LI 700 is an excellent tool to reduce the number of undesirable very fine droplets that are prone to drift.

Furthermore, its multifunctional chemistry opens cuticle pathways in the waxy layer of the plant and increases penetration and translocation to the target site. LI 700's acidifying properties protect many pesticides from chemical degradation.

Types of Additives

Wetting and Spreading Agents

These surfactants (wetting agents) are critical to the performance of most plant protection products (PPP's). They reduce the surface tension of the spray droplets on the target surface once they have been applied, thus allowing the spray liquid to adhere to and spread more evenly over the target surface. This is easily seen on waxy or hairy leaf surfaces.

It is quite possible for droplets to roll off the leaf surface if a surfactant is not added. On the other hand, addition of too much surfactant may also cause spray to run off the leaf by reducing surface tension and adherence.

The extra 'wetting' of target surfaces results in increased spray deposition plus the improved penetration of waxy surfaces. However, this may also result in less selectivity. Non-target species that were previously not affected by a pesticide can become susceptible. This effect can be seen with some selective herbicides where addition of a wetter can result in crop damage.

Sticking agents

Stickers increase spray adherence to leaves and reduce run-off during spraying while maintaining strong adherence of spray deposit after the spray has dried. This improves resistance to washing off with rain, irrigation or dew.

Penetrating agents

These assist in the absorption of the active constituent into treated surfaces. One way they achieve this is by dissolving the waxy cuticle of plants or insects so that penetration is better. Penetrants may include mineral oils, vegetable oils, organo-silicate surfactants and acidified surfactants.

Crop Oils/Anti-evaporants

Crop oils may be of petroleum or vegetable origin with emulsifiers/surfactants added so that they can be mixed with water. In some cases, the oil alone has been used as the secondary carrier without mixing with water. Oils reduce evaporation during application, hence the name anti-evaporant. They may also assist actives to pass through the cuticle by dissolving it or reducing its thickness.

Anti-foaming agents

These can reduce foaming in the spray tank, but they cannot be used with powder formulations because the powder can drop out of suspension.

Compatibility

Two or more pesticides, or a pesticide and a fertilizer, are compatible if no adverse effects occur as a result of mixing them together. Applying a tank mix of pesticides, or a pesticide and a liquid fertilizer, can save time, labour, energy and equipment costs. Pesticide combinations usually alter plant absorption and translocation as well as metabolism and toxicity at the site of action of one or more of the mixed products.

Not all changes are for the better. Negative effects can occur such as reduced pest control, increased damage to non-target plants (phytotoxicity) and incompatibility problems between materials.

There are basically four types of interactions that change the efficacy of pesticide combinations:

- Additive effects occur when mixing two pesticides provide the same response as the combined effects of each material when applied alone. The products neither hurt nor enhance each other. Such mixes save time, labour and equipment use. (This is a common outcome for many compatible spray mixes)
- Synergistic responses are often confused with additive effects and occur when two pesticides provide a greater response than the added effects of each material when applied separately. Unlike additive effects, the chemicals in a synergistic combination are not neutral toward each other. Rather, they interact in some way that increases their effect and may increase control. With true synergism, you can often reduce pesticide application rates without sacrificing control. An example would be the addition of piperonyl butoxide with the pyrethrum insecticides.
- Antagonism is when two pesticides applied together produce less control than if you applied each material separately. In addition to reducing control, antagonistic responses may also increase phytotoxicity to plants.
- Enhancement is another type of interaction, but not between two pesticides. Enhancement occurs when a pesticide is mixed with an additive to provide a greater response than if you applied the pesticide alone. A common example of enhancement is mixing an adjuvant with a pesticide.

Incompatibility (Chemical and Physical)

The deactivation of an active ingredient often occurs with chemical incompatibility. This is most affected by temperature, tank pH and length of time that you hold a spray mixture in the tank before use.

Physical incompatibilities usually involve the inert ingredients of a formulation. The mixture may become unstable, forming crystals, flakes, or sludge that may clog spray equipment.

For herbicides, incompatibility can occur when you mix an emulsifiable concentrate (EC) formulation with wettable powders (WP). Also check for incompatibility before mixing. EC insecticides with fungicides or herbicides. Liquid fertilizers can also cause compatibility problems, mainly due to their strong electrochemical nature.

Be sure to read and heed all pesticide labels at all times. They provide the best and most relative information about mixing.

The possible effects of mixing incompatible chemicals are many and include:

- Reduced effectiveness of one or both compounds.
- Precipitate in the tank, clogging screens and nozzles in the sprayer.
- Plant phytotoxicity, stunting or reducing seed germination.
- Excessive residues.
- Excessive runoff.

Other Incompatibilities

It is necessary to time pesticide applications when the pest is at its most vulnerable stage of development. When using two or more chemicals to manage different pests, it is critical that the mixture be applied at the correct time in the life cycle of the pests.

Timing is especially important when applying herbicides. If herbicides are applied to wilted or stressed plants, the efficacy may be less than expected and there is enhanced risk to the desirable plants.

Tank Mixing

A pesticide label may indicate if two products can be mixed together and provide guidance as to the proper order in which they need to be mixed. In this case, the applicator assumes all responsibility for the application.

Remember to follow label instructions if provided at all times. A pesticide can be tank mixed if the label does not prohibit its application with other products and the pesticides in the mix must be registered individually on the crop you are treating.

Potential problems with tank mixing include the failure of the products to remain uniformly dispersed which is generally caused by improper mixing, inadequate agitation, or a lack of stable emulsifiers in some EC formulations. Some pesticides will not mix with liquid fertilizer even when a compatibility agent is added.

When attempting pesticide combinations that are unfamiliar to you, use a jar test to check for incompatibility. In addition, test the combination on a few plants or a small area before larger-scale treatments. Wait at least 2 to 3 days for any problems to become apparent. Keep accurate records on compatible, safe combinations for future reference.

Tank mixing herbicides is a common practice to improve weed control and broaden the weed spectrum. There may also be some advantages in helping avoid herbicide resistance problems. Many tank mixes are included on registered herbicide labels. Generally, as long as herbicides are registered for a particular use, they may be tank mixed provided they are compatible and label mixing instructions are followed. Note that some herbicides although being physically compatible can be antagonistic to weed control. This information is usually outlined on herbicide labels under compatibility.

The Tank Mixing Order that herbicides are mixed is also important and the following mixing sequence is "normally" followed:

1. Water conditioning agents (if required - e.g. LI 700, Liase® or Primabuff®).
2. Water dispersible granules (WG)/dry flowable products (DF) (including those in water-soluble bags first).
3. Wettable powders (WP) Require constant agitation.
4. Flowables (F) or suspension concentrates (e.g. atrazine-simazine liquids).
5. Emulsifiable concentrates (EC) (e.g. Trifluralin, Topik®, Kamba®, bromoxynil).
6. Water-soluble concentrates (S) (e.g. glyphosate, Amicide® 500, Surpass®, Spray. Seed® 250, Gramoxone® 250).
7. Surfactants and oils (e.g. BS1000, Hasten™, DC Trate®).
8. Soluble fertilisers.

Water Supply

Most pesticide concentrates are diluted with water as the secondary carrier for spraying. The quality of the water used for spraying tends to be very variable, depending on its source.

Water for spraying should be clean and clear, not highly acidic, not highly alkaline or brackish. Rainwater is ideal. There may be a need to neutralise or buffer water before use. Test for pH with litmus paper or use a pool test kit.

Some of the problems that could be encountered include the following.

- Dirty Water
- Brackish Water
- Wrong Ph
- Hard Water
- Extreme Temperature
- Organic Matter
- Water Testing

If you have experienced problems relating to any of the above, consider having a sample of your spray water tested by a professional analyst to determine its suitability for spraying.
Poor water quality from dams and bores has often been reported as the reason for impaired or failed spray results.

Water Quality

The following table summarizes the effect of water quality on some herbicides:

Herbicide tolerances to water qualities:

Herbicide	**Water Quality**				
	Muddy	**Saline**	**Hard**	**Alkaline (> pH 8)**	**Acidic (< pH 5)**
2,4-DB			X	NR	
2,4-D or MCPA amine	✓	✓	X	NR	
2,4-D or MCPA ester	✓	Test	Test	✓	✓
Affinity®	✓	✓	✓	X	NR
Ally®	✓	✓	✓	Marginal	X
Brodal®		✓	✓	X	
Dicamba	✓	✓	NR	NR	
Diuron	✓	Test	✓	✓	
Diuron + 2,4-D amine	✓	Test	X	NR	
Diuron + MCPA amine	✓	Test	X	NR	
Fusilade® Forte	✓	✓	✓	NR	X
Glean®	✓	✓	✓	Marginal	X
Glyphosate	X	✓	X	NR	✓
Hoegrass®	✓	✓	✓	NR	✓
Logran®	✓	✓	✓	Marginal	X
Lontrel™	✓	✓	X	X	
Sertin®	✓	✓	✓	✓	✓

Herbicide	Water Quality				
	Muddy	**Saline**	**Hard**	**Alkaline (> pH 8)**	**Acidic (< pH 5)**
Simazine	✓	X	✓	NR	
Spray-Seed®	X	✓	✓	✓	✓
Targa®	✓	✓	✓	✓	✓
Tigrex®	✓	X	X	NR	
Trifluralin		✓	✓	✓	✓
Verdict®	✓	✓	✓	NR	✓

Source: Industry & Investment NSW Management Guide - Weed Control in Winter Crops 2010

RESIDUES

Introduction

There is increased national and international concern over chemical residues in food produce. There have been a number of cases where international trade has been jeopardised by chemical residues in export produce.

Controlling residues is important in all areas of food production but is particularly important in horticulture. The horticultural industry has very high value crops in terms of dollars per hectare. More pesticides are used per area in this sector than in broad-acre agriculture (particularly insecticides and fungicides). The crops are generally short term and often have high pest pressure. In these situations, the withholding periods are of extreme importance and unacceptable residues will occur if they are not adhered to.

The food industry has an ongoing responsibility to identify, manage and monitor potential health, safety and environmental issues relating to residues throughout the growth, harvesting, marketing, delivery and sale of produce.

Chemical Residues

What is a Chemical Residue?

A chemical residue is what remains of the chemical at a particular time and can occur as the chemical itself or as breakdown products.

All chemicals, when applied to crops, animals, water or soil, will leave residues. The size and nature of the residue, and the time it takes to break down, varies from chemical to chemical.

An increasing number of primary producers have certified their businesses to Food Safety Standard QA requirements enabling them to market their produce to key domestic & export markets.

Examples of Food Safety Standards that primary producers participate in:

- WQA(Woolworths)
- Freshcare (HACCP based) - fruit & vegetables
- HACCP (Hazard Analysis & Critical Control Point) eg Dairy, pig, poultry farmers
- Cattlecare, LPA (Livestock Production Assurance)

Many quality assurance (QA) programs have very specific guidelines and requirements regarding residues. These programs can include Cattlecare, Meat & Livestock Australia (MLA) and Freshcare

Chemicals and Food Safety

The agricultural and veterinary chemicals legislation under which the APVMA operates requires it to be satisfied that when the product is used according to the label directions it will not result in any appreciable risk to:

- consumers
- other persons handling, applying or administering the chemical
- the environment
- target crops or animals
- trade in an agricultural commodity.

The APVMA is also required to be satisfied that every product works effectively against the pest(s), disease(s) or conditions claimed on the label.

Assessment of agricultural and veterinary chemicals in food to ensure any potential residues are within safe limits is an important part of the regulatory process.

There are three main assessment steps:

1. Toxicological Evaluation
2. Maximum Residue Limit (MRL) Evaluation
3. The Dietary Exposure Evaluation

The Toxicological Evaluation

Scientists from the Department of Health and Aging undertake toxicological evaluations and provide their recommendations to the APVMA. Scientists review results from a wide range of experiments including the effects of short-term, medium-term and long-term dosing studies on animals of various ages, together with studies to determine the potential for formation of tumors, birth defects and effects on genetic material.

This information is used to determine:

The No Observable Effect Level (NOEL)

The evaluation of each toxicity study includes the determination of a NOEL—the maximum dose that does not cause any detectable (usually adverse) effect in the test animal. The NOEL used to set the acceptable daily intake for a chemical is generally the NOEL in the most sensitive species of test animal.

The Acceptable Daily Intake (ADI)

The ADI is the amount of chemical that may be consumed every day for an entire lifetime without causing an appreciable risk to health. The ADI is usually calculated by dividing the appropriate NOEL by a safety factor (often 100).

The Acute Reference Dose (ARfD)

The ARfD is an estimate of the maximum amount of a substance in food or drinking water, expressed as milligrams per kilogram of body weight that can be ingested in one meal or one day, without appreciable health risk to the consumer, on the basis of all the known facts at the time of the evaluation. The ARfD is calculated by dividing the appropriate NOEL by a safety factor (usually 100). The Department of Health and Ageing recommends ARfDs for new chemicals and chemicals being considered in the APVMA's Chemical Review Program. Health authorities also recommend first aid instructions and warning statements for chemicals, and safety directions for products.

The Maximum Residue Limit (MRL) Evaluation

The Maximum Residue Limit (MRL) is the highest concentration of a residue of a particular chemical that is legally permitted or accepted in a food or animal feed. The concentration is expressed in milligrams of the chemical residue per kilogram (mg/kg) of the commodity. MRLs are regulatory standards which help to monitor that the product has been used as directed on the approved label. If an MRL is exceeded, it usually indicates a misuse of the chemical but does not normally indicate a public health or safety concern.

The APVMA determines an MRL after a comprehensive evaluation of a chemical product's chemistry, metabolism, analytical methodology and residue trial data. When evaluating chemical products, the APVMA uses data from a series of residue trials and calculates whether the application or administration of the minimum amount of chemical that is required to achieve effective pest or disease control will leave any residue in the plant or animal commodity.

The APVMA ensures that MRLs for agricultural and veterinary chemicals are determined at levels that should result in long-term (chronic) human exposures below the ADI, and short-term (acute) human exposures below the ARfD.

Based on the residue trial data, the APVMA also sets an appropriate withholding period. A withholding period is the shortest time that must elapse between the last treatment with a chemical product and the harvest of a crop, or the grazing of a commodity by livestock, or the slaughtering of an animal for human consumption. By observing the withholding period, growers permit the residues in plant or animal commodities to deplete to levels below the MRL.

Once an MRL has been determined, the APVMA will do a dietary exposure evaluation which includes using FSANZ's Dietary Modeling of Nutritional Data (DIAMOND). FSANZ then reviews the APVMA's dietary exposure evaluation and once satisfied that any risk to public health and safety is acceptable, FSANZ undertakes public consultation in relation to incorporation of the MRL into the Food Standards Code.

