

guidelines

Herbicides:

knowing when and how to use them



Herbicides are a useful weed management tool

Application of herbicide is an effective technique for controlling weeds. Herbicides should generally be used in conjunction with one or more other control methods, such as mechanical control, biological agent, cultivation, burning or mulching. Herbicides can greatly enhance the results of these alternate techniques.

Before deciding whether or not to include a herbicide in your control program you need **knowledge** about herbicides and an understanding of their **relevance** in a weed management program. When used correctly, herbicides can be very effective and have limited impact on the environment. Effective use of herbicides requires a thorough knowledge of:

- The **target weed** (weed identification, biology, susceptible growth stages).
- The **herbicide** (herbicide activity and application methodology).
- The **site conditions** (surrounding plants and animals, weather conditions, residences, soil characteristics, proximity to water).

This publication provides general information on herbicides and how they work. Its aim is to give you the knowledge and understanding to help you decide whether or not application of a herbicide will be a useful technique for managing your weeds. **Always seek site specific professional advice.** You need to be able to answer the questions on page 7 so that your advisor can give you the best advice.

Should I use a herbicide?

When planning a weed control program and selecting weed control techniques to use, it is important not only to consider the effectiveness, but also the social and environmental impacts the technique may have. It is unwise to use a method that will obtain fantastic control but will also wipe out surrounding species. It is also unwise to ignore a technique, such as a herbicide, because of lack of understanding or misinformation.

Always remember that with adequate **knowledge** and **planning**, herbicides are a very useful technique for weed control and should be used in combination with other weed control techniques.

Herbicides can be:

- Very economic. They can control

weeds in large areas for less money and in less time than other methods.

- Complementary to other weed control techniques making the whole program much more effective.
- Used safely without harming the user.
- Applied using appropriate techniques without affecting the surrounding environment and non-target plants.

Use the table on page 4, *Weed control techniques* to assist with making a decision about whether to use a herbicide, or not.

What is a herbicide?

A herbicide is a '*chemical or biological agent which kills plants or inhibits their growth*' (The Macquarie Concise Dictionary, 3rd Ed.). A herbicide is a pesticide specifically for controlling

plants, just like an insecticide is a pesticide used to control insects. A herbicide can be a naturally derived or a synthetically produced substance.

Natural versus synthetic

There is a misconception that 'natural' pesticides derived, for example from plants, are safer in all respects than those synthetically produced. All substances used to control pests involve some degree of risk, whether derived naturally or synthetically. Understanding these risks is the key to their safe and effective use.

Pyrethrum is a common insecticide naturally derived from a plant extract. Like all pesticides, it has a chemical label which includes safety directions and should always be used with care.



What makes up a herbicide?

A herbicide generally has three main components which together are known as the formulation. They are:

- The **active ingredient**, which kills the target weed.
- The **surfactant**, which helps the active ingredient disperse, adhere and penetrate the surface of the target weed.
- The **carrier**, which stabilises the diluted product and aids application, coverage and retention of the herbicide.

How does a herbicide work?

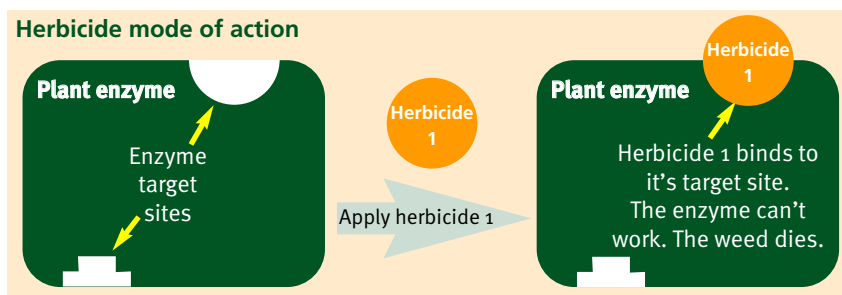
The **active ingredient** in a herbicide works by interfering with specific plant processes. In general terms, **enzymes** carry out functions in plant cells essential for normal plant growth. Herbicides interrupt the activity of a plant enzyme by binding to them at a **target site**. This disrupts the specific plant process and the plant dies. Herbicides can stop many plant functions such as respiration, photosynthesis or protein production. See figure page 2, *Herbicide mode of action*.

Mode of action

The active ingredient in a herbicide will disrupt the activity of one of many plant processes within the target weed. The enzyme or activity which a herbicide disrupts is known as the herbicide's **mode of action**. Herbicides are grouped by their mode of action.

