

# *Noxious and Environmental Weed Control Handbook*

A GUIDE TO WEED CONTROL IN NON-CROP,  
AQUATIC AND BUSHLAND SITUATIONS

**3rd Edition**



**Rod Ensbey  
Annie Johnson**



NSW DEPARTMENT OF  
PRIMARY INDUSTRIES

Dow AgroSciences Ready Weed Control Reference for Woody Weeds Ad

# ***Noxious and Environmental Weed Control Handbook***

A GUIDE TO WEED CONTROL IN NON-CROP,  
AQUATIC AND BUSHLAND SITUATIONS

## **3rd Edition**

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### Note

This handbook has been compiled as a guide for noxious and environmental weed control in non-crop, aquatic and bushland situations. For crop or pasture situations, see the following NSW DPI publications:

*Weed Control in Winter Crops*  
*Weed Control in Summer Crops*  
*Weed Control in Lucerne and Pastures*

or consult your nearest NSW DPI District Agronomist.

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## Cover photographs

Front cover

- Blue heliotrope (*Heliotropium amplexicaule*) infestation.
- Hudson pear (*Cylindropuntia rosea*) flower and spines. Photo: R. Holtkamp.
- Water hyacinth (*Eichhornia crassipes*) infestation.
- Fireweed (*Senecio medagascariensis*) flowers.
- Morning Glory (*Ipomoea* species) infestation.
- Bitou bush (*Chrysanthemoides monilifera* subspecies *rotundata*) flowers.
- African lovegrass (*Eragrostis curvula*) infestation.

Back cover

- Alligator Weed (*Alternanthera philoxeroides*).
- Horsetail (*Equisetum* species).
- Lagarosiphon (*Lagarosiphon major*) Photo: Sainty and Associates.
- Cabomba (*Cabomba caroliniana*) Photo: A. Petroshevsky.
- Water Caltrop (*Trapa natans*). Photo: Sainty and Associates.
- Hymenachne (*Hymenachne amplexicaulis*). Photo: Department of Natural Resources, Mines and Water, Queensland (Q NRM &W).
- Senegal Tea Plant (*Gymnocoronis spilanthoides*).
- Yellow burrhead (*Limnocharis flava*). Photo: K. Galway, Q NRM &W.
- Eurasian water milfoil (*Myriophyllum spicatum*). Photo: Alison Fox. [www.forestryimages.org](http://www.forestryimages.org).
- Hygrophila (*Hygrophila costata*). Photo: P. Gorham.

Other images: NSW DPI, R. Ensbey and B. Trounce.

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# Integrated weed management

by Rod Ensbey

## Integrated weed management: the key

Integrated weed management is the coordinated use of a range of suitable chemical and non-chemical control methods. The aim is to incorporate a variety of control methods and reduce the reliance on herbicides. Successful integrated weed management programs require long-term planning, knowledge of the weed's biology and ecology as well as appropriate weed control methods.

In many situations, weed control is more cost-effective and practical when herbicide and non-herbicide controls methods are integrated. Many weed infestations can be controlled or eradicated using integrated methods.

An example of good integrated management is when herbicide control is not economically feasible for large infestations of lantana. However, a combination of fire, herbicides, mechanical controls, pasture and grazing management can be used to successfully control lantana.

A suggested control program could be: remove stock for several months, burn at the appropriate time, sow an improved pasture in early summer, continue to exclude stock until pasture establishes and follow up with herbicide spot spraying on regrowth. This regime may need repeating for 2 or 3 years. Depending on the terrain and access, burning could be substituted with bulldozing or slashing to reduce the bulk of the mature plants and then followed up with spot spraying. A similar integrated program could also be used for blackberry control.

Bitou bush is another invasive environmental weed; it infests up to 75% of the New South Wales coastline. A long-term integrated control program is being implemented to combat this weed threat. This involves a combination of manual, biological and chemical controls.

## Biological control

Weed biological control involves the use of the plant's natural enemies such as insects, mites and diseases to control weed populations. It is an economical, effective and environmentally sound method of weed control.

However, biocontrol is a long-term technique with extensive development and establishment phases. Further, biocontrol will not eradicate a weed but, if successful, reduces it to an acceptable level where it can be controlled by other means.

There are two main types of weed biological control: inundative and classical.

### *Inundative control*

Inundation is the use of mycoherbicides to control single weed species that escape mechanical or chemical control.

Mycoherbicides are plant pathogens such as rusts and fungi that are applied to control a specific weed. They can be likened to a species-specific natural herbicide, but are not self-sustaining and have a short active period.

In Australia, researchers are investigating the potential of mycoherbicides for controlling Alligator weed, Noogoora burr and Bitou bush.

### *Classical control*

Classical biological control is the release of control agents such as insects, rusts and mites into a region to permanently suppress selected target weeds. The aim is to establish a natural balance between the weed and its control agent – similar to the balance found in the native range of the weed.

If the agent successfully establishes itself, control becomes self-perpetuating and self-regulating as the control agent becomes a permanent part of the region's ecology.

Biological control can also be an attractive option when the release control agent has established in other areas and has shown good results. However, successful programs may take more than 10 years to be effective, and results may vary from area to area.

Biological control is practical and effective in areas such as:

- inaccessible areas such as timbered, rocky and steep locations
- low-priority areas for control
- situations where biocontrol is the only option, for instance salvinia in sensitive aquatic areas
- where chemical control may be too expensive or not effective.

Many weeds in Australia have been targeted for biological control. Some programs have been extremely successful; other programs have varied from partly successful to completely unsuccessful.

The most spectacular success involved the control of the common pest prickly pear during the late 1920s. The *Cactoblastis* moth was introduced in 1926, but it wasn't until 6 years later that the moth made its full impact. The result was that millions of hectares of land were freed from prickly pear and again became viable for agriculture. The *Cactoblastis* moth hasn't totally eradicated prickly pear: isolated areas remain, normally in particularly cold and wet locations.