When the product is registered, the MRLs are notified in the APVMA's Agricultural and Veterinary Chemicals Gazette and entered into the MRL Standard available on the APVMA website: www.apvma.gov.au

The APVMA enters the MRLs it has determined into the MRL Standard when a chemical product is registered, or a permit is approved.

Agricultural authorities in Queensland, Western Australia, New South Wales (veterinary chemicals), Northern Territory (horticulture), South Australia (permits) and Tasmania (permits) all reference the APVMA's MRL Standard for monitoring the use of agricultural and veterinary chemicals in agricultural produce. The NSW government conducts trace backs for residue violations above MRL. For these purposes, the NSW agriculture authority uses the APVMA's MRL Standard.

State Food Safety Officers all use APVMA determined MRLs that have been incorporated into Standard 1.4.2 of the Food Standards Code for monitoring residue levels in food.

The action level for investigation used by all agricultural authorities except Victoria and NSW is half the MRL. Victoria and NSW use levels greater than the MRL for investigation purposes.

Exceeded MRL's

If monitoring reveals a potential residue problem, the source of supply is traced, and action is taken to avoid further occurrences. Action may include seizure and disposal of produce, more residue testing at the cost of the producer, quarantining a property (farm) and preventing the sale of produce until the commodity has been found to be safe for consumption and fit for sale in both domestic and export markets. Auditing of users and operators, re seller feedback and implementing industry Codes of Practice are also used to augment residue monitoring.

- Stewardship links & alliances
- APVMA-FSANZ & state agencies
- NFF, MLA, CropLife, Animal Alliance
- Agsafe-drumMUSTER, ChemClear, Fertcare
- EPA mandatory chemical user programs e.g. SpraySMART.
- HACCP QA food safety programs-Fresh care, HACCP

Withholding Periods (WHP)

The withholding period (WHP) is the specified minimum length of time that must elapse between the last application of a chemical product to any crop, pasture or animal and the commencement of production processes such as harvesting and grazing of that crop or pasture, collection of the animals produce such as wool or milk, or slaughter of that animal for human consumption.

The aim of withholding periods is to reduce residues in plants and animals consumed as food.

Are there withholding periods for all chemical products?

Only for those used in the production of food, whether crop or animal. They are printed on the label of a product and take into account normal production practices and are determined from residues data. Residues should not exceed the MRL if users of a pesticide or veterinary medicine adhere to the withholding period, as well as other label directions.

It is a legal requirement to observe a label withholding period when using a pesticide or veterinary medicine. This is essential for staying below the Maximum Residue Limit (MRL). Any absence of these on a label may require you to visit the APVMA website for further advice.

How do Violations of MRLs Occur in Plant Products?

The most common reasons for illegal residues in plant commodities include:

- **Using the wrong product** - This may be because the product has been put into the wrong container, the label has fallen off, the label instructions have not been followed or a product is used on a crop for which it is not registered. The latter situation is a common cause of MRL violations in produce
- **Applying too much product** - e.g. applying at twice the recommended rate in the mistaken belief that 'more must be better', or using faulty equipment including incorrectly calibrated equipment.
- **Harvesting the produce too soon** - e.g. not waiting for the withholding period specified on the label
- **Spray Drift** - Spray drift can contaminate off target areas including other crops and animal pastures.

Monitoring residues

Surveys are carried out on a regular basis to ensure that residue levels in food are as low as possible. There are three types of surveys carried out in Australia.

- National Residue Survey (NRS) - This is carried out by the Commonwealth Government on a range of chemicals and types of agricultural produce. It is primarily aimed at safeguarding our export industries, in particular meat and grains, but the results are also very useful to domestic consumers.

- Total Dietary Survey (TDS) - also carried out by the Commonwealth Government, by sampling a wide range of foods that are 'ready-to-eat' (i.e. chops are grilled, potatoes are boiled) for chemical and heavy metal residues.

The results of the NRS and the TDS are published every year and are available from the Commonwealth Government.

State Surveys - are carried out by state and territory government agencies generally on an annual basis or where there is a perceived risk. Results are available to the public and industry. Residues above the legal limit are investigated and, if there is a willful misuse, legal action can be taken.

Industry Surveys - industry groups carry out these surveys, usually as part of an industry's Quality Assurance program. An example of this is FreshTest, a fruit and vegetable program, which regularly samples fresh produce passing through the central markets.

Growers and wholesalers use FreshTest to ensure they are preferred suppliers to the major retailers. General results and trends are available from FreshTest for a fee. Some retailers carry out their own chemical monitoring and, in all cases, results are used 'in-house' and are not available to the public.

Keeping Residues below the Maximum Residue Limit (MRL)

The best way to keep residues below the MRL is to:

- **Observe the withholding period** - check the label and comply with the recommended withholding period. Never harvest, graze or slaughter before the withholding period has elapsed.
- **Apply the right product** - one that is registered for use in your state for that particular pest or situation. This means the product will have been thoroughly tested and will have an

  established MRL. Never use a product on a crop or type of animal for which it is not registered.
- **Apply at the right rate** - at the recommended rate shown on the label. It is also important to check that the application equipment is working correctly (nozzles, pressure, calibration, etc). Maintain application equipment and never apply products above the legal recommended label rate.
- **Be aware of spray drift** - avoid drift in your own spray operations and be alert to the risk of drift from neighbours.
- **Avoid contaminated livestock feed** - observe withholding periods and any other label directions that restrict the grazing of a treated crop, pasture, stubble, etc by livestock. Ensure that any stock food brought onto your property does not contain unacceptable pesticide residues.
- **Respond to accidents appropriately** - report any accidents and ensure that contaminated soil or water is identified and managed to minimise the risk of unwanted residues in produce.

Chapter 9

PESTICIDE RESISTANCE MANAGEMENT

"Always use label rates to minimise the risk of resistance"

INTEGRATED WEED MANAGEMENT STRATEGIES

Strategies that are designed to prevent and/or reduce the occurrence of resistance by adopting Integrated Weed Management (IWM) strategies do not rely on a single strategy to keep resistance at bay but integrate them into the crop production program. Some of the key strategies are:

- Refer to specific guidelines for each herbicide mode of action group.
- **Rotation of chemicals between different mode of action groups within and across years.**
- Keep accurate records of your herbicide applications on a paddock basis.
- Read the herbicide product label and literature carefully and follow the instructions.
- **Always use robust label rates but never use higher than label rates as this will increase the chance of resistance occurring as well as cause harm to human and animal health by leaving residues in plants and animals consumed as food.**
- **Rotation of crop and variety.**
- Identify and monitor your surviving weed populations and check for resistant weeds on your farm. Keep good records of weed populations.
- If a failure is suspected do not use the same product or product from the same mode of action group.
- Testing - confirm resistance exists.
- Additional cultural weed control techniques to reduce seed banks, e.g. burning, cultivation, delayed sowing, competitive crops and varieties, green manuring, grazing and collection of weed seed at harvest.
- **Control weed escapes before the weeds set and shed viable seed.**
- Do not introduce or spread weeds by contaminated seed, grain or hay.
- Consider crop and pasture topping.
- Attend training courses, e.g. GRDC IWM course, SpraySMART and field days.
- Seek advice from local advisers (agronomists).

Keep yourself informed and be pro-active in the fight-back against resistance.

For further information on resistance management strategies, consult your reseller agronomist, farm consultant or Departmental Agronomist, or refer to the "Integrated Weed Management Manual" found on the following website www.glyphosateresistence.org.au

You can do something to reduce the impact!

Follow the latest resistance management strategies described here.

Note: In the specific guidelines for each mode of action group in the following pages, the boxes contain the chemical families, followed by a list of active constituents, with the trade name of the first registered product or successor in parentheses. The active constituents and some products that were moved to a different group in February 2008 are listed in bold in red.

For a complete list of registered products containing each active constituent, refer to the website of the Australian Pesticides and Veterinary Medicines Authority (APVMA) at www.apvma.orq.au for the PUBCRIS database.

SPECIFIC GUIDELINES FOR GROUP A HERBICIDES

Group	A	Herbicide

High resistance risk

Group A resistance exists in Australia in the grass weeds including annual ryegrass, wild oats, phalaris, brome grass, crab grass, goosegrass and barley grass. Resistance has developed in broadacre and vegetable situations.

Research has shown that as few as 6 applications to the same population of annual ryegrass can result in the selection of resistant individuals. A population can go from a small area of resistant individuals to a whole paddock failure in one season.

- Fops, dims and dens are Group A herbicides and carry the same high resistance risk.
- Where a Group A herbicide has been used on a particular paddock for control of any grass weed, avoid using a Group A herbicide to control the same grass weed in the following season, irrespective of the performance it gave.
- Frequent application of Group A herbicides to dense weed populations is the worst-case scenario for rapidly selecting for resistance.
- Where resistance to a member of Group A is suspected or known to exist, there is a strong possibility of cross resistance to other Group A herbicides. Therefore, use other control methods and herbicides of other mode of action groups in a future integrated approach.

The above recommendations should be incorporated into an Integrated Weed Management (IWM) program. In all cases try to ensure surviving weeds from any treatment do not set and shed viable seed. Keep to the integrated strategies mentioned in this brochure including rotation of mode of action groups. Make sure you rotate between products from different mode of action groups.

SPECIFIC GUIDELINES FOR GROUP L HERBICIDES

Group	L	Herbicide

Moderate resistance risk

Group L resistance exists in Australia in annual ryegrass, barley grass (2 species), silver grass, capeweed and square weed. Most instances have occurred in long-term lucerne stands treated regularly with a Group L herbicide, but Group L resistant barley grass has also occurred in no-till situations.

The following factors are common to all cases of Group L resistance:

- A Group L herbicide is the major or only herbicide used.
- A Group L herbicide has been used for 12 - 15 years or more; and
- There has been minimal or no soil disturbance following application.

The risk of resistance to Group L herbicides is higher in zero tillage broadacre cropping. Other high resistance risk situations include irrigated clover pivots, orchards, vineyards or pure lucerne stands where frequent applications of a Group L herbicide are made each season, cultivation is not used and there is reliance on a Group L herbicide alone for weed control.

Below are strategies that address these high resistance risk situations to reduce the risk of Group L resistance developing.

- Rotate Group L herbicides with other knockdown herbicides with a different mode of action.
- Consider utilising the double knock technique1 where glyphosate is sprayed first followed within 1-7 days by a paraquat application.
  A full label rate for the weed size targeted should be used for the paraquat application for resistance management.
- Consider occasional mechanical cultivation to aid weed control.

SPECIFIC GUIDELINES FOR GROUP M HERBICIDES

Group	M	Herbicide

Moderate resistance risk

Group M resistance occurs in Australia in annual ryegrass, awnless barnyard grass, fleabane, liverseed grass and windmill grass.

Herbicide resistance to glyphosate was first discovered in annual ryegrass in Australia in 1996. Since that time, a number of new cases of glyphosate resistance in annual ryegrass, awnless barnyard grass, fleabane, liverseed grass and windmill grass have been confirmed.

The following factors are common to all cases of Group M resistance:

- A Group M herbicide is the major or only herbicide used.
- A Group M herbicide has been used for 12 - 15 years or more; and
- There has been minimal or no soil disturbance following application.

Given the very important role of glyphosate in Australian farming systems, the Australian agricultural industry has developed strategies for sustainable use of glyphosate.

For more information refer to the Australian Glyphosate Sustainability Working Group website
http://www.glyphosateresistance.org.au

All cases of glyphosate resistant weeds confirmed to date share three common factors:

- Intensive (year to year) use of glyphosate.
- Lack of rotation of other herbicide modes of action; and
- Little or no tillage/cultivation following the application of glyphosate.

A number of these cases of ryegrass resistance to glyphosate have occurred in horticultural and non-cropping situations (e.g. firebreaks, fence lines, driveways, irrigation ditches), with the balance occurring in no-till broadacre cropping systems.

Given the demonstrated propensity of annual ryegrass to develop resistance to multiple herbicide classes, Integrated Weed Management principles should be incorporated wherever possible to minimise the risk of selecting for glyphosate resistant ryegrass. Strategies may include the use of cultivation, the double knock technique, strategic herbicide rotation, grazing, baling etc.

The above recommendations should be incorporated into an Integrated Weed Management (IWM) program. In all cases try and ensure surviving weeds from any treatment do not set and shed viable seed. Always try to apply herbicides to the smallest weed density. Keep to the integrated strategies mentioned in this brochure including rotation of mode of action groups. Make sure you rotate between products from different mode of action groups.

Insecticide Resistance Management Strategies

Developed by the CropLife Australia Insecticide Resistance Management Review Group
Valid as at 28 September 2011.

INTRODUCTION

The CropLife Australia Insecticide Resistance Management Review Group (IRMRG) has drafted insect resistance management strategies in conjunction with growers, researchers and agronomists to minimise the development of insect resistance to insecticides. These strategies provide growers with guidelines for insecticide use (and other methods) for sustainable insect control.

PRINCIPLES OF RESISTANCE MANAGEMENT

Insecticide or acaricide resistance management strategies seek to minimise the selection for resistance to any one type of insecticide or acaricide. This requires an understanding of insecticides as they are grouped according to similarity of Mode of Action (MOA) in controlling insects and mites.

In practice, sequences or rotations of compounds from different MOA groups provide an effective approach to resistance management. In practice, sequences or rotations of compounds from different MOA groups provide an effective approach to resistance management. These MOA groups are shown in the Mode of Action Classification for Insecticides Table.

EFFECTIVE RESISTANCE MANAGEMENT STRATEGIES USE ALTERNATIONS OR SEQUENCES OF DIFFERENT MODES OF ACTION

The objective of Insecticide Resistance Management is to prevent or delay resistance developing to insecticides, or to help regain susceptibility in insect pest populations in which resistance has already arisen. IRM is important in maintaining the efficacy of valuable insecticides. It is usually easier to prevent resistance occurring than it is to reactively regain susceptibility.

Insecticide applications are often arranged into MOA spray windows or blocks that are defined by the stage of crop development and the biology of the pest(s) of concern. Local expert advice should always be followed with regard to spray windows and timings. Several sprays of a compound may be possible within each spray window, but it is generally essential to ensure that successive generations of the pest are not treated with compounds from the same MOA group.

WHAT IS RESISTANCE?

Resistance may be defined as 'a heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species.

Resistance arises through the overuse or misuse of an insecticide or acaricide against a pest species and results in the selection of resistant forms of the pest and the consequent evolution of populations that are resistant to that insecticide or acaricide.