Herbicide activity

There are three basic groups of herbicides related to their activity, or the way they work.



A herbicide binds to a specific enzyme inside the plant cells at target sites. This blocks the target site and stops the enzyme from doing its normal work. The plant cannot function properly and the plant or weed dies. Figure by Annabel Bowcher

1. **Contact** herbicides kill the parts of the target that they touch, so thorough coverage is important to kill the target weed. They are mostly used to control annual weeds. They do not move around the plant to the roots, and therefore, are generally not effective on perennial plants. Examples of contact herbicides are Sprayseed® and bromoxynil.
2. **Translocated** herbicides enter the plant and then circulate around to all parts, including the roots. This type of herbicide is used when targeting perennial plants to completely kill the whole plant. Examples of translocated herbicides are glyphosate and MCPA.
3. **Residual** herbicides remain active in the soil for a period of time ranging from several weeks to a few years. They provide ongoing weed control killing weeds as they germinate, and are very effective on weeds with multiple germination periods. Examples of residual herbicides are simazine and diuron.

Herbicide selectivity

Some herbicides are **non-selective** and kill a broad range of plants (eg glyphosate and Sprayseed®). Other herbicides are **selective**, and kill a specific range of plants (eg bromoxynil and MCPA). Selectivity is possible because some plants:

- Break down the toxic active ingredient to a non-toxic product, and are not killed.
- Convert a non-toxic active ingredient to a toxic compound, killing the plant.

Selectivity can also be based on application method by physically preventing the herbicide from contacting non-target plants (eg shielded sprayers and wick wipers).

Herbicide uptake

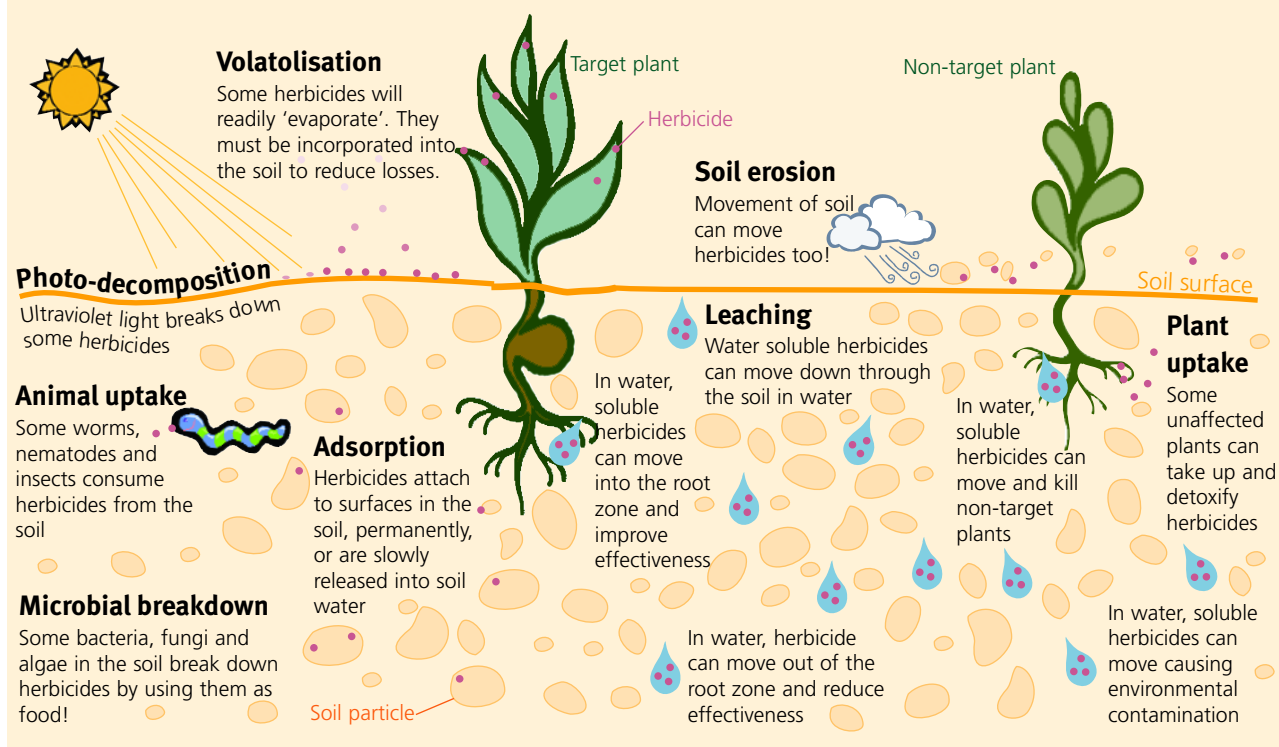
Herbicides need to be absorbed by the target weed. This can occur via the foliage (leaf and/or stem) or the roots, and is dependent on the type of active ingredient. The way a herbicide is taken up will determine the way it should be applied.