Other successful agents include the *Cyrtobagous salviniae* weevil introduced for the control of the aquatic weed, salvinia. This agent is particularly successful in Queensland and northern NSW, becoming less reliable as the climate becomes cooler.

There have been numerous examples of insects that have been released and have either failed to establish, or have established but have had little impact on the weed. Lantana has had 25 agents trialled and released for its control. Some have been partly successful, with the majority having little impact.

In a worldwide review of biological control of weeds, it was calculated that 63% of agents released became established, but only 24% of releases were considered effective in controlling their weed host.

Many programs now underway in NSW are in the early stages of implementation. Most of today's biological control programs will benefit the next generation of land managers.

## Flame cultivation

Flame cultivation—or flame weeding, as it is also known—has been recognised for a number of years but has never developed into a legitimate weed control method in Australia. Currently there are a number of trials underway assessing this form of weed control in crop and non-crop situations.

In Sweden, flame weeding has been used for many decades, particularly in organic farming situations for pre-emergent weed control in carrots and other slow-germinating row crops. Flaming has also been used in Sweden for selective post-emergent control in heat-tolerant crops and for general weed control on hard surfaces in urban areas.

Liquefied petroleum gas or propane is the fuel most commonly used in flame weeders. The efficacy of flame weeding is attributed to a direct effect of the flame on the plant's cell membrane and an indirect effect during subsequent desiccation.

The weed flaming process does not require the weed to be burnt: it raises moisture temperatures to above 100°C, at which time the moisture turns to steam and ruptures the plants' cells.

Small dicotyledons are generally more susceptible to flaming than large ones. Species with upright habit and thin leaves are also more sensitive than species with a low stature and protected growth points. Theoretically, then, upright-growing species such as Parramatta grass and setaria should be more susceptible than lower, prostrate-growing species such as couch and kikuyu.

Until flame weeding is fully evaluated, trial work completed, and suitable equipment developed, this control method is not a viable option. However,

within the next few years flame weeding may become a viable weed control option, particularly for organic farming and other environmentally sensitive areas.

## Hot water application

Hot water application or steaming is a relatively new weed control method. Applying hot water to a weed results in the loss of the plant's waxy coating, a reduction in moisture, and therefore dehydration.

The system operates by plumbing water under pressure through a heated chamber on to the weeds. The combination of heat, pressure, and water volume breaks down the cellular structure, causing discolouration and death within hours or a few days. One treatment can kill most annuals and some young perennials. The top growth of older perennials is scorched off, but the impact on the roots is minimal unless treatment is repeated frequently.

This form of weed control is still in the developmental stage. A number of large city councils have trialled the equipment, reporting mixed results on its effectiveness. Trial work and assessments in various situations are still being conducted.

Field trials carried out in New Zealand have shown that hot water application has similar results to glyphosate, except in controlling perennial weeds. Preliminary observations indicate that hot water treatment kills annual weeds in 24 hours. The foliage from some perennials also dies within 24 hours, but regrowth recurs from the roots within a week or two.

## Goats

The ability of goats to control weeds in Australia has been well documented. Goats have been used for sustainable pasture management and weed control in a range of weed situations. They can be integrated with sheep, cattle and cropping enterprises to provide weed control and pasture improvement. In most situations, goats should be seen as only one aspect of an integrated weed control program, which can also include

burning, mechanical removal, spraying and pasture improvement.

Goats control weeds by preferentially grazing them, thereby placing the weeds at a disadvantage by preventing them from flowering and by ring-barking and structurally-weakening some shrub species. Goats eat a variety of undesirable plants and shrubs that sheep and cattle avoid, and quite often the nutritional value of these species is quite high. They are efficient browsers and grazers of weeds in steep, rocky areas, around trees, and in other inaccessible areas where conventional control methods are not applicable.

The use of goats for weed control is a medium- to long-term proposition and, therefore, expectations should be realistic. In some situations, goats can give effective control of a weed. In other cases, they may only limit the spread or have very little effect on the weed at all.

For goats to be effective, stocking rates, timing, weed palatability and farm management strategies need to be considered. In most cases, it is also important to have a competitively based pasture to overcome the weed and colonise bare areas.

There are many weed species that are eaten by goats; the degree of control depends on the palatability of the weed.

Highly palatable weeds include: blackberry, sweet briar and scotch broom.

Palatable weeds include: scotch thistles, variegated and nodding thistles, Paterson's curse, lantana and horehound.

Other species that are moderately palatable and eaten occasionally include fireweed, groundsel bush, St John's wort, serrated tussock and spear grass.

## Herbicide control

Herbicides are widely used for control of weeds in both agricultural and non-agricultural situations. The early herbicides such as arsenic trioxide and iron sulfate were mostly by-products of the chemical industry. Specifically manufactured materials are now used.

These newer materials generally act on specific enzyme systems in plants. In comparison with the past, herbicides are

now generally used at significantly lower rates with declining amounts of active ingredients.

With the increasing array of products and the continuing refinement of application equipment, herbicides are a particularly attractive option because of their effectiveness and practicality in a wide variety of weed control situations. In many situations, herbicides alone or integrated with other control methods can prove to be the most economical means of control, requiring less labour, fuel and equipment than other methods.

Herbicides kill weeds by interfering with the growth processes of the plant, replacing hormones in the plant, or blocking chemical reactions in other ways. Some herbicides do this where they make contact with the plant; others need to be translocated in the plant system to the site of action. Herbicides are therefore grouped as either translocated or contact.

### **Contact herbicides**

Contact herbicides kill the parts of the plants they touch, which is usually limited to leaves and stems of the plant. They work more effectively on annual or seedling perennial weeds and kill relatively quickly. Contact herbicides can be either selective or non-selective, depending on weed types and the crops involved. When contact herbicides are applied, the plants need to be actively growing and stress-free. Good coverage is required to achieve effective results. Contact herbicides include paraquat and diquat.