MODE OF ACTION, TARGET-SITE RESISTANCE AND CROSS-RESISTANCE

In the majority of cases, not only does resistance render the selecting insecticide ineffective but it often confers cross-resistance to other chemically related compounds. Compounds within a specific chemical group usually share a common target site within the pest, and thus share a common Mode of Action (MOA). It is common for resistance to develop that is based on a genetic modification of this target site. When this happens, the compound loses its pesticidal efficacy. Because all compounds within the chemical sub-group share a common MOA, there is a high risk that the resistance will automatically confer cross-resistance to all the compounds in the same sub-group. It is this concept of cross-resistance within chemically related insecticides or acaricides that is the basis of the Mode of Action classification.

ALTERNATION OF CHEMISTRY

Constant use of products from one chemical grouping (MOA) will increase the risk of rapid buildup of resistance to that chemical group. Rotate your chemicals between chemical groups with different Mode of Actions will slow down the process of selection for resistance.

USE OF CULTURAL PRACTICES

Incorporation of cultural techniques for controlling an insect pest will reduce selection pressure from the insecticides. Any resistance management strategies should incorporate all available methods of control for the insect pest concerned.

UNDERSTANDING OF THE INSECT/MITE LIFE CYCLE

A good understanding of the life cycle of the pest is essential so that control methods can be effectively targeted. An insecticide or acaricide should always be targeted at the pest growth stage that is most susceptible for that insecticide or acaricide.

APPLICATION

Label Recommendations

Insecticide labels have been carefully developed to ensure the most effective control of the pest. The label should at all times be carefully read and adhered to.

Rates

Full recommended rates of registered insecticides should always be used to ensure the most effective control of the pest.

Coverage

The majority of insecticides require good coverage of the target area to ensure the best possible chance of contact and subsequent control of the pest.

RESISTANCE MANAGEMENT STRATEGY DESIGN

Pest or Regional Strategies

The strategies below are provided on a CROP by PEST basis (e.g. Tomato - Heliothis). However, in horticultural and agricultural areas often a range of crops are grown that are attacked by a range of pests.

In many cases, a specific MOA insecticide can be used across this range of crops to control multiple pests that have the ability to move from crop to crop. There is interaction between intensive horticulture and broadacre farming, as with Diamondback Moth (DBM) in Brassica vegetables and resistance strategies that could be compromised by widespread use of insecticides for DBM control in canola.

Also, the pest complex for a specific crop will vary within production regions, especially between Northern and Southern Australia.

For this reason, CROP by PEST strategies can be flawed and further Insecticide Resistance Management (IRM) advice for specific pests should always be sought on a local basis.

An alternative to the CROP by PEST strategy is that of "Regional strategies" such as those for Cotton, Brassicas and the Southern NSW and Northern Victorian IRM strategy for grain and annual horticultural crops".

The overall Resistance Management Strategy of avoiding overuse of individual Modes of Action insecticides should be followed, not just on a specific crop and pest but on a broad perspective of crops and pest complex.

Fungicide Resistance Management Strategies

Developed by the CropLife Australia Fungicide Resistance Management Review Group and industry researchers

Valid as at 28 September 2011

INTRODUCTION

WHAT IS FUNGICIDE RESISTANCE?

Resistance by fungal pathogens to fungicides usually evolves following the intensive use of fungicides for disease control. In any fungal population there are likely to be individuals that have some degree of natural resistance and which are less susceptible to fungicides, even before the chemicals are used. Resistance arises through the incorrect use of fungicides by selection of the resistant forms of fungi. Continued use of a fungicide or fungicide chemical group can result in a significant buildup of resistant individuals in the fungal population - to the point where that particular product, or other products from the same chemical group, is no longer effective. In some cases, removal of the selection pressure can result in the fungal population regaining its sensitivity to the fungicide group, but this is not always the case. The risk of fungicide resistance developing varies between different chemical groups and different fungal pathogens, such that specific strategies are recommended for those situations considered to carry the highest risk.

WHAT CAN BE DONE TO PREVENT OR DELAY RESISTANCE?

The most common approach to managing fungicide resistance is through responsible use of fungicides, of which the resistance management strategies presented in this document are good examples. In their most basic form, these strategies advocate rotation of fungicide products with a different chemical activity group to prevent over-use of any one product or activity group. More complex strategies safeguard against the development of cross-resistance or resistance to multiple chemical groups. In Australia, all fungicide products are labelled to identify which activity group they belong to. The activity group is indicated by a number (or letter/number combination) code on the product label.

Selecting the most effective or appropriate way to apply fungicides will make them work better and assist

in delaying the development of resistance. A good understanding of the pathogen's life cycle and epidemiology will also help in the selection of the most appropriate application method. As a general rule, targeted applications to control a certain development stage or population level are most effective, whereas shotgun approaches like application of fungicides through irrigation systems could accelerate the development of resistance by exposing a large portion of the fungal population to sub-lethal rates. Particular attention should be given to label recommendations, rates and coverage. Adherence to suggested disease threshold levels is also good resistance management practice.

The use of cultural practices or growing varieties of crops with a high degree of natural resistance to diseases - requiring fewer or less frequent fungicide applications.

Working with industry bodies such as the CropLife Australia Fungicide Resistance Management Review Group to establish resistance management strategies for minor crops and/or those crops for which no strategies exist. Of particular concern are permitted uses of fungicides, often in minor crops, where repeated use of a limited number of fungicide alternatives occurs. Although not explicitly stated on agricultural use permits, such permitted uses should also incorporate measures to prevent resistance.

In the event of tank mixing products and/or co-formulations, always follow the recommendation from the most recent Fungicide Resistance Management Strategies and apply the most stringent strategy applicable to the pathogen most at risk of developing resistance.

Certain environments are conducive to continuous infection and consistently high disease pressure. Examples of such environments are nurseries, tunnels, glasshouses and other structures of protected cultivation. Because protected cultivation usually requires multiple applications of fungicides at short intervals to control high disease incidence, these are often the origin of resistance to fungicides.
Users of fungicides should be particularly mindful of the resistance risk under these conditions. Do not use a fungicide product to which resistance has been confirmed and stop using a product if resistance is suspected. When the fungicide in question no longer gives adequate control, stop using it temporarily and consult the supplier on its current resistance status.

In the absence of an established resistance management strategy for a particular crop/disease situation, it is recommended that the use of fungicides from any given activity group (excluding Group M) be limited to a maximum of one-third of the total number of fungicide applications. The use of consecutive applications of fungicides from the same activity group should also be limited by alternating between products from different activity groups. The use of Group M fungicides is not limited, as these fungicides carry an inherently low risk of fungicide resistance developing.

ACTIVITY GROUP LABELLING IN AUSTRALIA

In order to help fungicide users to manage fungicide resistance, all fungicide products sold in Australia are classified according to the chemical activity group of their active constituent. The activity group must be indicated by a letter code on the product label. Australia was the first country to introduce compulsory activity group labelling on products. Since the introduction of activity group labelling in Australia, other countries have adopted activity group classification systems, however caution should be shown if cross-referencing activity groups between Australia and other countries, as there are some differences in classification.

CHANGES TO ACTIVITY GROUPS

In 2008, CropLife Australia completely revised Australia's fungicide activity grouping system to bring it into line with the international Fungicide Resistance Action Committee (FRAC) activity group classification system. This was the first major revision of the Australian classification system since its introduction several years ago. Activity group codes have now been changed from letters to numbers (or letter/number combinations). For a complete list of all fungicide active constituents registered in Australia and their old and new activity groups, see the Fungicide Activity Group Table on the CropLife Australia website at www.croplifeaustralia.org.au.

The activity group codes for all fungicide products have been changed and the new activity group code should be used when referring to the fungicide resistance management strategies. Fungicide product registrants have three years (from October 2008) to update labels to reflect the new activity groups, but in the interim, some product labels may display the old activity group code. Where there is a temporary difference in activity group code on fungicide product labels, the new activity group code should be used when choosing the appropriate resistance management strategy.

NOTES

Chapter 10

PESTICIDE APPLICATION

"Calibrate your equipment for best results"

Introduction

The aim of pesticide application is to control pests that have the potential to reduce agricultural/horticultural productivity and harm or destroy our natural resources.

Pest and disease management application activities are many and varied, for example:

- Control of weeds
- Control of insect pests
- Control of diseases
- Control of internal/external parasites
- Vertebrate pest control
- Control pests that enter our country

The application of pesticides is important because they:

- Help reduce the losses to agriculture
- Have an essential role in quarantine and protecting Australia's unique flora and fauna from exotic pest species
- Play a part in human recreation through controlling weeds and pests in public and private spaces
- Ensure our natural resources are protected and preserved from damaging pests.

Types of Equipment

There are various pesticide/veterinary chemical application techniques available for use in different situations. The most common equipment used is as follows:

1. Backpack/Knapsack Sprayers
2. Handgun with powered spray unit
3. Drench Gun
4. Boom Spray
5. Vaccinator
6. Canid

Backpack/Knapsack Sprayers

Hand-operated backpack sprayers are generally non-motorised with a single adjustable cone nozzle with a 15L tank capacity and are commonly used for small-scale application of pesticides generally for plant protection (weed control) purposes. A hand-operated pump generates the pressure to spray out the liquid through a hand-held wand and nozzle(s).

A knapsack sprayer poses particular hazards for the operator because the pesticide is carried on the back in close proximity to the skin and the spray is released in close proximity to the body. Knapsack application may be prohibited for some pesticides with relatively high toxicity. Be careful when filling and do not allow the outside of the equipment to become contaminated. Avoid overfilling and make sure that the tank lid is replaced correctly and firmly. Avoid breathing in the spray mist. Wear PPE as recommended by the product label.

Knapsack sprayers and powered handguns present a relatively low risk of spray drift because they generally operate at low pressure and deliver a limited volume of spray mix. Do not use excessive pressure to operate the sprayer because this will increase the risk of spray drift.

Knapsack sprayers are not usually sold with pressure gauges and regulators, but these are worthwhile additions, particularly if the sprayer will be used in situations where even and accurate application is a priority. Knapsacks can be fitted with a shielded nozzle to reduce the risk of off-target damage to nearby desirable plants when spot-spraying weeds.

Knapsack spray lances often come with extended range or hollow cone spray nozzles producing a fine spray quality. However, there are also low-pressure air induction nozzles such as the Teejet AIXR nozzle that will fit into most spray lance caps and give a coarse spray quality.

Powered Sprayers with Handgun

The basic operation of a powered sprayer with handgun is similar to a knapsack sprayer. A **motor-driven** pump provides pressure to a tank of spray liquid and the spray is delivered through a **handgun with a single nozzle** that is connected to the tank by a length of hose. Tank size varies from small units that can be pushed around or carried on an all-terrain vehicle up to much larger vehicle-mounted units. This unit is generally used for **plant protection** (weed control) purposes.

As with a knapsack, the spray is released in close proximity to the body so similar recommendations apply for protective clothing and equipment and avoidance of the spray mist. For vehicle-mounted sprayers, do not operate the handgun while driving. Spray only when the vehicle is stopped, or work in pairs with one person driving and the other spraying.

A powered sprayer with handgun is capable of generating higher pressure and delivering a higher flowrate, compared to a knapsack, so there is a higher potential for off-target damage. Operate only at the correct pressure and use an appropriate low drift nozzle in the handgun.

With hand-operated sprayers, it is easy to under-dose or overdose by using an incorrect spraying technique. Under dosing may give poor control of the target. Overdosing is wasteful and may cause excessive pesticide residues in the target, soil or water.

For application through hand-operated equipment, product labels may either specify a dilution rate (e.g. mL of product/L of water) or a rate per area (e.g. mL of product/ha), or both.

For the dilution rate method, it is critical to spray according to the label directions so that the correct amount of active ingredient is actually applied to the target. In general, the aim is to achieve a thorough even coverage of the target without runoff.

For the rate per area method the sprayer must be calibrated to ensure correct application.

Boom Spray

Boom sprayers are generally specialised motorised, multi-nozzle spray units designed to spray pesticide over large areas to control weeds, pest and diseases of crops. They are used in agriculture, forestry and right-of-the-way pest control operations. **They deliver low to moderate application rates with a medium potential for spray drift.** Boom sprayers help in the uniform distribution of chemicals throughout the crop foliage.

Aerial Application

Aerial application is highly specialised, motorised, multi-nozzle spray units designed to spray pesticide over large areas to control weeds, pest and diseases of crops. They are used in agriculture, forestry and right-of-the-way pest control operations. **They deliver low to very low application rates with a high potential for spray drift.**

Drench Gun/Vaccinator

Drench guns and vaccinators are **single dose handheld applicators used to administer animal health preparations** to livestock in accurate doses depending on the size of the animal. The accuracy of the individual unit should be checked prior to each day's work or as soon as the operator feels that the unit is no longer administering an accurate dose.

Specialised Application Equipment

In situations where standard equipment is not available for use, specialized equipment is often developed by industry members to improve the efficiency and safety of application of the product. An example is the application of 1080 baits to wild dogs or foxes to minimise their impact upon the sheep and cattle industries. In order to make the application of the bait more species specific the **Canid Pest Ejector (CPE)** was developed. Benefits of the ejector include:

- Ejector capsules containing 1080 are sealed and protected from the elements so that the 1080 remains viable for extended periods in the field. CPE devices are pinned to the ground so they cannot easily be moved or cached by foxes, wild dogs or birds
- **Once set, a CPE is only activated by a direct pull on the lure head that activates the spring-loaded plunger to propel the contents of a single capsule directly into the mouth of the wild dog or fox.**
- As the ejector can only be activated by an animal with an upward pull force of >1.6kg, many small non–target animals are excluded from activating ejectors.

Calibration

Spray/Application equipment will only deliver the chemical effectively if it is calibrated correctly. **Always calibrate your application equipment according to the manufacturer's specifications and with any specific requirements of the spray plan for the job at hand.**

The aim of calibration is to determine output over a given area

Once you know the output of your application other calculations can be done to determine how much chemical to add to the tank and how many tanks you will need to complete a job. Calibration Exercise Examples have been included with this manual to assist you with the calculation processes.

Calibration of a hand operated knapsack sprayer or powered handgun

- Measure a test area, normally 10 m^2 for a backpack sprayer or 100 m^2 for a power line sprayer.
- Calculate the amount used to spray the test area: Determine the time taken to spray the test area and spray into a measuring jug for the same amount of time.
- Calculate the output of the sprayer by dividing area into amount used.
- Sprayer output = amount used L ÷ area sprayed m^2.
  To convert from L/m^2 to L/ha you multiply by 10,000).
- Now calculate the amount of chemical to put in each full tank.
  To do this you need to know the tank size plus the rate of the chemical product to be used.