Uptake by foliage

Herbicide uptake by foliage depends on **interception** and **retention** of the spray mixture. This is affected by leaf shape, angle and arrangement, and the nature of the leaf and stem surface eg waxiness or hairiness.

Herbicide application method and/or equipment can be modified to help retention and coverage. Changes can be made to droplet size and volume of spray applied, as well as the addition of a **wetting agent**. If addition of a

What happens to a herbicide after application?



The fate of a herbicide after application depends on its chemical properties, the amount applied, its distribution, and the soil environment (temperature, moisture, pH and microbial presence and activity). The diagram outlines the most common processes that occur following herbicide application.

wetting agent is recommended it will be stated on the herbicide label.

Once on the leaf (intercepted and retained) a herbicide enters through the cuticle and/or stomates, before it can attach to the target enzyme.

Movement through the cuticle can be affected by waxy layers on the leaf surface, humidity and plant health.

Uptake by roots

Roots and other underground plant parts (eg rhizomes and tubers) can take up herbicides that have been applied to the soil. This happens in a number of ways which is primarily affected by soil moisture content. It is also affected by soil temperature and pH, and the target plant growth rate. Healthy fast growing plants are more effective at taking up herbicide.

See figure page 3, *What happens to herbicide after application?*

What happens to herbicides after application?

The fate of a herbicide varies depending on the type of chemical and how it is applied. There is a large variation in how long they continue to be toxic or effective. Many herbicides do not persist for long in the environment. They act on their target and are rapidly broken down by chemical or microbial processes into a range of non-toxic compounds. On the other hand, some do remain for longer periods and care should be taken when applying these herbicides.

The ability of a herbicide to move through the soil is dependent on its

solubility in water. Water soluble herbicides can become very mobile in soil water and move large distances.

The speed at which a herbicide is broken down depends on its chemical properties, the amount applied, its distribution, and the soil environment (temperature, moisture, pH and microbial presence and activity). See figure page 3, *What happens to herbicide after application?*

Know your target!

It is important to understand your target weed's **life cycle** before a successful management plan can be implemented. There are three types:

- 1 **Annual** weeds germinate, grow, set seed and die in one season or year (eg wild oats, Paterson's curse, capeweed). Annual weeds are some

of the worst weeds of annual crops, such as wheat, canola and sorghum, as they match the growth pattern of the crop.

- 2 **Biennial** weeds live for up to two years, growing in the first year and flowering and setting seed in the second (eg some thistles).
- 3 **Perennial** weeds persist for three or more years (eg willow, madeira vine, blackberry). They usually initially flower and set seed in the first few years then continue to reproduce until they die. Many also have the capacity for vegetative reproduction via rhizomes, tubers, corms and suckers. These weeds tend to grow in areas where they can become established and are not disturbed for a number of years, and tend to cause problems in perennial pastures and natural environments. However some are encouraged by cultivation (eg couch grass and field bindweed).

It is important to know the **yearly growth pattern** of your target weed so that control can occur when it is most susceptible to herbicide, and prior to seed maturity. Some weeds are summer growing, producing seeds in autumn (eg blackberry) while others are winter active, producing flowers and seeds in spring (eg Paterson's curse).

An understanding of the method of reproduction and dispersal helps us understand the way weeds spread, but is less important for deciding on



Photo: DPI Victoria
Cut and paint, one of many methods available to apply herbicides to weeds.

whether or not to use a herbicide. It is knowledge of the **timing** of the yearly growth pattern and reproductive phase that is needed to manage weeds, so that application of herbicide occurs when the weed is most vulnerable and it will be most effective.