### **Translocated herbicides**

Translocated herbicides move within the plant to a site of action. 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.

Herbicides are also available in a range of forms, including selective, non-selective, residual and pre-emergent products.

The *Pesticides Act 1999* provides for registration of herbicides, labels and containers. Only a registered herbicide should be used for the control of weeds. Herbicides are to be used only according

to the directions on the label, which give an outline of the product's use, mixing, application, restraints and directions. Labels are designed to prevent misuse of a product. Users have a legal obligation to read and follow the instructions on the label.

### **Handling and applying pesticides**

Pesticides, including herbicides, should be handled and applied with consideration of their toxic nature and potentially harmful effects on human health, livestock, and the environment. By following label instructions and applying herbicides in the correct manner using best practices and trained staff, off-target damage and adverse effects can be avoided.

There are numerous forms of application techniques and equipment available to apply herbicides. Equipment available includes boom sprayers, hand guns, knapsacks, wick-wipers, granular soil applicators, aerial sprayers and gas guns. Application methods include foliar spraying, basal bark and cut stump application, stem injection, and wick-wiping methods (See pages 20–22).

The type of equipment and application method chosen for weed control depends on the size of the infestation, type of weed, topography, access, potential environmental and health hazards, and susceptibility or suitability of a certain weed to a particular application method.

For application equipment to operate effectively, the weather, soil conditions and time available for spraying must be considered. Suitable weather conditions are essential if herbicides are to be applied safely and effectively. Weather conditions should be assessed and monitored throughout the application period to reduce the risk of drift and subsequent off-target damage (see page 13).

Heavy rains following herbicide application can reduce the effectiveness of a treatment and may cause contamination through run-off.

## **Cultivation**

Cultivation is a proven way of controlling weeds. Implements range from large tractors and ploughs down to hand tools and the humble chipping hoe. This method results in direct control of weeds.

Cultivation is option that must be used wisely. Smaller weeds are more rapidly, efficiently and cheaply destroyed by cultivation. Shoots can also be buried deep to prevent regrowth, the roots exposed to dry out, shoots separated from the roots, or a combination of all three.

Cultivation has two main objectives, to prevent seeding and to destroy the existing plants. Cultivation can be used to cut off weed problems before they get out of control. However, eradication of perennial plants by cultivation can be difficult and depends on the root system. You can control some types of weeds by repeated passes, where the roots are dragged to the surface to dry out and die. This is, however, seldom entirely effective.

Cultivation should be used strategically, choosing the most appropriate equipment for the varying stages of crop and pasture production. For effective control by cultivation, weeds should be attacked before flowering and under reasonably dry conditions.

Manual cultivation using chipping hoes, mattocks and other suitable hand tools is another viable means of weed control in small-scale situations, although this method is time consuming and labour-intensive.

## **Slashing**

Slashing can be used to prevent tall growing weeds from flowering and setting seed. This method can be undertaken with a tractor and slashing implement or by using a hand-held brush-cutting machine.

Slashing can also be used to remove unpalatable or inedible weeds left after stock have selectively grazed a paddock and to prevent these weeds taking over. Care must be taken as slashing may also encourage the growth of more prostrate, less desirable species.

Slashing is not effective in eradicating a weed, just in temporarily controlling the plant until it re-shoots. Continual slashing may control a weed to a desired level if a more desired prostrate-growing species is present and is encouraged to replace the weed. It can be used for the control of vegetation and weeds along



roadsides, but is not suitable for the control of weeds in crops.

Slashing is cheaper than cultivation and preserves the ground cover, thus reducing soil erosion and improving access in wet weather.

## Mulching

Mulching involves the use of physical barriers to exclude sunlight and thus prevent weed establishment. Artificial barriers such as black plastic sheeting, woven paper products or woven cloth. Mulching has been used in various situations, particularly in row crop production where machinery is available to lay black plastic. Woven black plastic is also useful along roadsides where areas need to be revegetated on steep banks and cuttings. This option is viable only for small areas but can assist in weed control, bank stabilisation and erosion.

Natural mulches include sawdust, timber chips, straw, manures and grass clippings. Natural mulches have other beneficial effects by adding organic matter and nutrients to the soil. They are, however, awkward and time-consuming to apply and, in some cases, may introduce weed seeds.

Most perennial weeds will also penetrate mulches such as sawdust and wood chips. Mulching for weed control can be effective, but is limited to suitable row-cropping production such as strawberries, isolated areas along roadsides, organic farming and general backyard garden usage.

## Fire

Fire has been used for many years as a form of vegetation and weed control. Its success depends on the amount of fuel, the speed and intensity of the fire, and the time of year that burning takes place. Fire can play a major role in the management of woody weeds in western regions of NSW and can also be a useful option for the control of lantana and blackberry in certain situations.

The best fire strategy for woody weeds is a controlled managed burn. The aim is to burn only the desired area, using firebreaks and back-burning techniques. A managed burn unlike a wildfire is

controlled and minimises the damage to the environment with, ideally, no damage occurring to property and livestock.

Controlled burning for managing woody weeds can help restore land to a more open condition suitable for pasture growth and subsequent increase in grazing. The direct costs of managed burning are far lower than those of alternative techniques such as chemical treatment and mechanical clearing.

An integrated management program may be required when using fire for weed control. For example, lantana can be controlled with a combination of fire, improved pastures, and follow-up spot spraying. Large, dense woody weed infestations are most suitable for fire control, as larger areas burn more effectively.

## Reafforestation

Reafforestation is a long-term method of weed control. The aim of reafforestation is to form a dense tree canopy that restricts sunlight penetration to weeds on the forest floor.

Mature trees compete for moisture, nutrients and sunlight and restrict potential weed establishment and growth. It can take 5 to 10 years before trees form a dense canopy and, during this establishment phase, weed control can be critical to the success of the plantation. It may therefore be necessary to use other forms of weed control, such as herbicides and mechanical means, to assist in this establishment phase. A competitive, desirable, shade-tolerant grass or legume can also assist with forest management and weed control.