Amount (L) = Size of tank (L) X Chemical Rate (L/ha) = Sprayer Output (L/ha)

- Calculate the total amount of spray mix required by multiplying the area to be sprayed (in ha) by the sprayer output.
- Calculate the total number of tanks to do the job by dividing the tank size into the total amount of spray mix required.

Example: using the method to Calibrate a hand operated knapsack sprayer

Test area = $10m^2$ (or $100m^2$ for powered hand line)

- Amount used = 0.6 L
- Sprayer output = Amount ÷ area sprayed or 0.6 ÷ 10 = $0.06L/m^2$
- $0.06\ L/m^2$ (then times m^2 by 10000 to get a hectares worth) = 600 L/ha

Amount of chemical to put in tank = Size of tank **x** chemical rate ÷ sprayer output

- 15 x 5 ÷ 600 = 0.125 L or 125 mL

Total amount of spray mix required if area is 0.25 ha = Area to be sprayed in ha **x** sprayer output in L/ha

- 0.25 x 600 = 150L

Number of tanks required to complete the task = Spray mix required ÷ tank size

- 600 ÷ 15 = 150L
- 150 ÷ 15 = 10 tanks

Calibration of Boom Sprays

Chemicals should be applied evenly and at the prescribed rate. An accurately calibrated boom will ensure that this is achieved. Calibration of boom sprayers is not just a once-a-year activity; it should be checked regularly to ensure that the prescribed rate is maintained.

There are many methods of calibrating a boom spray. Never calibrate the boom with chemical in the tank. Always use clean water and flush out the boom before checking flow rates.

An accurate and simple method is as follows:

Calibration steps

1. Determine the "Boom Factor". Measure the distance between nozzles along the boom in millimetres, then divide by 100. For example, 500 mm spacing, then divide the number by 100, giving a **Boom Factor of 5**.

2. Time tractor. Run the tractor over a distance of 100 metres at a speed and engine revolutions per minute (rpm) suitable for spraying. Record the time taken in seconds, the tractor gear and engine revs.

3. Select spraying pressure. Choose a suitable operating pressure between 200-350 kPa for flat fan nozzles or 300 kPa or greater for hollow cone nozzles. It should be noted that while hollow cones can be operated up to 1000 kPa there is an increased risk of spray drift. Set the pressure at the engine rpm to be used.

4. Measure nozzle outputs. Park the tractor and operate at the selected pressure and engine rpm. Measure the outputs of the nozzles (in mL) for the number of seconds it took to travel 100 m. Average the outputs.

Example: Where 3 nozzles have outputs of 250, 270, 245 in mL:

Average output (mL): $\frac{250 + 270 + 245}{3} = 255$ mL

Check sprayer and calibrate using water only.

5. Calculate the water rate.

$$\text{Water rate (L/ha)} = \frac{\text{average output (mL)}}{\text{Boom Factor}}$$

Example: The Boom Factor is 5 the average nozzle output is 255 mL in the time it took to travel 100m.

$$\text{Water rate (L/ha)} = \frac{255\text{ mL}}{5} = 51\text{ L/ha}$$

6. Calculate the chemical requirement.

Once the water rate is known, the tank mix can be calculated and made up. If the tank is not completely filled, only the amount of water used should be entered in the equation instead of tank capacity.

Example: If the tank capacity is 2000 L and the chemical rate from the label is 2 L/ha.

$$\text{Chemical/tank} = \frac{\text{tank capacity (L) x chemical rate (L/ha)}}{\text{water rate (L/ha)}}$$

$$\text{Chemical/tank (L)} = \frac{2000\text{ L x 2 L/ha}}{51\text{ L/ha}}$$

$$= 78.4\text{ L of chemical per tank}$$

When spraying, always use the same gear, revs and nozzle pressure. Any changes will alter the applied dose of chemical.

Calibration of a Drench Gun or Vaccinator

Please Note: It is important to establish an accurate weight of the animal prior to treatment to ensure you achieve an effective dose rate.

Most drench guns or vaccinators can be calibrated using the following technique:

1. Fill the drench gun or vaccinator reservoir with sterile water.
2. Set the drench gun or vaccinator to a specific graduation mark.
3. Squirt at least 10 shots into an accurate measuring cylinder.
4. Average the total volume by dividing the total in the measuring cylinder by the number of shots to give you an actual dose rate.
5. Compare your test result with the mark you have chosen in step 1. If the dose rate is not within 5% of the mark then re-adjust the device and repeat the calibration process.
   This step may have to be done more than once to get the dose accurate.

Woody Weed Control

Control of woody weeds is a key component of any bush regeneration program. An integrated approach is recommended, with the following options all having an important role to play:

- Mechanical/Cultivation, e.g. cutter bars, ploughing, discing all damage the root systems of plants and can assist in control
- Slashing/Burning, e.g. this practice may reduce the size of infestation to a more manageable level
- Livestock, e.g. can aid in reducing seedling establishment, suppress regrowth and keep pastures competitive

- Herbicides, e.g. applied at the right time, using the right rate and application technique, are often the most economical, effective and practical method for long-term woody weed control.
- Cycle 1 = Treat. The aim is to reduce the infestation to a more manageable level.
- Cycle 2 = Follow-up. This is vital, with the aim being to follow-up what was treated in the previous cycle.
- Cycle 3 = Check. Continue to check over time to ensure no seedlings get away.

Treatment of Woody Weeds

There are a number of different methods you can use to treat woody weeds. The option you choose will be determined by the size of the problem, the resources you have available and the time constraints you are working within. Always refer to the product label for correct application rates.

The following application methods all have a place in controlling woody weeds
:

- **Aerial Spraying Application** - used for large infestations, or in difficult to access areas. **Potential for drift is high.**
- **Basal Bark Application** - used to treat saplings and regrowth less than 5 cm in basal diameter. This method involves mixing an oil soluble herbicide with diesel and spraying the full circumference of the plant stem/trunk. Basal bark spraying is suitable for thin- barked woody weeds and undesirable trees, saplings, regrowth and multi-stemmed shrubs and trees.
  This method works by allowing the herbicide to enter underground storage organs and slowly kill the targeted weed. The whole circumference of the stem or trunk should be sprayed or painted with herbicide solution from ground level to a height of 30 cm. It is important to saturate the full circumference of the trunk, and to treat every stem or trunk arising from the ground.
  Basal bark spraying is a very effective control method and is a good way to tackle inaccessible areas such as steep banks. This method will usually kill difficult-to-kill weeds at any time of the year, as long as the bark is not wet or too thick for the diesel to penetrate.
- **Cut Stump Application** - used for saplings that are too small to be stem injected. The plant is cut off completely at its base (no higher than 15 cm from the ground) using a chainsaw, axe, brush cutter or machete (depending on the thickness of the stem). Herbicide is then sprayed or painted onto the exposed surface of the cut stump straight away, (within three seconds).
  The objective is to kill the stump and the root system. Delays between cutting and applying the chemical can give poor results thus working in pairs is best. The herbicide can be applied from a knapsack, with a paint brush, drench gun or a hand-spray bottle, using a coloured dye in the solution to mark the stumps that have been treated.
  For large trees it is only necessary to place the solution around the edge of the stump (as the objective is again to target the cambium layer inside the bark). The stump circumference should be bruised with the back of an axe and each successive blow treated with herbicide.
  Herbicide is applied directly to the cut stump, immediately after the cut is made.
- **Foliar Spray Application** - normally refers to high volume application using a handgun to treat the foliage of the plant.
- **Hand Application** - used to apply granules/pellets to the soil prior to spring or summer rains.
- **Stem Injection Application** - used for control of larger woody weed species.

Correct identification of the weed species and knowledge of the growth habit of the weed are paramount to the application technique and product chosen for control.

Guide for choosing a suitable application technique.

Situation	Techniques to "USE"	Techniques to "AVOID"
Seedling Woody Weeds or perennial wood with small root systems and simple stems	Foliar spray	Stem injection - stem too small to inject Cut stump, basal bark spray - too laborious Granular application - too expensive
Woody weed with extensive fine stems	Basal bark spray Pellet/granular application	Foliar spray - insufficient leaf area to spray Cut stump - stems too thin and too many Stem injection - stems too small to inject
Advanced growth (>2m tail) from seed	Stem injection Cut stump application Granular application	Basal bark spray - bark and stem too thick to allow penetration of chemical Foliar spray - plant too big
Eucalypt or paper bark tea- tree regrowth from lignotuber	Cut stump application Basal bark spray Granular application	Stem injection - stem too thin to inject Foliar spray - insufficient leaf cover
Standing timber single or multi-stemmed	Stem injection Cut stump application	Foliar spray - not cost effective Granular application - ineffective, plant too big Basal bark spray - bark and stem too thick to allow chemical penetration
Regrowth following mechanical clearing or poor cut-stump treatment	Stem injection Basal bark spray	Cut stump - stems too small Foliar spray - insufficient leaf area to control root system
Brigalow regrowth or root ^ suckering plant up to 3m tall	Granular application	Cut stump, basal bark spray and foliar spray - all too laborious

Foliar Spraying

Using the correct spray volume is essential to ensure acceptable control when using the Foliar Spray Application technique.

A "Woody Weed Control Guide" produced by Dow AgroSciences Australia provides excellent guidelines on calibration for woody weed control. This guide specifies the volume of spray that should be applied to a bush of particular size (height x diameter) to achieve correct coverage.

Treat at the Right Time

When carrying out treatment of woody weed infestations it is most important to treat at the right time.

- Ensure plants are actively growing
- Ensure plants are not stressed
- Ensure at least one metre of regrowth
- Apply herbicide when there is sufficient sap flow down to the root system, to ensure control of the entire plant above and below the ground.

Splatter Guns

It's not always practical to drag a hose and reel through thick bush (could also damage sensitive areas) and so the use of splatter guns has become popular in these areas with difficult access, particularly in the control of Lantana, which is a weed of national significance (WONS)

The method

- The splatter gun method involves applying a low volume of concentrated herbicide (1:9 glyphosate and water concentrate mix) to foliage. A specialized nozzle produces large droplets of herbicide that can be applied from a distance of 6-10 metres away.
- Only a small portion of the foliage needs to be sprayed so off target damage can be minimized.
- Use a marker dye to identify splatter bushes, check toxicity of marker dye as some are poisons (Dy-Mark and Big Red are unscheduled).
- Apply approximately 15-20 millilitres of herbicide mix per splatter on large bushes to achieve the registered rate of 2 x 2ml per 0.5 metre of bush height.
- Arch the spray over the top of the bush and down the front face and if treating dense lantana, applying one splatter every two strides, with an occasional horizontal pass low across the front edge of the bushes to treat any seedlings.
- As with all herbicide treatments, apply to actively growing plants with full foliage.
- Like all lantana controls, follow-up treatments are recommended to control seedlings and/ or regrowth.

Mapping Weed Control Activity

Because weed control requires consistent and timely follow up for many years it is now common practice to map weed distribution and treatment on an ongoing basis using hand held GPS and graphical information systems, which greatly simplify and speed up the mapping of weed distribution. Using these tools it is possible to reliably return to any position in the landscape to monitor progress or retreat an area.

Weed mapping is useful at a range of scales and is one of the keys to operating a successful weed management plan.

The purposes for mapping are:

- Identifying and locating species in order to plan management actions at the local scale.
- Recording treatments and progress in managing the weed problem.
- Providing a record so that a history is compiled which will guide management actions over many years.
- To inform management of local weed distribution which can then be aggregated into district, state and ultimately national data. This is of particular value when planning the prevention of spread, training and targeted remediation programs.

In order for weed mapping to be of use at all scales a set of national core attributes has been endorsed by the Australian Weeds Committee. These are supported by "A Field Manual for Surveying and Mapping Nationally Significant Weeds" published by the Bureau of Rural Sciences, which describes the methods for, recording and reporting on, field data sheets for on the ground use.

Vertebrate Pest Control

The term 'vertebrate pest' refers to skeletal animals that have reached a population that causes problems of an economic, social or environmental nature.

In Australia, the most common pests are introduced species including rabbits, foxes, mice and rats, wild dogs, feral pigs, feral cats, some bird species and many other species that simply do not have a place in the

Australian environment.

- Foxes inflict serious damage on newborn lambs and kill other livestock. They also threaten survival of many native mammals and birds.
- Rabbits have devastated large tracts of land by damaging young seedling trees and shrubs, destroying native grasses and pastures, and by creating erosion.
- Rodents, including mice and rats, cause damage in crops, damage farm infrastructure and pose disease and spoilage problems in food storages and stock feeds.
- Predatory wild dogs cause damage to farm livestock, native animal species and may pose risks to human safety.

These introduced species cost the Australian economy hundreds of millions of dollars annually through lost production and spoilage of products and foodstuffs.

The costs at an environmental level are impossible to calculate but there is no doubt that introduced predators such as foxes, cats and wild dogs have directly contributed to the extinction or endangerment of many of Australia's unique marsupial species and birds.

Integrated Pest Management

Integration of a range of pest management techniques is most effective against the pest species and reduces the reliance on vertebrate pesticides.

Management techniques include:

- Habitat modification, e.g. destruction of rabbit warrens
- Biological control
- Trapping and exclusion
- Shooting and hunting
- Enterprise management.

Vertebrate pest management can be integrated opportunistically with population control exerted by environmental conditions such as drought.

Vertebrate Pesticides

There are three key issues that set use of vertebrate pesticides apart from other pesticides:

- The targets are warm-blooded animals and, despite being pests, are perceived by large portions of the general community as "cute and cuddly"
- Other warm-blooded animals could be affected by the poisons
- Because animals are involved, animal welfare issues must be considered.

Key Vertebrate Pesticides used in Australia, and the Species that they target

Pesticide	**Target Animal**
Sodium Fluoroacetate (1080)	Rabbits, foxes, wild dogs/dingoes
Strychnine	Wild dogs/dingoes, mice, emus(WA)
Chloropicrin	Rabbits
Phosphine	Rabbits, mice
Pindone	Rabbits

With the exception of **Pindone, which is a schedule 6 poison**, these products are classified as Schedule 7 poisons because of high oral toxicity.

Pindone

Pindone is an anti-coagulant poison used for rabbit control. Rabbits are more susceptible than many other species to Pindone but, to consume a lethal dose, they must have repeated feeds of bait three to four days apart.

Risks

Compared to 1080, Pindone poses a much lower risk of accidental poisoning of non-target animals by both direct and secondary means. Pindone is degradable and non-cumulative so should a bait be accidentally moved from the treatment areas and consumed by a non-target animal an incidental dose is able to cleared from its body relatively quickly. Furthermore, administration of Vitamin K is an effective antidote

Risk management

Nevertheless, caution should always be used when laying baits so that no other animals have direct access to the baits.