Using herbicides near water

When using herbicides near waterways always minimise the risk of contaminating the water. If herbicides are to be used near a waterway or where run-off is likely to enter a waterway, read the herbicide label carefully. Product labels give information on situations where a herbicide may be applied. **Always seek advice.**

See Weeds CRC Guidelines *Herbicides: guidelines for use in and around water* at www.weeds.crc.org.au

Weed control techniques	
Control technique	Comments
Mechanical or physical - chipping, cutting, brush-cutter, hand weeding, chain and dozer, cultivation, flame weeding, steaming, slashing, mowing, grazing etc	<ul style="list-style-type: none"> • Can help break up thickets and large infestations into more manageable sized areas, especially with perennial woody weeds. • Timing is critical to get effective control, especially with techniques such as slashing and cutting. • Can be used as part of a 'cut stump' herbicide application technique. • Allows access for use of other methods of control. • Herbicide application following mechanical control can improve overall effectiveness.
Burning	<ul style="list-style-type: none"> • Best used in combination with another control techniques. • Rarely effective on perennial weeds. • Most successful with seedlings and reducing seed survival. • Herbicide application on regrowth following burning can improve overall effectiveness.
Cultural - fertiliser application, replanting & mulching	<ul style="list-style-type: none"> • Must be used in conjunction with other weed control techniques or as final treatment. • Planting competitive species strongly assists herbicide effectiveness.
Biological agent	<ul style="list-style-type: none"> • Can be very effective if agent establishes well. • Useful in sensitive areas as other species are not affected or damaged. • Best used in combination with other control techniques. • Can be a cheap way of controlling large areas of weeds in areas difficult to access.
Chemical - herbicide	<ul style="list-style-type: none"> • Effective on large infestations, and can be economic compared to other techniques. • Can be targeted to specific weeds by either herbicide choice or application method. • Should be well timed to gain maximum control with minimal impact on the environment. • Best used as part of an integrated and well planned program using as many control techniques as available.

Getting started with herbicides - application methods				
Application method	Description	Situations	Advantages	Disadvantages
Spot spray	Diluted herbicide applied by hand-held spray guns for targeted application.	Small populations of weeds over a number of locations.	Can kill low populations of weeds spread over large areas quickly and cheaply.	Time consuming for larger areas. Application rate difficult to determine.
Boom spray	Diluted herbicide applied through a series of nozzles attached to a boom which travels across the ground at a specified height and speed giving uniform coverage.	Common in agriculture (broad-acre cropping, vegetables, turf and pastures).	Covers large areas in short time. Herbicide applied at a specific rate.	Equipment is expensive. Limited to level ground and non-treed areas. Limited to use where weeds and surrounding vegetation are shorter than maximum possible boom height.
Aerial spray	Diluted herbicide applied using a fixed wing plane or helicopter.	Inaccessible country and broadacre agriculture.	Covers very large areas in short time. Can be used in inaccessible areas (due to wet soil, rough terrain, crop or weed height).	Risk of spray drift. Possible damage to non-target species. Spray coverage can be a problem.
Cut stump	Undiluted or lightly diluted (1:1) herbicide painted on the cut stump of a woody weed immediately after cutting.	Low numbers of woody weeds.	Only kills treated weed.	Time consuming for large numbers of weeds. Weed has to be felled prior to treatment. Can cause suckering from roots.
Stem injection	Concentrated herbicide is injected into small fresh cuts just into the sap around the base of a woody weed.	Low numbers of large woody weeds.	Kills weed without risk of regrowth. Only kills treated weed.	Time consuming for a large number of weeds.
Basal bark application	Diluted in diesel, herbicide is applied to the bark around the base of a woody weed.	Low numbers of large woody weeds (shrubs and small trees).	Kills weed without risk of regrowth. Only kills treated weed.	Time consuming for a large number of weeds.
Granules	Root absorbed herbicide is applied to the soil as a granule or pellet. They are applied to the surface of moist soil or incorporated into the top soil.	Various.	No spray drift or risk of contact with off target foliage. Avoids mixing chemical preparations. Controlled release can reduce need for repeat applications.	Rain (moisture) required. Herbicides are more expensive. Even spread can be difficult. Choice of herbicide is limited. Some herbicides are less effective as granules. Un-incorporated herbicide may be washed off the site.
Wick wiper	Herbicide is wiped onto tall weeds using a weed wiper, rope wick applicator or sponge roller.	Tall weeds which grow above the surrounding non-target plants.	Herbicide only applied to target foliage - no wastage. No drift - not affected by wind. Relatively cheap to purchase and operate.	Only controls weeds which grow above surrounding vegetation. Slow to operate and need even ground. Rope wicks can drip and clog with dirt reducing effectiveness. Limited number of herbicides registered. Dense weed thickets often need multiple treatments.