Large areas of land are more suitable for reafforestation, as other forms of weed control can become uneconomic or impractical.

NSW State Forests can help with tree selection, site preparation, planting and general forest management. A weed control program can also involve agro-forestry principles, which include tree growing in conjunction with other agricultural enterprises such as cropping or domestic animals.

The effectiveness of reafforestation for weed control depends on the tolerance of various weeds to shading, the added competition, and forest management.

Reafforestation to control groundsel bush has been tried in a number of situations but is not satisfactory unless good forest management methods are adopted. Trials are also being carried out to assess the effectiveness of reafforestation to control serrated tussock and giant Parramatta grass.

## Land management

Proper farm management can play a major role in reducing the incidence and impact of weeds on a property. The initial increase in cost of better management will be compensated for by the reduced amount of weed control required and the increased long-term farm productivity.

Management strategies such as pasture maintenance, good crop vigour, crop rotations, reduced tillage, grazing management, early weed identification and farm hygiene can all reduce weed problems.

### *Grazing management*

Grazing management and the introduction of competitive, desirable pasture species can also be an effective weed control method. Stocking rates should be set at appropriate levels so as to not overgraze and allow weeds to establish.

### *Pasture management*

A vigorous pasture competes more effectively with weeds and has the added benefits of increased production. Weeds can be controlled in a pasture situation by either improving the existing pasture or removing it and replacing it with a more suitable or competitive species. Pastures can be improved by adding fertilisers and lime according to soil test results, and the use of a selective herbicide may be required to further suppress weed competition.

### *Crop management*

Sound crop rotations can also minimise weed problems. Crop rotations help control diseases and insects and help build up soil fertility and structure to

produce increasing yields. Increased fertility reduces the impact of weeds, and rotating crops can break the seeding and germinating cycle of the weeds.

#### ***Farm hygiene***

All weed control methods are of little use if crop and weed hygiene is not practised. This includes sowing only weed-free seed, cleaning machinery, and removing sources of reinfestation around the farm.

New stock being introduced on to a property should be quarantined for several days so any potential weed seeds can pass through their systems in a known area and be treated later.

#### ***Weed identification***

Early identification and awareness of potential new weed problems will reduce the impact of weeds and save the property manager time and money. If a potential weed is identified in the early stages of infestation, it will be a lot easier and more economical to eradicate.



NSW DEPARTMENT OF PRIMARY INDUSTRIES

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- Requirements and obligations under the *Noxious Weeds Act 1993*.
- Support for councils in regional weed planning, applying for grants and weed officer training.
- Weed Control Manuals including the national Lantana and Salivina manuals.
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# Managing your legal responsibilities when applying pesticides

by Mark Scott

The *Pesticides Act 1999* is the primary legislative instrument controlling the use of pesticides in NSW and is administered by the Department of Environment and Conservation. The underlying principle of the *Pesticides Act* is that pesticides must be used only for the purpose described on the product label and all the instructions on the label must be followed. Consequently, all label directions must be read by, or explained to, the user before each use of the pesticide.

All pesticide users should take reasonable care to protect their own health and the health of others when using a pesticide. They should also make every reasonable attempt to prevent damage occurring from the use of a pesticide, such as off-target drift on to sensitive areas or harm to endangered and protected species.

## Record keeping

A regulation gazetted on 14 December 2001 requires all commercial pesticide users (that is, all farmers and spray contractors) to keep records of their pesticide application (Records Regulation). The regulation came into effect on 31 July 2002.

**While no set form has to be used, records must include the following:**

- full product name
- description of the crop or situation
- rate of application and quantity applied
- description of the equipment used
- address of the property, identification of the area treated and order of paddocks treated
- date and time of the application (including start and finish)
- name, address, and contact details of the applicator and of the employer or owner if an employee or contractor is the applicator
- estimated wind speed and direction (including any significant changes during application)
- other weather conditions specified on the label as being relevant (temperature, rainfall, relative humidity).

A form that captures all the information required by the Records Regulation, together with notes on how to fill it in, is included on the next page. The form and notes can also be downloaded from the NSW DPI website. [www.dpi.nsw.gov.au/reader/14833](http://www.dpi.nsw.gov.au/reader/14833)

A self-carboning record book is available from Murrumbidgee Rural Studies Centre, Yanco. Phone 1800 138 351.

Records must be made within 24 hours of application, be made in legible English, and kept for 3 years.

## How to fill out your pesticide application record

### *Property/holding:*

Attach a detailed property map (for instance, line drawing), showing adjoining sensitive areas, with paddocks and other features clearly identified.

Fill in the residential address.

### *Applicator details:*

The applicator, or person applying the pesticide, must fill in their contact details. If the applicator is not the owner (for instance, a contractor or employee), then the landowner's details also have to be filled in. In the case of a contractor, one copy of the record should be kept by the applicator and another given to the owner.

### *Sensitive area identification:*

If there are sensitive areas, either on the property or on land adjoining, these should be identified in advance and marked on the sensitive areas diagram, together with any precautions or special instructions. When using a contractor or giving the job to an employee, this section should be filled in and given to the person doing the application **before** the job starts. The property map with sensitive areas marked should be shown to them, and the job fully discussed.

### *Paddock identification:*

Identify the paddocks/blocks and order of treatment (if there is more than one) in the 'paddock' row of the form. This

should be filled in before the start of application, along with the residential address. If using a contractor or employee, this information should also be given to them **before** they start the job. Applicators using global positioning systems (GPS) could include a GPS reading in addition to the paddock number/name.

### *Crop/animal identification:*

The left-hand side of the table is for crops, pastures and plants (non-crop, bushland and fallow); the right-hand side for animals. As a minimum, identify the host (crop/situation) and the weed. It would be helpful to provide as much detail about the weed as possible, for instance, '4-leaf'. Addition of details such as crop variety and growth stage are often important for quality assurance schemes, but may also be necessary to positively identify the area treated, as required by the regulation.