Pindone concentrate is supplied only to authorised Government agencies and licensed contractors for them to use in the preparation of bait. A ready-to-use preparation of treated oat bait is available commercially.

Sodium fluoroacetate (1080)

Sodium fluoroacetate (1080) is a synthesized poison but the active constituent is identical to a compound that occurs naturally in some Australian plants, mainly from WA. Introduced mammal pests such as rabbits, dingoes and foxes have a very low tolerance to 1080, so these species can be targeted in poisoning programs.

Hazard

The primary source of poisoning with 1080 is via the oral route (ingestion).1080 is potentially toxic to all vertebrate species if the baits are moved away from the treatment area because it has **no known effective antidote.** Emptying the stomach can get rid of most of the poison in the early stages but any treatment is unlikely to be effective unless it is administered soon after ingesting the poison.

Risks

Using 1080 for vertebrate pest control has the risk of potentially poisoning non-target animals, either through the direct taking of 1080 baits (primary poisoning) or through the consumption of poisoned animals (secondary poisoning). Non-target animals vary considerably in their tolerance to sodium fluoroacetate.
Domestic dogs are most susceptible and accidental poisoning of dogs is considered to be the most general risk associated with use of 1080. Cats are also quite susceptible. In general, birds show considerably more resistance than mammals. **Cold-blooded animals such as reptiles and fish are the most resistant.**
Sensitivity of native animals to 1080 is variable and depends partly on the extent to which the species has developed a tolerance to the ingestion of fluoroacetate, which occurs naturally in a variety of native plants. Of these plants, over 38 species are confined to the southwest corner of WA and others are found across northern Australia. No fluoroacetate-bearing plants are known to occur in SA, NSW, Victoria and Tasmania.

In all animals there is a delay of approximately 0.5-2 hours between ingestion of the poison and the onset of symptoms. Poisoned animals may consequently die in an area away from where they ingested the bait, and this must be taken into account when the risk of secondary poisoning is assessed. The slight risk of fox or dingo baits being moved from where they are laid initially should also be considered.
The properties and use patterns of 1080 are such that contamination of air, soil or water is not significant. **1080 readily degrades in soil and water through microbial activity, although it may persist under arid conditions.** Degradation of 1080 also occurs readily in living organisms.

Application

The application of 1080 is normally by the use of pre-made baits that can be purchased or baits that are prepared just prior to their use using different types of fresh meat dependent upon what the targeted animal is used to eating. These baits are either buried (normally 8-10cm below ground) in areas where pest animal activity has been observed or in remote areas dropped via aircraft in pre-mapped areas.

In recent years the development of the **Canid Pest Ejector (CPE)** has provided a new tool in the control of wild dogs and foxes. Field trials have confirmed a number of benefits that make ejectors suitable for use as an additional wild dog and fox control tool.
Ejector capsules containing 1080 are sealed and protected from the elements so that the 1080 remains viable for extended periods in the field. Therefore, the ejector can be set and left in the field for extended periods to provide a sentinel station, so long as the bait head remains attractive to target species. CPE devices are pinned to the ground so they cannot easily be moved or cached by foxes, wild dogs or birds. **Once set, a CPE is only activated by a direct pull on the lure head that activates the spring-loaded plunger to propel the contents of a single capsule directly into the mouth of the wild dog or fox.** As the ejector can only be activated by an animal with an upward pull force of >1.6kg, many small nontarget animals are excluded from activating ejectors. Researchers in Victoria identified that "only red foxes, wild dogs and feral cats had been recovered in field trials when cyanide was used as the active agent, suggesting a high level of target specificity" (Busana et al. 1998; Marks et al. 2003). NSW Office of Environment and Heritage (OEH) trials used monitored sand plots, remote triggering cameras and carcass collection to assess non-target risks after the use of cyanide (quick kill) capsules on 100,000 exposure nights. Few non-target activations were recorded despite many non-target animals being observed within close proximity to the devices. Ejectors can be re-used many times.

Risk management

The supply and use of 1080 is regulated in all Australian States and Territories.
In general, 1080 products are only available from authorised personnel experienced in vertebrate pest control. **Applicants are required to sign a written agreement for supply of 1080 baits.**

The agreement should establish that the applicant:

- Has a genuine need to reduce impact of specified pest animals
- Has assessed what off-target risks may be present and made attempts to manage these risks
- Understands all conditions of use and safety requirements and agrees to abide by these conditions.

In some States, there is a training requirement for applicants who want to purchase or use 1080 or other Schedule 7 poisons, e.g. Agricultural Chemical User Permit in Victoria.

Conditions and restrictions are attached to the use of 1080 to address safety concerns.

These relate to such things as:

- Correct transport, storage, preparation and placement of baits
- Distance restrictions around sensitive areas
- Display of warning signs
- Notification of neighbours
- Removal of carcasses
- Removal of fox/dingo baits or burial of rabbit oat trail.

Dogs should be restrained for the duration of a 1080 baiting program, and muzzling should also be considered, to minimise the risk of them consuming bait or poisoned carcasses.

Strychnine

Strychnine may be used for application to dingo trap jaws to hasten death in pastoral areas or certain designated local government areas, for the emergency manufacture of dingo baits in SA, for emu control in WA and in prepared bait to control mice under certain conditions in SA.
Hazard

Strychnine is toxic to all vertebrate species.

Risk

The use of strychnine for vertebrate pest control in Australia is severely restricted because of the risk of poisoning of off-target species, including humans. Accidental poisoning of meat-eating birds and domestic dogs is the major risk when using strychnine for dingo control. Accidental poisoning of grain-eating birds is the major risk when using strychnine for mouse or emu control.

Risk management

Strychnine powder can only be supplied by, (or to) authorised personnel experienced in vertebrate pest control and only under permit to landholders with a legitimate need.

Applicants must have a minimum level of training in the use of poisons, e.g. **current Level 3 accreditation** or equivalent. Surrounding landholders must be notified, and approved signs displayed at property entrances and near baited areas. During the baiting period and for a specified time afterwards, all dead animals found on the baited and adjacent properties must be burned or buried. All remaining bait must be removed and destroyed at the completion of the baiting program.

The use of strychnine grain bait to control emus in WA is restricted to authorised officers of DAFWA. Landholders must previously have received a damage license from the Department of Environment & Conservation (DEC) allowing emus to be controlled on their property.

Baiting mice with strychnine is permitted in SA under certain exemptions in the Controlled Substances (Poisons) Regulations 1996.

A person can possess strychnine in SA without being licensed only if:

- The person is the owner or occupier, or an agent or employee of an owner or occupier, of land situated outside metropolitan Adelaide and outside any township
- The strychnine is a constituent of baits designed for destroying mice
- The quantity of bait in the person's possession does not exceed 5 kg, and
- The proportion of strychnine in the bait does not exceed 0.5% (5 g/kg).

The bait can only be used to control mice in and around storage buildings on land situated outside metropolitan Adelaide and outside any township. Strychnine bait should not be used around grain storage areas and must not be allowed to contaminate other grain.

The bait must not be placed in the open where it may be accessible to grain-eating birds and unused bait, bait containers and all dead mice should be burnt.

Chapter 11

RECORD KEEPING

"Record keeping is a legal requirement"

Introduction

Accurate record keeping is a legal requirement and is essential for safe pesticide management. Keeping accurate records will assist users of urban pesticides to minimise risks, continually improve practices, and accurately diagnose problems.

Records serve as a long-term archive of practices undertaken, as well as providing an immediate management tool for urban pesticide management.

Never keep records, SDS, or PPE in the storage area where they may become contaminated, or damaged/destroyed in the event of fire.

Benefits of Records: Accurate records are necessary because:

- **They assist with making decisions on product selection** e.g., for resistance management, to avoid repeat use of products with the same mode of action.
- **To plan purchases and for budgeting.** Knowing what products are on hand, and what purchases will be required for the year, will help minimise carryover of unused product that may deteriorate or not be used in future.
- **To keep a check on product performance.** Matching product results with the rate at which it was applied, and the conditions under which it was used will assist in future decision making.
- **To help determine what went wrong if the product did not work as expected.** Reviewing records helps to determine whether or not the product was used according to label directions and may give you an indication of reasons for poor performance. Records may also help you avoid making repeat mistakes.
- **Industry quality assurance and best management practice schemes** require the keeping of records. This is to ensure product safety and integrity.
- **Accurate records may assist in emergency management,** e.g., mass poisoning of livestock, or environmental contamination, or a fire in the chemical store. To provide evidence in the event of insurance claims - e.g., if there is theft of chemical from the chemical store.

The following records are required by law.

Training Records: Training records should highlight when retraining is required.

Employers have a range of responsibilities under Work Health and Safety legislation to provide employees with induction and training in the use of Hazardous substances including pesticides.
AQF 3 training meets these WHS requirements because it is competency based and within the Australian Qualifications Framework.

The type and level of training required is not always specified but must be in line with the level of risk. The Hazards Identified in workplace risk assessments then helps to determine the appropriate training requirements.

Training Record Example

No	Learners Name	Course Completed	USI No.	Accreditation No.	Date Completed	Renewal Date
1	Dan Austin	SpraySMART Level 3	ABCDEFGHIJ	0001-40867	10/1/16	10/1/21
2						

Application / Pesticide Use Records

Record Keeping Requirements – State/Territory Summary		
State/Territory	**How long to make a record**	**How long to keep a record**
NSW	48 hours	3 years
VIC	48 hours	2 years
QLD	N/A	2 years
SA	24 hours	7 years
WA	N/A	3 years
TAS	N/A	N/A
NT	N/A	2 years
ACT[1]	N/A	N/A

1- Currently (Jan 2019) in the process of amending legislation to adopt a few of the national AgVet reforms, which will include record keeping. It is intended that records will have to be made within 48 hours and kept for a period 2 years. Current advice is to follow best practice for record keeping and that the ACT copies NSW requirements.

Records showing the details of each application task:

- Are important tools in showing 'due diligence' as part of your obligations under State 'control-of-use' legislation.
- Are required for industry quality assurance and best management practice (BMP) programs.
- Are required when using restricted products as designated by the APVMA, or your State authority.
- Are useful in providing information on product performance allowing decisions to be made on long term, objective data.
- Help to avoid product misuse.
- Assist with questions regarding residues, compensation, drift damage, injury, litigation, etc.

It is best that information be recorded as soon as practicable (no later than 24 hours) after the use. The records must be in writing and legible.

The minimum information required is:

- The full product name(s) of the pesticide(s) applied.
- The pest or pests being targeted.
- The rate of application of the pesticide(s) and the quantity applied.
- A description of the equipment used, particularly nozzle information.
- A description of the manner in which the pesticide was applied.
- A general description of the area treated.
- The specific location and address of the treated area.
- The date and time of application (including start and finish time).
- If applied outdoors, details of the weather conditions at the start and finish.
- The name, address and contact details of the applicator or, if an employee, the details of the employer.
- The name, address, contact details of the property owner on which the pesticide was applied.

If the application was outdoors, then a record of the weather conditions is necessary. This should include wind speed, direction and the temperature, immediately before and during the pesticide application. It is also advisable to measure humidity with a suitable instrument.

If the application is made by a third party such as a spray contractor, then the applicator must supply the owner/occupier with a copy of the application record. **This copy must also be kept for a required amount of time for each State/Territory.**

The need to keep records does not extend to home gardeners, but also include:

- Pesticide use on **bowling greens and golf courses** and like enterprises.
- Pesticides applied by **Shire Councils** and other public authorities.
- Pesticides used by **Community groups**, eg. Landcare, Bushcare.
- Pesticides used by **landscapers and commercial gardeners**.
- The activities of the **Pest Control industry.**
- All agricultural, farming and forestry activities.

Application Record Sample

SPRAY APPLICATION RECORD

Business/Name	**Business or property name**		
Address	**Business or Property Address**		
Contact Name	**Contact's name**	**Mobile**	**Contact's mobile**
Phone	**Contacts Phone**	**Email**	**Contact's Email Address**

OPERATOR INSTRUCTIONS

Worksite	Details on area to be treated – e.g., 10 rows in between grape vines										
Vehicle					**Spray Equipment**	15 lt motorised backpack					
PPE	**Rubber**	✓	**Goggles**	✓	**Respirator**	✓	**Face Shield**		**Gum boots**		
Overalls	✓	**Apron**		**Hat**	✓	**First Aid**	✓	**Other**			
Lt/Ha	**5.0**	**Speed**	10km/h		**Pressure**	3.0	**Nozzle**	Adjustable solid cone			
No Spray	**N/A**		**Yes**	✓	**Neighbours**	✓	**Date**	**20/7/16**			
WHAT TYPE OF PEST ARE YOU TREATING											
Insect	✓	Weed		Disease		Vertebrate		Internal/External Parasite		Other	
Instructions: (Identify the appropriate treatment and insert details here) **Treat rows between the grapevines for control of caterpillars**							**Site Map:** (draw a site map of the treatment area in relation to the property)				

Operator Name	**Start Time**	**Finish Time**	**Chemicals Applied**		**Application Label Rate**	**Amount Mix Used**
			Trade Name	**Active Constituents**		
Applicators name	**8.30am**	**10.45am**	Pest Aside	350 g/l Piereefrum 250 g/l Rogore	100mls/15lts	8x15lts

SITE WEATHER DURING APPLICATION

Time	**Temperature**	**Rainfall**	**Wind Speed**	**Wind Direction**	**Humidity**	**Delta T**
	On treatment day	On treatment day	On treatment day	On treatment day	On treatment day	On treatment day

Spray Operators Comments	e.g., all went well, had to stop for short period due to wind		
OPERATORS SIGNATURE	**Applicator's name**	**DATE**	**Treatment date**

Chemical Store Records

Store records, or manifest or inventory as it is sometimes called, is simply a list of products kept in the store. This list is useful for:

- Planning purchases (knowing what you already have in store)
- Advice to emergency personnel in the event of a fire or other emergency
- Insurance claims (proof of products kept)
- Meeting the requirements of Occupational Health and Safety Regulations
- Determining if the store requires a Dangerous Goods License

This manifest must not be kept in the pesticide store (in case of fire). It may be combined with Stock Control records.

The record should include:

- Product trade name
- Active constituents
- Poison Schedule
- Dangerous goods; Class, Packing group, UN number
- Batch number
- Date of manufacture (DOM) or Expiry date
- Quantity stored (preferred), or approximate maximum quantities in store at peak times

The store will require licensing if the maximum expected quantities of Dangerous Goods exceeds the exemption limits.