Adapted from *Efficient weed management - protecting your investment in the land*

Herbicide application methods

Herbicides can be applied in many ways, each suitable for a different situation. Choice of the most appropriate application method increases the effectiveness of the herbicide and minimises the risks to the operator and the environment. See page 5 table 'Getting started with herbicides - application methods'.

Your responsibilities when using a herbicide

The use of herbicides (and other pesticides) is managed by state based legislation across Australia. The legislation aims to reduce the risks associated with the use of pesticides to human health, the environment, property, industry and trade.

It is an offense to use a pesticide in a way that causes:

- Injury to another person.
- Damage to another person's property.

- Harm to a non-target plant or animal.

All herbicides must be **registered** by the Australian Pesticides and Veterinary Medicines Authority (APVMA) before they can be manufactured, supplied, sold or used.

All herbicides carry an APVMA approved **label** that provides instructions on safe use and storage. Information on the label is intended to minimise impacts on health, the environment and trade, and is based on good practice. It is illegal to disregard label instructions, and you must read (or have read to you) all the label instructions - not just the rate.

Herbicide labels have information on:

- The active ingredient formulation and it's concentration in that product.
- Situations of use, weeds controlled and application rates.
- General instructions for use.
- Safety directions, emergency contact and first aid.
- Safe storage, transport and handling instructions.

- Withholding periods for re-entry, harvest, and grazing livestock.
- Dangerous and hazardous goods and toxicity schedule.
- Toxicity to fish and birds.

All herbicides must be stored in a container that bears it's approved label. Do not store herbicides in unmarked or open containers.

A **Material Safety Data Sheet** (MSDS) is also available for each product. The MSDS provides detailed information about the product as well as safety information including:

- storage, transport and handling.
- personal protection and first aid.
- dealing with spillages.
- toxicology.
- ecological information.
- disposal considerations.
- chemical and hazard information.

Read the herbicide MSDS before use. They are available from the retailer and on the internet at www.msds.com.au or www.pestgenie.com.au.

Further information

People to contact	Websites	Publications
Weeds Officers - at your local council, rural lands board, or state department of agriculture, primary industries, environment or natural resources. They have excellent local knowledge, a wide network of contacts and access to appropriate literature.	www.weeds.crc.org.au CRC for Australian Weed Management	Efficient weed management - protecting your investment in the land. <i>Darren Bayley</i>
	www.apvma.gov.au Australian Pesticides and Veterinary Medicines Authority	Bushland weeds. A practical guide to their management. <i>Kate Brown and Kris Brooks</i> .
Agronomists or horticulturalists employed by state government departments or rural supply retailers for information on using herbicides in production situations.	www.pestgenie.com.au - search for product label and material safety data sheet (MSDS).	Introductory weed management manual. <i>CRC for Australian Weed Management</i> .
Landcare , Bushcare or Catchment Management staff will have information on using herbicides in natural environments.	www.msds.com.au - search for product material safety data sheets	Herbicides: guidelines for use in and around water. 01/2005/gl <i>CRC for Australian Weed Management website</i> www.weeds.crc.org.au .
Local plant nursery or hardware outlets may be able to help or give you a contact.	www.landcareaustralia.com.au - Landcare Australia for general information on weed management.	

Deciding on a herbicide - information you need!					
Circle the response to each question. The answers will help your advisor help you!					
Your target weed					
Do you know the name of your target?	yes _____		no - then find out!		
What is its life cycle?	annual	biennial	perennial	not sure	
What type of plant is it?	herb	shrub	woody shrub		
	tree	not sure			
How does it reproduce?	not sure	seed	fruit	rhizome	bulb
	fragment/plant pieces				
What time of the year does it ripen?	spring	summer	autumn	winter	
At what time of the year does it actively grow?	not sure	spring	summer	autumn	winter
How is the weed distributed?	widespread, scattered plants		widespread thickets		isolated plants
	isolated thickets				
Your site conditions					
What is the terrain like?	trafficable	flat	undulating	steep	rough
	not trafficable				
How accessible is it?	vehicular	4WD	ATV (4 wheel bike)		on foot only
Is it close to a sensitive area?	residential	children's play area		livestock grazing area	
	waterway	organic production area		other _____	
Are there non-target plants?	scattered amongst target		adjacent to or surrounding target		
If there are non-target plants do you know what they are?	no	yes	_____	_____	_____
	_____	_____	_____	_____	_____

For further information visit the Weeds CRC's website: www.weeds.crc.org.au

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