### *Product details:*

The product name and rate/dose should be transcribed from the label. For tank mixes, include all products in the mixture.

If the use pattern is on-permit, include the permit number and expiry date as well as the label details. The permit rate/dose may vary from that on the label. Don't forget to include the label product name.

The water rate may come from the label or from your standard practice or as a result of your calibration. If additives or wetters are included in the mixture, it is helpful to note these.

The total L/kg can be calculated when the application is finished.

If the label has a withholding period (WHP), for example 7 days, note this down. To calculate the date when treated produce can be harvested or slaughtered, add the WHP, in this example 7 full (24-hour) days to the time when you finished applying the chemical. If you want to harvest or slaughter earlier in the day than that time, you will have to wait until the next (eighth) day.

### Equipment details:

As a minimum, you have to fill in what equipment you used. Positive identification can be assisted by specifying the settings used for the application: for instance, nozzle type and angle, and pressure. The nozzle type will usually include the angle. With pressure, the reading should be as close to the nozzle as possible. Other details are useful as a reminder for future use, or as a check on your set-up should you have a treatment failure: for instance, date of calibration and water quality.

Water quality is important for herbicide efficacy. At the most basic level, water quality can be described in terms of its source: for instance, rainwater, dam water, bore water.

### Weather:

As a minimum, record wind speed and direction. This is better measured with instruments than estimated. Record any changes during application. Also record the time of day when you started and the time when you finished. Weather records have to be made for all equipment that distributes pesticide through the air.

Rainfall should be recorded for the 24 hours before and the 24 hours after application, unless a different figure is given in the restraints or critical comments sections of the label. Rainfall before or after application can affect efficacy.

Temperature and relative humidity should also be recorded, particularly if either or both are referred to in the restraints or critical comments sections of the label. Temperature and relative humidity can affect efficacy and increase the risk of off-target drift or may damage the host (phytotoxicity), or a combination of all three.

## Example record keeping sheet

### Location, Applicator, Date of Application

Property/Holding: (Residential Address)					Date:										
Applicator's Full Name:			Owner (if not applicator):												
Address:			Address:												
Phone:	Fax:	Email:	Phone:	Fax:	Email:										
Sensitive Areas (including distances, buffers):			Comments (including risk control measures for sensitive areas):												
<table border="1"><tr><td></td><td>N</td><td></td></tr><tr><td>W</td><td>Treat Area</td><td>E</td></tr><tr><td></td><td>S</td><td></td></tr></table>				N		W	Treat Area	E		S					
	N														
W	Treat Area	E													
	S														

### 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:		Paddock Area:		Order of Paddocks Sprayed:	
Permit No:	Expiry Date:	Additives/Wetters:			
Total L/kg:	WHP:	ESI:	Date Suitable for Sale:		
Equipment Type:		Nozzle Type:		Nozzle Angle:	Pressure:
Date Last Calibrated:		Water Quality (pH or description):			

### Weather

Showers <input type="checkbox"/> Overcast <input type="checkbox"/> Light Cloud <input type="checkbox"/> Clear Sky <input type="checkbox"/>					
Rainfall (24 Hours before and after) Before: mm During: mm After: mm					
Time (show time in this column)	Temperature °C	Relative Humidity	Wind Speed	Duration	Variability (i.e. Gusting)
Start:					
Finish:					
Comments:					



## Pesticide User Training

The *Pesticides Act 1999* contains a User Training Regulation. This Regulation requires all commercial pesticide users to be trained in pesticide application. All previous training, e.g. FarmCare/ ChemCert and SMARTtrain, will be recognized for a period of five years from the time when the training was completed.

The training of aerial applicators, pest control operators and fumigators is recognised as satisfying the requirements of the Regulation. Apart from these groups, all commercial users must have a prescribed qualification. Only domestic use, such as home gardens, is excluded, provided the pesticide is a specific domestic/home garden product. Covered by the regulation is pest control by/on:

- public authorities, e.g. State Rail
- golf courses, sporting fields and bowling greens
- agricultural, horticultural, aquacultural and forestry operations
- businesses, educational institutions and hospitals.

The minimum prescribed training qualification is the AQF2 unit of competency, 'Apply chemicals under supervision'. Owner-applicators are encouraged to train and be assessed in the two higher AQF3 competencies, 'Prepare and apply chemicals' and 'Transport, handle and store chemicals'.

Growers are recommended to undertake the SMARTtrain course, Chemical Application, or the standard ChemCert course, both of which cover the higher AQF3 competencies. For growers with literacy and/or numeracy problems, the lower level AQF2 competency will provide a minimum qualification that satisfies the Regulation.

## Notification plan

The Department of Environment and Conservation (DEC) has introduced a Notification and Miscellaneous Regulation under the Pesticides Act, with a phase-in period by February 1 2007. This Regulation will affect public authorities controlling weeds on public places.

The Regulation requires the development of a notification plan for public places

where pesticides are applied and to which the public has access. Public places requiring a notification plan include aquatic areas, gardens, picnic areas, playgrounds, parks, sporting fields, road verges, electricity or rail easements legally accessible by the public, national parks, state forest, crown lands, public schools and TAFEs. Public authorities include government departments, statutory bodies and staff or persons who exercise functions on behalf of a public authority such as weed contractors for a local council.

The plan will have to define the means by which the community will be notified of pesticide application to public places, such as on-site signs, letters to affected community members, and news items in the local paper or on the local radio.

The notification plan should set out what information about the proposed pesticide application will be provided to the community. This should include (as a minimum) the product name of pesticide applied, the purpose for which the pesticide was applied (e.g. weed control), the place applied, the date applied, applicator contact details (phone number and/or internet address) and re-entry period (if relevant).

Once the plan is drafted, it will be necessary to develop arrangements for public input. The finalised plan has to be accessible to the public and the DEC has to be notified in writing that the plan has been prepared and finalised in compliance with the Regulation.