Chemical Store manifest Record Example

CHEMICAL STORAGE RECORD

I.D No	Trade Name	Active Constituent (s)	Chemical Type	Signal Heading	D.G. Code	Batch Number	Date In	Amount In Stock	Date Out	Taken By
1	Pest Aside	350 g/l Piereefrum 250 g/l Rogore	Insecticide	Caution	Yes	ABC12345	1/1/16	5.0 lts		
2	Insect Aside	600 g/l Clophos	Insecticide	Poison	Yes	ABC54321	7/9/15	20 lts		
3	Bug Aside	750 g/l Oldron	Insecticide	Dangerous Poison	Yes	ABC00001	3/6/15	10 lts		

Risk Assessment

It is a legal requirement under the Work Health and Safety Act that risk assessments are conducted annually or whenever practices change, and that these be documented. If there is an accident or a WorkCover inspection, these records will need to be produced. Such risk assessment records will help managers fulfil their duty of care in providing a safe work environment and to identify hazards and improve practices.

Risk assessment records should include:

- An analysis of every step in the chemical management process from purchase to application of product and final disposal of waste.
- Identification of the hazards in this process and an evaluation of the relative risks.
- Documentation of steps to minimise risks and a timeline (or priority order) and responsibility delegation to achieve this.
- Record of when risk minimisation has been completed.

Incident Reporting

WHS regulations require that serious workplace accidents/incidents are reported to the relevant authority as soon as possible. A further written notification should be lodged within 48 hours of the accident/incident.

The duty for notifying the state authority rests both with employers and self-employed people who have management and control of the workplace.

Notification is required where a workplace incident results in death or serious injury. For instance, serious injury may constitute medical treatment within 2 days of exposure to a pesticide.

Health Surveillance Record

It is a legal requirement under some State legislation, that people whose health is at risk from the handling or use of organophosphate pesticides undergo health surveillance. It is not necessary for all users of organophosphate pesticide, but it is necessary for the employer to demonstrate that monitoring and surveillance procedures are in place. Testing should be routinely conducted when there is risk of exposure, and also at times when there is no risk of exposure (baseline determination).

The surveillance must be under the direction of a medical practitioner acceptable to the employee, and at the cost of the employer. The employer must keep the employee's records in a confidential manner for 30 years after the exposure. These records could form part of the personnel/training records. If the business ceases activity within this period, any employee records are to be forwarded to WorkCover/WorkSafe.

Spray Orders

Where a contractor is employed to apply chemicals, or employees or other operators are entrusted with the task, it is essential that there be no confusion regarding the application of the chemical. Liability for any damage resulting from mistakes or misuse is shared between all involved - the owner, manager, advisor/consultant and contractor/ operator. Giving directions in writing will help to avoid misunderstandings. It is not compulsory but is a good management practice.

The minimum information that should appear on the spray order includes:

- Product to be applied (trade name, active constituent/s and concentration/s)
- Where it is to be applied (use of an accurate map appropriately marked is the preferred option, rather than a 'mud map')
- When it is to be applied with date and time window within which the application should take place (conditions permitting)
- Contact details for grower representative who will be available during the application window
- Precaution/hazards to be aware of, including physical, environmental, human and neighbouring situations
- Authority for the applicator to suspend application in the event of any unfavorable conditions or circumstances arising during the application
- Rate at which it is to be applied
- Signatures of manager and operator
- Date

WHS Records

- A record of the risk assessments carried out for high-risk activities involving Hazardous chemicals.
- Health surveillance records - employers must arrange the health surveillance of workers who handle and apply organophosphates.
- Records of induction and training to workers in the handling and use of pesticides.
- Records of accidents/incidents in the workplace and details of investigations into causes.

Property/Site Plan

A property plan (map) of your workplace and surrounding area should include important features such as;

- Neighbouring properties and sensitive areas.
- Building structures including chemical storage areas.
- Public roads and places.
- Aquatic areas.
- Power lines and aircraft hazards.
- Contaminated sites (old dumps, sheep dips etc.).
- Buffer Zones.

Electronic Equipment as an Aid to Record Keeping

Weather Measuring and Recording devices

There is a vast array of electronic equipment capable of providing quick and accurate weather information 'on the job'. Handheld devices are very useful in improving the accuracy of recording temperature, wind speed and humidity data. Some of these hand-held units now have a download capability to transfer the stored data to a computer. Portable weather monitoring units are also available that can be set up as a stationary unit in the paddock or the area being worked in, with wireless connection to a monitor in the spray vehicle or tractor providing live weather data.

It is important to check electronic equipment occasionally to ensure that records are accurate, and that the reliability of your pesticide applications is not affected by faulty equipment.

Record Keeping - Applying this knowledge in your workplace.	
You should now have the knowledge and skills to:	
Update chemical store records	
Update application records	
Meet the requirements of relevant QA programs	
Report or rectify equipment faults	
Report any injuries or accidents	

Chapter 12

CONTROL WEEDS

CONTROL WEEDS

Significance of Weeds in Australia

A weed is considered to be a plant that is growing in a place where it is not wanted. For example, a plant that is a valuable resource to a cattle/sheep/dairy farmer i.e. clover is considered to be a weed to a turf farmer.

In Australia there are approximately 3207 species of introduced plants that have become naturalised. About 500 of these are declared noxious or are under some form of legislative control.

Weeds reduce the quality, quantity and value of agricultural, horticultural and forestry products and are estimated to cost the economy around $4.8 billion per year.

Weeds can also affect the, environment and human health in the following ways:

1. The structure and function of land and aquatic based ecosystems.
2. Increase biomass potentially leading to more frequent and intense bushfires.
3. Change the structure and composition of native vegetation.
4. Threaten the integrity of nationally significant sites such as, sensitive ecological communities, World Heritage sites, National Parks, nature reserves, urban and peri-urban public use land.
5. Human and animal health due to injury, allergies, dermatitis, poisoning and asthma.

Primary Spread Pathways

Most weeds in Australia (50%-70%) were initially introduced as garden ornamentals and have "escaped" from there to invade our farming and bushland areas. This spread has occurred through a variety of means such as:

1. Wind
2. Birds and animals
3. Water movement

Dispersal methods via these pathways are impossible to stop. However, dispersal caused by human activity can be reduced by education and regulation.

Significant agricultural weed-dispersal pathways include:

1. Transporting livestock and fodder.
2. Planting contaminated crop and pasture seeds.
3. Trade and other deliberate introductions of new species.
4. Movement of contaminated machinery such as harvesters and tillage equipment.

Weed Management Strategies and Legislation

There are currently strategies and legislative arrangements in most jurisdictions that aim to manage the movement of plant materials and goods that could be contaminated. These include:

1. **Australian Weed Strategy 2017-2027.** (Commonwealth). The strategy provides national guidance on best practice weed management. It aims to guide coordination of effort across all jurisdictions and affected stakeholders and to inform plans and actions by state and territory governments, local governments, regional natural resource management (NRM) agencies, as well as by industry, landholders and the wider community. The strategy provides information on where improvements can be made at the national level that will result in benefits across Australia. It draws attention to areas that require national collaboration and will drive the development of consistent and coordinated national approaches by providing clarity around priorities, roles and responsibilities. This strategy supports three national goals: prevention, detection and early intervention; minimise the impact of established weeds; and enhance Australia's capacity and commitment to weed

management. It also identifies priority areas where improving the approach to weed management has the potential to reduce instances of new weeds establishing and spreading in Australia as well as the negative impacts of established weed species.

2. **Weeds of National Significance.** In 1999 the Australian Government declared the inaugural list of 20 WoNS. In 2013 an additional 12 WoNS were approved. Nomination as a WoNS recognises a species as a priority current and future weed threat to Australia, requiring coordinated and strategic management along with shared stakeholder investment to develop and implement best practice to prevent, eradicate, contain and/or minimise its impacts in different parts of the nation. They are causing major economic, environmental and/or social impacts in a number of states or territories with strong potential for further spread.
3. **The Intergovernmental Agreement on Biosecurity**, or IGAB, (Council of Australian Governments 2012) is an agreement between the Commonwealth, state and territory governments (with the exception of Tasmania) that aims to improve shared management of risks posed by pests and diseases entering, emerging, establishing or spreading in Australia. The IGAB was developed to improve the national biosecurity system by identifying the roles and responsibilities of governments. It provides the direction and framework to achieve a national biosecurity system. The schedules to the agreement outline agreed priority areas for collaboration to improve the system.
4. **State and Territory Legislation and Strategies:**

Queensland	Land Protection (Pest and Stock Route Management) Act 2002 Land Protection (Pest and Stock Route Management) Regulation 2003 Queensland Weeds Strategy.
New South Wales	Biosecurity Act 2015 New South Wales Weed Strategy.
Victoria	Catchment and Land Protection Act 1994 Local Government Act 1989 Victorian Pest Management: Weed Management Strategy.
South Australia	Landscape South Australia Act 2020 Weed Strategy for South Australia
Western Australia	Agriculture and Related Resources Protection Act 1976 Plant Diseases Act 1989 A Weed Plan for Western Australia Western Australia Environmental Weed Strategy.
Northern Territory	Weeds Management Act 2001 Northern Territory Weed Management Strategy.
Tasmania	Weed Management Act 1999. Tasmanian Weed Management Strategy
Australian Capital Territory	Pest Plants and Animals Act 2005. Australian Capital Territory Weeds Strategy.

5. **Regional:**
   a. Regional Natural Resources Management plans.
   b. Regional Natural Resources Management weed or pest management plans.
6. **Local:**
   a. Local government weed or pest management plans and development plans

Getting to Know Weeds

The primary principle in controlling a pest (pests include weeds, insects, diseases and animals) is identification. Correct identification will supply you with the knowledge to allow the appropriate management/control actions. Identifying a weed is very simple – a plant growing where you don't want it to be growing. Identifying what type of weed you have can be more difficult.

Basically, there are two types of weeds.

1 – **Grasses or Monocots**
Simply identified by looking at the veins in the leaf. **ALL** veins run parallel to the mid vein.

2 – **Broadleaf or Dicots**
The veins in the leaf branch out in a network from the mid-vein

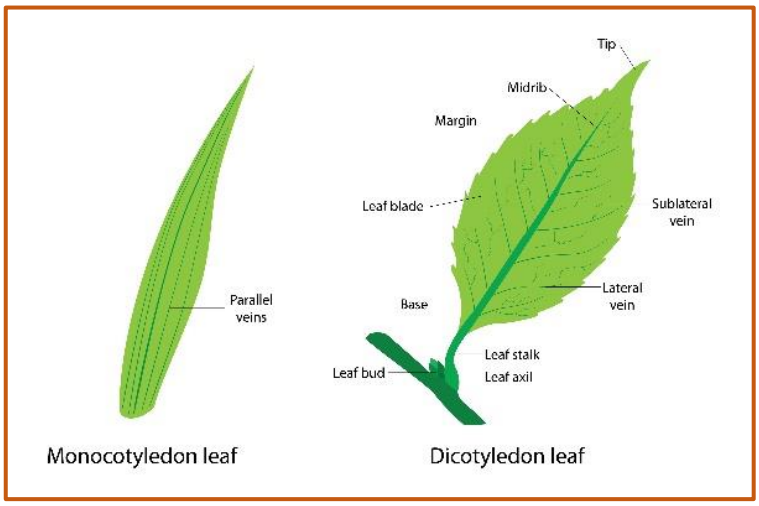
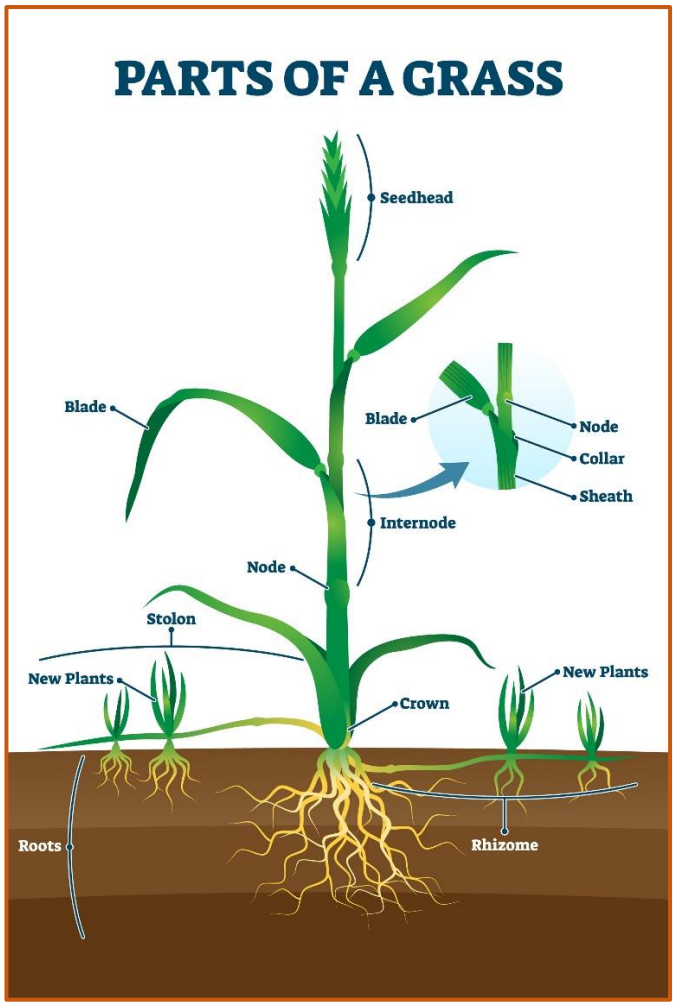


Fig 1

Monocotyledons (Grasses)

Monocots differ from dicots in four distinct structural features: leaves, stems, roots and flowers.



Flowers. Floral parts (petals) are usually in multiples of three.

Stems. Vascular bundles in the stem are usually in a scattered or complex arrangement.

Roots. Fibrous root system, shallow growth to take advantage of any moisture.

Rhizome – underground root type.

Stolon – above ground root type.

Fig 2

Dicotyledons (Broadleaf)

Dicots differ from monocots in four distinct structural features: leaves, stems, roots and flowers.

Flowers. Floral parts (petals) are usually in multiples of four or five.