## Occupational Health and Safety

### *Hazardous Substances legislation*

Many registered pesticides are classified as hazardous substances, and most of those that are not pose some risk to the health of those who use them or are exposed to them.

The *Occupational Health and Safety Act 2000* and the Hazardous Substances section of the Occupational Health and Safety Regulation 2001 give details of the legal requirements of suppliers, employers and employees in the workplace for hazardous substances management. The Act and accompanying Regulation are intended to protect

workers from both the short- and long-term health effects of exposure to hazardous substances and to improve current health and safety practices by:

- provision of health and safety information to workers (including a list or register of all hazardous substances and an MSDS for each hazardous substance)
- consultation with workers
- training of workers
- assessment of the risks arising from hazardous substances exposure
- control of the risks
- recording of the risk assessment and control measures implemented, training of those applying and exposed to hazardous substances, and health surveillance (if warranted by the risk assessment in respect of organophosphates).

Both storage and use are covered by the Occupational Health and Safety Act. Records of training and risk assessments have to be kept for 5 years.

### *Dangerous Goods Regulation*

The dangerous goods legislation has been revised to bring it in line with hazardous substances legislation. The main requirements include:

- provision of MSDSs
- carrying out and documenting risks assessments
- keeping a register of Dangerous Goods.

All these requirements already apply to hazardous substances. In practice, the only change will be to add to existing management and record systems any Dangerous Goods that are not also hazardous substances.

Storage limits have changed. Premises storing large quantities require placarding of both the storage shed and the entrances to the premises. If very large quantities are stored – which would be rare on-farm, a manifest, site plan and written emergency plan are required. Consult your local WorkCover office for advice.

WorkCover NSW's *Code of Practice for the Safe Use and Storage of Chemicals (Including Pesticides and Herbicides) in Agriculture* is an approved industry code of practice and provides practical

guidance to help farm chemical users to comply with the legislation. This has been recently revised to reflect the new Dangerous Goods requirements.

Copies can be obtained from your local WorkCover office, by download from the WorkCover website – [www.workcover.nsw.gov.au](http://www.workcover.nsw.gov.au) – or by ringing 1300 799 003.

## Pesticides and Worker Safety

Pesticides can have both immediate (acute) effects and chronic (long-term) effects on the health of people who are exposed to them.

### Acute toxicity

The acute or immediate toxicity of a farm chemical is reflected in the Poisons Schedule or poison warnings, which appear on the label of a pesticide product. The acute toxicity is assessed in terms of the potential of the active ingredient of the chemical to poison an individual by the route of exposure that is most lethal, for example, by ingestion (swallowing).

#### Poison schedules

Pesticides are classified into four categories in the Poisons Schedule on the basis of their acute health hazard to the user of the pesticide. Each schedule has a corresponding signal heading, which appears in large contrasting lettering on the label of the pesticide product.

Poison schedule	Toxicity	Label heading
Unscheduled	Very low toxicity	No heading required
Schedule 5	Slightly toxic	Caution
Schedule 6	Moderately toxic	Poison
Schedule 7	Highly toxic	Dangerous Poison

The Poison Schedule will largely determine the Safety Directions and First Aid Instructions that appear on the label. The Safety Directions specify what personal protective equipment (PPE) should be worn and what safety precautions should be taken, for example, 'Do not inhale spray mist'. The First Aid Instructions specify what action should

be taken in the event of a poisoning. Safety Directions and First Aid Instructions may be different for different formulations of the same pesticides.

**Note:** Before opening and using any farm chemical, consult the label and Material Safety Data Sheet (MSDS) for specific Safety Directions. The *Hazardous Substances* section of the Occupational Health and Safety Regulation 2001 requires the reseller to provide the end-user with an MSDS.

If you suspect a poisoning, contact the Poisons Information Centre, emergency phone (24-hour) **131 126**.

#### Solvents and distillates

In addition to the active ingredient, pesticide formulations contain surfactants and carriers that may also be toxic. Many liquid pesticide formulations are based upon petroleum distillates or organic solvents, which are corrosive to the skin and eyes, and their vapours may affect the brain if inhaled. An example of such a distillate is xylene, which is highly toxic. As with the active ingredient, the exposure risk is highest when handling the concentrate. This is why pesticide labels often carry warnings to avoid inhaling the vapours, and to avoid splashes to the skin and eyes.

#### Routes of exposure

With **all** pesticides (except fumigants) the most hazardous route of exposure is dermal absorption (through the skin) and the most hazardous phase of application is mixing and loading the concentrated product.

With the exception of fumigants, the inhalation risk for most pesticides and application technology is low. Nevertheless, a respirator may be required when mixing/loading or applying pesticides:

- in an enclosed space (such as a shed)
- if the pesticide is highly volatile and liable to be breathed as a vapour (such as 2,4-D ester)
- if application carries the risk of inhaling the spray mist (such as having to turn back into the drift in crops with short rows).

Ingestion or swallowing is a risk to applicators who don't wash their hands before eating and drinking or who smoke during application. Unsecured storages

represent a high risk to children, who could accidentally ingest a pesticide.

Many pesticide formulations can have direct or topical effects on the skin and eyes. These effects are often unrelated to whether or not the chemical is acutely toxic. Some pesticides may have low acute toxicity but severe topical effects. For example, glyphosate has very low acute toxicity but is irritating to the skin and eyes. Warnings regarding skin and eye irritation and other topical effects are usually found on the product label under 'Safety Directions'.

#### Re-entry intervals

The re-entry interval is the time that must elapse between applying the pesticide and re-entry into the sprayed crop, unless the PPE specified for re-entry on the label is worn. The reason for setting a re-entry interval is that pesticides sometimes remain on crops in the form of foliar aerosol particles. These residues can be dislodged by contact with the crop and absorbed through the skin by those working in the crop.

Re-entry intervals appear on the labels of only a small number of pesticide products. These include newer products, or older products that have been subject to a technical review by the Australian Pesticides and Veterinary Medicines Authority (formerly the National Registration Authority). If a re-entry period is not specified on the label, the rule of thumb is to wait 24 hours after application or until the crop is dry, whichever is the longer. Crops should never be re-entered when wet from dew or light rain, irrespective of the time elapsed, unless appropriate PPE is worn.

### Chronic toxicity

The effect of long-term exposure to small doses of chemical is referred to as chronic toxicity. Some of these chronic toxicity effects include:

- neurotoxic effects (toxic effects on the brain and central nervous system)
- reproductive system effects
- carcinogenicity (causing cancer)
- endocrine (hormone) disruption.

#### Neurotoxic effects

Organophosphate pesticides (insecticides) are suspected of having long-term, subtle effects on the central nervous system. The effects detected to

date are slight and have been detected only in a tiny proportion of those exposed. What is clear is that all effects, both acute and chronic, are dose related. This means that sticking to the label directions to control acute exposure will similarly control chronic exposure.

### **Reproductive effects**

Some pesticides are suspected of being fetotoxic (fatal to foetuses) and teratogenic (causing birth defects) on the basis of laboratory studies involving animals. However, there is little evidence that pesticides can affect human reproduction or the health of the unborn foetus at the levels of pesticide exposure that most of the population experiences through their food supply.

The Australian College of Occupational Medicine recommends that women who are pregnant or likely to become pregnant protect themselves against chemical exposures that may have adverse reproductive effects. Pregnant women should not be involved in spraying agricultural chemicals or working in recently sprayed crops. You can get advice on pregnancy and occupational exposure to pesticides from a medical practitioner accredited by WorkCover NSW in occupational health.

### **Cancer and pesticides**

Despite widespread public suspicion of pesticides as cancer-causing agents, evidence is lacking to implicate all but a few. As most cancers are caused by a multiplicity of factors, it is extremely difficult to determine whether or not a particular cancer was the result of pesticide exposure or other factors. Apart from the organochlorines and arsenic, which are now banned, only chlorothalonil, dichlorvos and amitrole have been classified as possible (less weight of evidence than probable) carcinogens by the WHO (World Health Organisation).

### **Endocrine disruption**

The endocrine system is made up of many glands in the body and the hormones they secrete. These hormones guide the development, growth, reproduction and behaviour of all animals, including humans. The female ovaries and male testes are endocrine glands. Endocrine disruptors are chemicals that interfere with the normal

functioning of the endocrine system. Large acute exposure to some chemicals such as the organochlorines has caused adverse effects to the endocrine systems of animals.

It is unclear whether long-term, low-level exposure to endocrine-disrupting chemicals will affect human reproduction. One reason why it is difficult to establish the specific effects caused by pesticides is that we are surrounded by naturally occurring sex hormones, particularly in plants. Our exposure to naturally occurring plant hormones is far greater than to synthetic ones such as pesticides—by a factor of 40 million. Nevertheless, the United States Environmental Protection Agency is developing a set of tests that will help screen pesticides for their endocrine-disrupting potential. These tests will also be adopted by other risk assessment agencies around the world, including in Australia.

The best way to manage any long-term risks of chronic pesticide effects is to reduce exposure by following all the directions on pesticide labels.

## **Disposal of farm chemicals and containers**

After chemicals have been applied according to the label directions, you must dispose of empty chemical containers and any unused chemicals in an environmentally responsible manner.

### **drumMUSTER**

To solve the problem of what to do with used non-returnable chemical containers, Croplife Australia, the NFF (National Farmers' Federation), the Veterinary Manufacturers and Distributors Association (VMDA) and local governments Australia-wide have developed drumMUSTER.

From 1 February 1999, farmers have paid a 4c per litre or kilogram levy on non-returnable chemical containers with capacities greater than 1 L or 1 kg. This levy funds the national collection and recycling scheme, drumMUSTER. The levy funds local government to pay staff to inspect returned containers; for processing the returned containers; and

for publicising local collection sites and times.

Local councils, either individually or in groups, enter into an agreement with drumMUSTER. Farmers are then able to deliver cleaned (that is, triple or pressure-rinsed) containers to designated collection points run by participating councils. At these collection points, the delivered containers are inspected and either accepted or rejected.

To locate a drumMUSTER collection site near you, check the drumMUSTER website – [www.drummuster.com.au](http://www.drummuster.com.au) – or ring the national office on (02) 6230 6712.

## **Cleaning containers for collection**

When rinsing, the personal protective equipment (PPE) specified on the label for application and/or mixing and loading the pesticide should be worn. This is because the chemical remaining in a container is the concentrate – the most toxic form of the chemical – even though it is diluted during the rinsing process.

To triple-rinse a container with a capacity of up to 20 L to meet drumMUSTER standards:

- remove the cap, invert the container and allow it to drip drain into the mixing tank for 30 seconds
- add rinse water 20% (1 L/5 L of container volume)
- replace cap and shake vigorously for 1 minute
- remove cap, invert and drip drain into mixing tank for 30 seconds
- repeat twice
- wash cap separately and replace on container.

Triple-rinsing is only suitable for small containers up to 20 L.

Rinsing is most effective while the containers are still moist inside. The longer the residue has time to dry and cake on the inside of the container, the more difficult it is to remove. This is the reason for rinsing during mixing and loading. If rinsing is done during mixing and loading, the rinsate can be emptied into the spray or mixing tank of the application equipment, where it can be 'disposed of' on the crop. Using the rinsate in this way avoids the need to dispose of the container residues

separately (see 'Disposal of rinsate or dilute chemicals' below).

An alternative to manually triple-rinsing small containers is a pressure rinsing nozzle. There are two main types. One has a rotating spray head that can be used to rinse an inverted container in the induction hopper or directly over the tank. The other has a hardened, pointed shaft to pierce drums, and the hollow shaft itself has four holes at 90° to spray the water around the container.