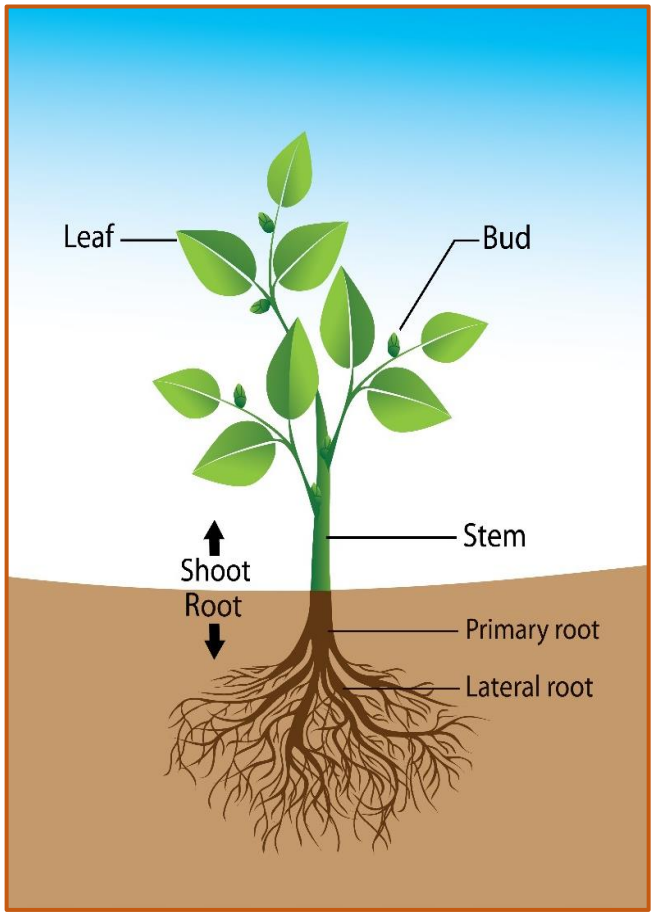
4 or 5

Stems. Vascular bundles in the stem are usually arranged in a ring.

Ringed

Roots. Woody root system, tap root usually present, deep growth to take advantage of any sub-surface moisture during dryer periods

Tap roots



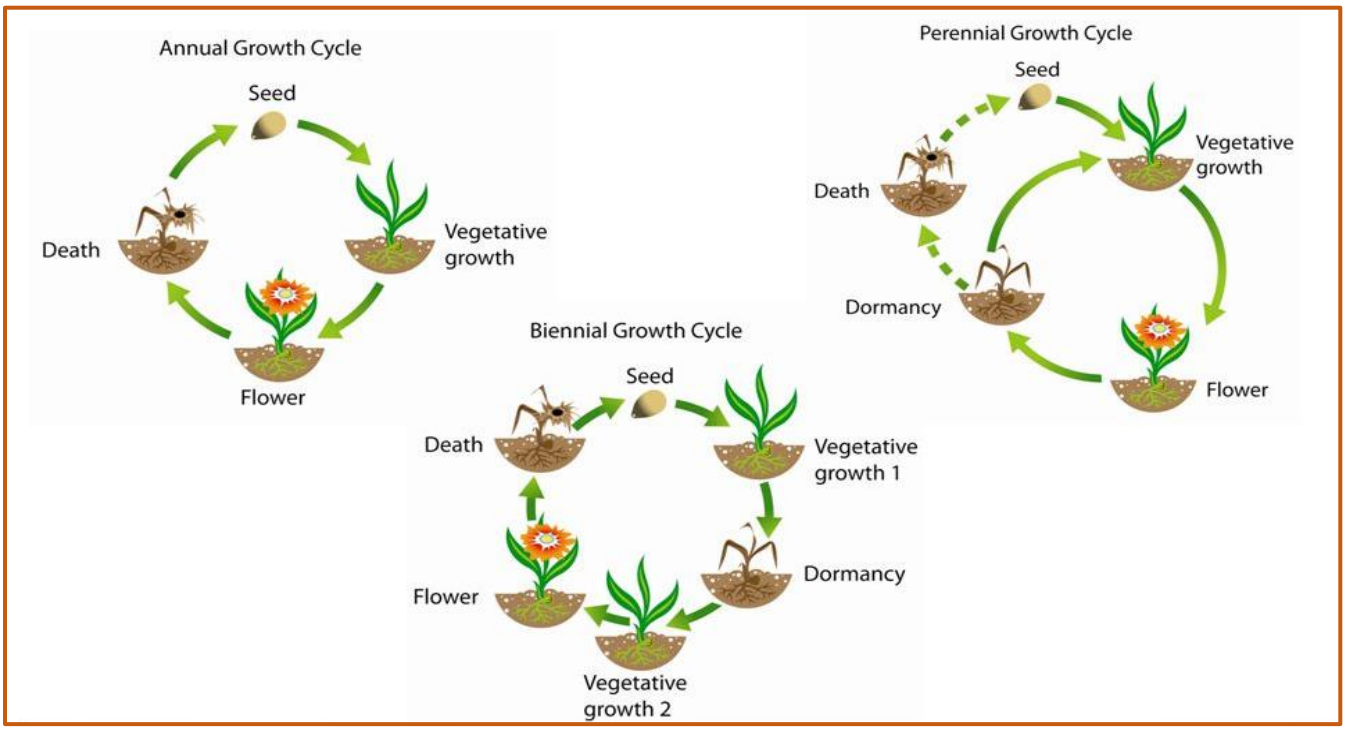


Fig 3

Weed Life Cycles

Annual Life Cycle – A weed that sprouts from seed, grows to maturity, flowers, sets seed and dies in one growing season. This type of weed can only reproduce by producing seeds.
Biennial Life Cycle – A weed that grows from seed over a 2-year period usually with a dormant period in between.

Perennial Life Cycle – A weed that can grow from seeds or other vegetative parts and does not die after flowering. These weeds can live for many years and usually differ from annuals/biennials by their thickened stems and woody roots.

Simple perennials will spread by seed and root segments. These plants have persistent root systems, but they do not usually spread by root segments unless broken into parts by mechanical methods.

Creeping perennials can spread vegetatively from stolons (horizontal stems running on the soil surface usually rooting at the joints) by rhizomes (underground horizontal stems modified for food storage and asexual reproduction) (Fig 2), or by seed. Creeping perennials usually occur as a patch that continues to enlarge each year.

Reducing Weed Numbers

Reducing weed numbers is best carried out using Integrated Weed Management (IWM) techniques. The first and most important factor is to have the weed correctly identified. This will enable the correct management strategies to be planned and implemented.

Weed populations can either be active or passive. Active populations represent only about 5 % of the weed population and are made up of seedlings, juveniles and mature weeds. Passive populations make up the other 95% of the weed population and is primarily the seed bank in the soil. These seeds can remain dormant in the soil for up to 20 years, or more and their germination can be triggered by many different methods including bush fire.

Most weed control techniques rely upon short term management of the active weed population generally in response to an established intervention point, Economic Injury Level (EIL) or Economic Threshold Level (ET).

Economic Damage

Economic damage is the most elementary of the EIL elements, being defined by Stern et al. as *"the amount of injury which will justify the cost of artificial control measures."* the economic injury level, is the lowest population density that will cause economic damage. The EIL is the most basic of the decision rules; it is a theoretical value that, if actually attained by a pest population, will result in economic damage.

The economic threshold (ET) differs from the EIL in that it is a practical rule, rather than a theoretical one. Stern et al. defined the ET as "*the population density at which control action should be determined (initiated) to prevent an increasing pest population (injury) from reaching the economic injury level.*".

Subjective v/s Objective ET:

Subjective Threshold determinations are the crudest approach to ET development. They are not based on a calculated EIL; rather, they are based on requirements and/or experience, they are sometimes called "Aesthetic Thresholds". These have been called **nominal thresholds** by Poston et al. (1983) and are not formulated from objective criteria.

Practical reasons/considerations for the determination of a Subjective Economic Threshold.

A local council Parks and Gardens Division has had a direction from their Councillors that the. weeds in urban hard surfaces should be no more than 50mm high for the following reasons:

1. To prevent them from flowering and setting seed.
2. Beyond this point they become unsightly and complaints start coming in from the public.

Objective Threshold determinations

These are based on calculated EILs and can change due to changes in the primary variables of the EIL. e.g., current market values. The Fixed ET is the most common type of objective ET and is set at a fixed percentage of the EIL e.g., 25%. The name "fixed" does not mean they do not change it means that their % if the EIL does not change. They will change whenever the EIL changes.

All thresholds can only be accurately determined by the use of accurate weed mapping to provide information on the distribution and density (severity) of the weed infestation.

Weed Mapping

Developing standard operating procedures for weed mapping provides accurate advice on the distribution and coverage of weeds. Mapping weed species is an important step in setting priorities for control work. If standard techniques are consistently applied, these records can provide a measure of the effectiveness of weed management activities over time.

When should I map my weeds?

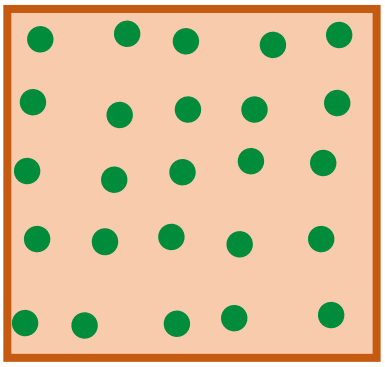
To develop a weed map for your site you must first understand that you have a potential weed problem i.e., **IDENTIFY** your weeds. Identification is the first and most important step in any control program. Start at the local level by contacting your local control authority e.g., local council. They will have a list of the weeds in your area that you are required to manage and can often provide links to other organisations that can provide information at a state and federal level.

Weed Assessment

The development of a **Weed Assessment Record,** see Appendix I below, is an ideal way to survey your site and assess the level of severity of your weed infestation. This record can then be used to gauge whether or not you even need to implement a management program at that time. These records, if kept updated, can then be used to assess the degree of success of any implemented ongoing management program. They can also be used to modify these programs should control measures prove to be not completely effective.

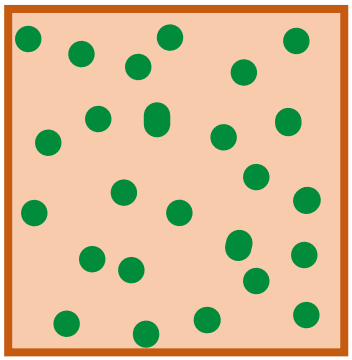
WEED DISTRIBUTION PATERNS & PERCENTAGE COVERAGE

Weeds can generally be grouped in 3 ways for the manner in which they spread



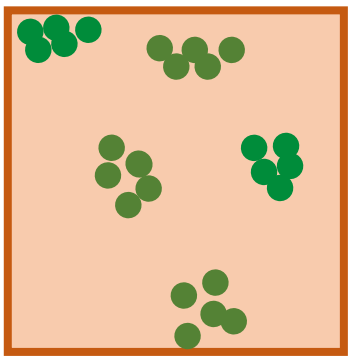
Uniform

Weeds evenly spaced over the area they infest.
Typical for species that have to compete for scarce resources such as water.



Random

Weeds have an unpredictable distribution.
Typical of weeds that do not compete strongly so have to invade bare patches.



Clumped

Weeds are clustered together in small groups.
Typical of weeds that are taking advantage of patchy resources.

Mapping

Looking at the distribution pattern on your site and transposing that to a grid reference developed for the site such as that in Fig 5, you can fairly accurately determine the percentage (%) of your site that is infested by the weeds. This information can then be used in conjunction with your established site "economic threshold" to determine if implementing an **Integrated Weed Management** control program is viable.

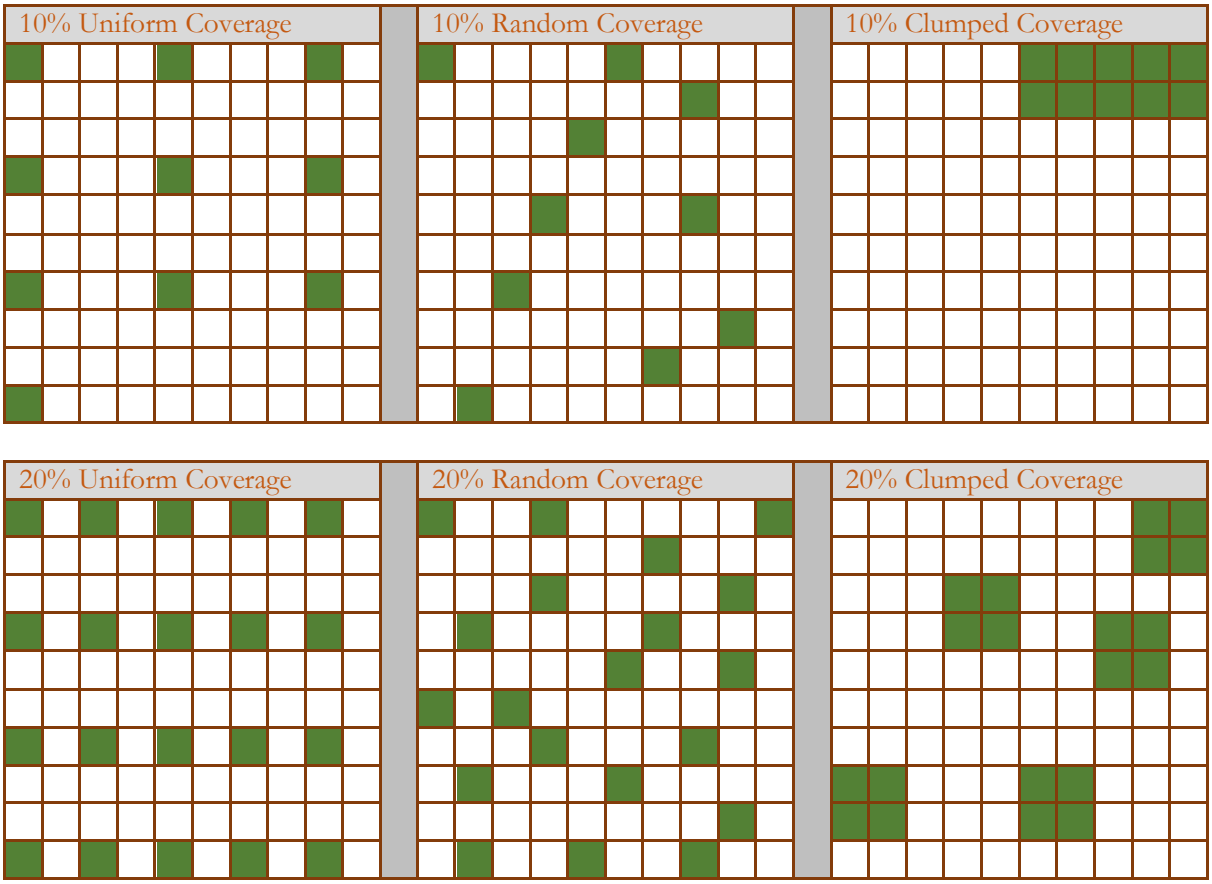


Fig 5

Integrated Weed Management

Integrated weed management is the coordinated use of a variety of control methods, reducing reliance on herbicides alone, and increasing the chances of successful control or eradication. Integrated weed management programs require long-term planning, knowledge of a weed's biology and ecology and appropriate weed control methods.
For example, an integrated weed management program for a large weed infestation on grazing land could involve:

- removing stock for several months
- burning at the appropriate time (depending on the terrain and access, burning could be substituted with bulldozing or slashing to reduce the bulk of the mature plants)
- sowing an improved pasture in early summer
- continuing to exclude stock until pasture establishes
- following-up with herbicide spot spraying on regrowth
- repeating this regime for 2 or 3 years.

Establishing an Integrated Weed Management Program would involve the following:

Weed identification

When weeds are identified in the early stages of their infestation, eradication is more likely. Control is economical when carried out early, rather than waiting until the weed infestation has spread and become established.

Biological control

Biological control of weeds uses a plant's natural enemies such as insects, mites and diseases to reduce and control its population. It is an economical, effective and environmentally sound method, but is a long-term technique with extensive development and establishment phases. Biocontrol does not eradicate a weed, but can reduce it an acceptable level, or suppress it to a level where it can be controlled with other methods.

Flaming

Flaming is not a common or well-developed control method in Australia, however in Sweden it has been used for many decades for:

- weed control on organic farms
- pre-emergent weed control in carrots and other slow-germinating row crops
- selective post-emergent control in heat-tolerant crops
- general weed control on hard surfaces in urban areas.

Steaming

Steaming is a relatively new weed control method, still in the developmental stage. Applying hot water to a weed results in the loss of the plant's waxy coating, a reduction in moisture, dehydration and death.
The system operates by plumbing water under pressure through a heated chamber and applying it to the weed. The combination of heat and water pressure breaks down the cellular structure, causing discolouration and death within hours or over a few days.

Goats

Controlling weeds with goats is a medium-to-long-term proposition and can be highly effective in certain situations. Goats can be integrated with sheep, cattle and cropping enterprises to provide weed control and pasture improvement. Generally, goats should be only one aspect of an integrated weed control program and stocking rates, timing, weed palatability and farm management strategies need to be considered. It is usually important to have a competitive pasture to colonise bare areas.
Goats control weeds by selectively grazing their foliage, bark, stems and flowers. Goats eat a variety of weed species that sheep and cattle avoid, such as blackberry, sweet briar, scotch broom, thistles, Paterson's curse and horehound.

Herbicides

Herbicides are widely used to control weeds in agricultural, commercial and domestic situations. Herbicides are chemicals that kill plants by affecting their enzyme systems, interfering with their growth processes, replacing their hormones or blocking their chemical reactions. Herbicides are effective and practical in a wide variety of situations, and often provide the most economical means of control.
Some herbicides act on contact with the plant; others need to be translocated through the plant's system.

Contact herbicides

Contact herbicides kill the parts of the plants they are applied to - usually limited to leaves and stems of the plant. They are more effective on annual weeds or on seedlings of perennial weeds. Contact herbicides can be either selective (i.e., they only kill broadleaf plants) or non-selective (i.e., they kill all plants). Plants need to be

actively growing when contact herbicides are applied, and g good coverage is required to achieve effective results.

Translocated herbicides

Translocated herbicides must be moved around a plant's system. They disrupt growth processes and interfere with biochemical reactions. This usually occurs where cells are actively dividing in growth tissue, such as at the bases of stems in grasses, and in growing tips or buds in broadleaf weeds.

Cultivation

Destroying weeds through cultivation is a proven method of control. It is particularly effective on young weeds. Implements are used to dig up and destroy weeds, ranging from large tractors, discs and ploughs to hand tools such as mattocks and chip hoes. Shoots can be separated from their roots or buried deeply to prevent regrowth, and roots can be dragged to the surface to dry out. Some types of weeds can be controlled with repeated passes; however, eradication of perennial weeds can be difficult and depends on their root systems.
Cultivation is more effective if weeds are cultivated before they flower and under reasonably dry conditions. Manual cultivation is a viable means of weed control in small-scale situations or as a follow-up control measure.

Slashing

Slashing can be done mechanically with a tractor and slasher or by using a hand-held brush-cutter. It is cheaper than cultivation and preserves ground cover, reducing soil erosion and allowing access in wet weather. Continual slashing may provide control if a desirable pasture species is present and encouraged to replace the weed, but slashing will not eradicate a weed, and can't be used for weed control in crops.
Slashing can:

- prevent tall weeds from flowering and seeding

- remove unpalatable or inedible weeds left after stock have selectively grazed a paddock
- temporarily control weeds until they re-shoot
- control vegetation and weeds along roadsides

However, slashing can also have negative effects, such as encouraging the growth of less desirable weed species or spreading weeds that grow vegetatively.

Mulching

Mulching involves the use of physical barriers such as black plastic or woven weed matting to exclude sunlight and prevent weed establishment. Mulching is used for weed control in row crop production such as strawberries, where machinery lays black plastic between rows. Woven weed matting is useful along roadsides, steep banks and cuttings where areas need to be revegetated and where bank stabilisation is necessary.
Natural mulches include sawdust, timber chips, straw, manures and grass clippings. These have other beneficial effects including adding organic matter and nutrients to the soil. However, there can be a risk of introducing weed seeds in the mulch material. Most perennial weeds can penetrate mulches such as sawdust and wood chips.

Fire

The success of fire as a weed control method depends on the amount of fuel, the speed and intensity of the fire, and the time of year that burning takes place. Fire is best used as part of an integrated weed management program.
Unlike wildfire, a controlled burn - where only the desired area is burned using firebreaks and back-burning techniques – is the best approach for woody weed control. Direct costs are lower than alternative methods such as herbicide treatments or mechanical clearing.

A controlled burn:

- minimises damage to the environment
- avoids damage to property and livestock
- helps restore land to an open condition suitable for pasture
- creates access for further weed control.

Reafforestation

Reafforestation is a long-term method of weed control, where a dense tree canopy is formed to restrict sunlight penetration to weeds on the forest floor. Reafforestation can be in the form of revegetation with native species or through establishment of plantation forests. A weed control program can involve agro-forestry principles, which include growing trees in conjunction with other agricultural enterprises such as cropping or domestic animals. Reafforestation is suitable over large areas where other forms of weed control are uneconomic or impractical.

Land management

Good land management is critical to reducing the incidence and impact of weeds. The initial increased costs associated with better land management are compensated with reduced weed control. Management strategies that help to reduce weed problems include:

- grazing management and maintenance of pastures or desirable ground covers
- reduced disturbances and tillage and management of nutrient run-off
- early weed identification and good weed hygiene.

Grazing and pasture management

Competitive, desirable pastures can provide effective weed control. Stocking rates must be managed so as not to cause overgrazing, as weeds will establish in overgrazed areas.
A vigorous pasture competes more effectively with weeds and has added benefits of increased production. Weeds can be controlled in a pasture situation by improving the existing pasture or replacing it with a more suitable or competitive species. Pastures can be improved by adding fertilisers and lime according to soil test results.

Crop management

Crop rotations can minimise weed problems, help control diseases and insects, and improve soil fertility and structure – producing increased yields. Crop rotations can break the seeding and germinating cycle of the weeds.

Weed hygiene

Weed hygiene includes sowing only weed-free seed, cleaning machinery and vehicles, checking clothing and equipment for weed seeds or fragments, and removing sources of weed reinfestation around a control site. New livestock being introduced to a property should be quarantined for several days so any potential weed seeds can pass through their systems into a known area and be treated later.

Integrated Weed Management (IWM)

Is the coordinated use of a range of these non-chemical and chemical control methods to manage an ongoing weed problem.

The primary aim of an IWM program is to reduce the reliance on chemical control measures to improve safety to the operator, other people and animals and the environment.

Successful IWM programs require a sound knowledge of the targeted weds biology and ecology, long-term planning and the application of the appropriate weed management options.

In many situations, weed management is more cost-effective and practical when chemical control options are integrated with a range of nonchemical control options resulting in the targeted weed being controlled or eradicated.

Appendix I

SpraySMART WEED MAPPING ASSESMENT RECORD										
DATE										
LOCATION										
GPS Co-ordinates										
Common name of weed				Scientific name of weed						
Legal Status (in yoiur state/territory										
Life Cycle	Annual		Biennial		Perennial					
Economic Threshold for Site (as a % of area covered by weed)										
Density (% of area covered by the weed)	<10%	<20%	<30%	<40%	<50%	<60%	<70%	<80%	<90%	100%
Average Growth Stage	Seed		Seedling		Flowering		Seeding		Dead	
Priority for Control	Low		Medium		High		Urgent			
Other weeds present										
COMMENTS										
Name of Person doing mapping				Signature						

SITE MAP

APPENDIX II

SAMPLE PESTICIDE APPLICATION RECORDS

NSW GOVERNMENT | Industry & Investment

Location, Applicator, Date of Application

Property/Holding: (residential address)					Date:
Applicator's Full Name:			Owner (if not applicator):		
Address:			Address:		
		Phone:			Phone:
Mobile:	Fax:	Email:	Mobile:	Fax:	Email:
Sensitive Areas (including distances, buffers): N / W Treated Area E / S			Comments (including risk control measures for sensitive areas):		

Host/Pest

Paddock Number/Name:	Paddock Area:	Order of Paddocks Sprayed:
Crop/Situation:	Type of Animals:	
Crop/Pasture Variety:	Age/Growth Stage:	
Growth Stage:	Mob/Paddock/Shed:	
Pest/Disease/Weed:	Animals — Number Treated:	
	Pest Density/Incidence: Heavy ❑ Medium ❑ Light ❑	

Application Data

Full Label Product Name:		Rate/Dose:	Water Rate L/ha:	
Permit No.:	Expiry Date:	Additives/Wetters:		
Total L or kg:	WHP:	ESI*:	Date Suitable for Sale:	
Equipment Type:		Nozzle Type:	Nozzle Angle:	Pressure:
Date Last Calibrated:	Water Quality (pH or description):			

Weather

Showers ❑ Overcast ❑ Light Cloud ❑ Clear Sky ❑

Rainfall (24 hours before and after)
Before: mm During: mm After: mm

Time (show time in this column)	Temperature °C	Relative Humidity (%)	Wind Speed	Direction	Variability (e.g. gusting)
Start					
Finish					

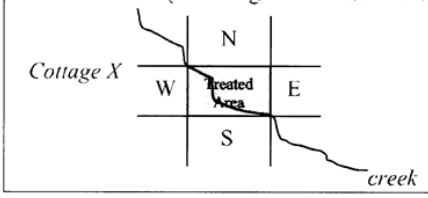
Comments:

* When using herbicides in mixtures with fungicides and insecticides, an ESI may apply to the non-herbicide component of the mixture.

SAMPLE OF COMPLETED PESTICIDE APPLICATION RECORDS

NSW Agriculture

Location, Applicator, Date of Application **No. 000005**

Property/Holding: (residential address): *'Hillview', Yellow Brick Road, NUNDLE*					Date: *20.1.02*
Applicator's Full Name: *John Farmer*			Owner (if not applicator)		
Address: *'Hillview', Yellow Brick Road*			Address:		
NUNDLE		Phone: *02 6769 0000*			Phone:
Mobile: *0418 123 456*	Fax: *02 6769 0001*	E-mail: *jf@bigpond.com.au*	Mobile:	Fax:	E-mail:
Sensitive Areas (including distances, buffers 			Comments (including risk control measures for sensitive areas): *Avoid spraying over creek and getting herbicide into water.* *Keep 50 m upwind of cottage.*		

Host/Pest

Paddock Number/Name: *creek number 2, number 4*	Paddock Area: *15 ha, 7 ha*	Order of Paddocks Sprayed: *no. 4 – no. 2*
Crop/Situation: *phalaris pasture*	Type of Animals:	
Crop/Pasture Variety: *Sirolan*	Age/Growth Stage:	
Growth Stage: *dormant*	Mob/Paddock/Shed:	
Pest/Disease/Weed: *blackberries*	Animals – Number Treated:	
	Pest Density/Incidence: Heavy ☐ Medium ☐ Light ☑	

Application Data

Full Label Product Name: *Dupont Brush-Off*		Rate/Dose: *10 g/100 L + oil 1%*	Water Rate @ L/ha: *3000 L/ha*	
Permit No:	Expiry Date:	Additives/Wetters: *Uptake – 1 L in 100 L*		
Total L or kg: *500 g ai*	WHP: *0*	ESI:	Date Suitable for Sale:	
Equipment Type: *Silvan PTO sprayer*		Nozzle Type: *D5*	Nozzle Angle:	Pressure: *100 psi*
Date Last Calibrated: *18.1.02*	Water Quality (pH or description): *creek water*			

Weather

Showers ☐ Overcast ☐ Light Cloud ☑ Clear Sky ☐

Rainfall (24 hours before and after)
Before: *30* mm During: mm After: *15* mm

Time (show time in this column)	Temperature °C	Relative Humidity (%)	Wind Speed	Direction	Variability (e.g. gusting)
Start *7.00am*	*12*	*60*	*0*		
8.30	*16*	*50*	*7 km/h*	*E*	*steady*
10.30	*23*	*40*	*3.6-9 km/h*	*E*	*gusting*
Finish *12.30pm*	*26*	*38*	*9-11 km/h*	*E*	*gusting*

Comments: *Wind became more variable as day warmed up. Unable to get good coverage on creek side of berries. Will have to retreat next season.*

Department of
Environment and Conservation (NSW)

PESTICIDES: Example record keeping form

Note: It is not compulsory to use this format. This example form was developed to assist the market gardeners in the Sydney basin. For further information, see the guidance brochure on record keeping.
If you use a short name for something in filling out this form, you must write the full name somewhere else such as a book or farm diary.

Pesticides Application Record Sheet

Record the name, address and contact details of the owner or occupier of the land where pesticide was applied:

Date, start and finish time	Operator details	Crop or place where pesticide was applied	Type of equipment used	Name of pesticide used	Amount of concentrated product used	Total quantity applied	Size of block sprayed	Order blocks were treated	Estimated wind speed and direction		Other weather details
	Name, address and contact details	*Also record spraying of fallow land and any pesticides used in and around crops**		*Record all the pesticides you used.*	*If you mixed two pesticides together, you can record both on the same form.*	*Total amount of water, oil or other things mixed with the concentrated product.*	*Refer to your farm map***	*Write which block was sprayed first, second, third, etc.*	*If these conditions change significantly during spraying then also record the changes.*		*Only if they are specified on the label or National Registration Authority (NRA) permit.*
									Speed	Direction	

Records must be in English

* It is not compulsory to record the pest or disease but it is recommended as part of good operating practices.
** A farm map is recommended because it would make recording this information easier.

APPENDIX III

DELTA T CHART