To pressure rinse a container up to 20 L:

- remove the cap, invert the container and allow it to drip drain into the mixing tank for 30 seconds
- ensure clean rinse water is between 35 and 60 psi
- insert pressure-rinsing probe either through the container opening or through the pierced base of the container (depending upon the type of nozzle)
- invert container over mixing tank and rinse for 30 seconds or longer if the water coming from the container neck is not clear, moving the probe about to ensure all inner surfaces are rinsed
- wash cap in clear rinse water from container
- turn off water, remove probe and drip drain container into mixing tank for 30 seconds
- replace lid on container.

Large containers (for instance, 200-L ones) are best rinsed with a chemical transfer probe that has a flushing cycle as well as the primary suction cycle.

Such probes are standard on many boom sprays and optional on most others. The drums may have to be slightly inclined to ensure all rinsate is removed. Typical rinse time for a 200-L drum would be 3 to 5 minutes.

Non-rigid containers (that is, bags and cartons) have to be buried (see 'Disposal of rinsate' for conditions). Plastic bags should be rinsed first, and paper bags punctured or shredded. Cartons, too, must be punctured or shredded before burial. Burning is specifically prohibited.

## Disposal of unwanted chemicals

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In addition to unwanted chemical containers, many farms also have unwanted chemicals. To manage this problem there is an on-going collection scheme, ChemClear. This is an agreement between chemical manufacturers, NFF and local government. Currently registered chemicals in original containers with identifiable labels are collected free of charge. Unregistered, unknown and unlabelled chemicals incur a fee. Collections have to be booked through the website – [www.chemclear.com.au](http://www.chemclear.com.au) – or by ringing 1800 008 182.

Occasionally, manufacturers run their own return/recall schemes. These are not covered by ChemClear, as the costs are borne by the manufacturers of the chemicals involved.

## Disposal of rinsate or dilute chemicals

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Labels contain a prohibition on disposing of concentrate on-site or on-farm, as does State environmental legislation. Unused chemical has first to be diluted and, if not applied in terms of the label use pattern, has to be disposed of in an environmentally responsible manner, such as in an evaporation pit.

The pit should be 1 metre deep and lined with plastic sheeting over which has been spread hydrated lime. Any wastes must be covered with at least 0.5 m of soil.

Disposal pits are suited only to small volumes and diluted chemicals. In the case of a concentrate spill, the chemical would have to be diluted to at least standard label rates before transfer to the disposal pit.

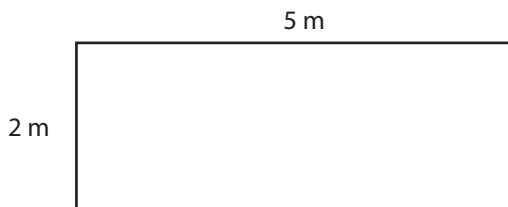


# Calibration of equipment

## Hand gun

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1. Mark out an area  $5\text{ m} \times 2\text{ m} = 10\text{ m}^2 = 1/1000\text{th}$  of 1 hectare (representative of the area to be treated).



2. Time in **seconds** time taken to spray  $10\text{ m}^2$ .
3. Measure **output in litres/seconds** taken to spray  $10\text{ m}^2$ .
4. Multiply **output**  $\times 1000 = \text{L/ha}$ .

## Boom sprayers

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1. Record **output** from each nozzle for **1 minute** (replace if flow rate varies  $\pm 10\%$  or if spray pattern is visually faulty).
2. Record total **spray output** (add **output** for all nozzles) as **litres per minute**.
3. Measure effective **spray width** and record in metres.
4. Determine actual **ground speed** by timing in seconds the **time taken** to travel **100 metres**

$$\text{* Actual ground speed} = \frac{100 \text{ metres} \times 3.6}{\text{Time taken (seconds)}} = \text{km/h}$$

**Note:** 3.6 is a conversion factor to convert seconds to hours

5. Determine **water application rate** by using steps 2–4

$$\text{* Water application rate} = \frac{\text{spray output (L/minute)} \times 600}{\text{spray width (m)} \times \text{ground speed (km/h)}} = \text{L/hectare}$$

**Note:** 600 is a conversion factor to convert L/minute to L/hectare.

See Appendix 1 for a comprehensive boom spray calibration.

# Reducing herbicide spray drift

by Andrew Storrie

When applying pesticides the aim is to maximise the amount reaching the target and to minimise the amount reaching off-target areas. This results in:

1. Maximum pesticide effectiveness
2. Reduced damage and/or contamination of off-target crops and areas.

In areas where a range of agricultural enterprises co-exist, conflicts can arise, particularly from the use of pesticides. All pesticides are capable of drift.

People have a moral and legal responsibility to prevent pesticides from drifting and contaminating or damaging neighbours' crops and sensitive areas.

## How to minimise spray drift problems

### *Before spraying*

- Always check for susceptible crops in the area, e.g. broad leaf crops such as grape vines, cotton, pulse crops, if using a broadleaf herbicide, and sensitive areas such as houses, schools, riparian areas
- Notify neighbours of your spraying intentions

Under the Records Regulation of the Pesticides Act it is essential that weather and relevant spray details are recorded. See pages 9–10.

### *During spraying*

- Always monitor meteorological conditions carefully and understand their effect on 'drift hazard'
- Don't spray if conditions are not suitable, and stop spraying if conditions change and become unsuitable
- Record weather conditions (especially temperature and relative humidity), wind speed and direction, herbicide and water rates, and operating details for each paddock.
- Supervise all spraying, even when a contractor is employed. Provide a map marking the areas to be sprayed, buffers to be observed, sensitive crops and areas.
- Spray when temperatures are less than 28°C.

- Minimise spray release height (lowest possible boom height).
- Use the largest droplets which will give adequate spray coverage.
- Always use the least-volatile formulation of herbicide available.
- Maintain a down-wind buffer which may be in-crop e.g. keep a boom width from the downwind edge of the field.
- If sensitive crops are in the area, use a herbicide which is the least damaging.

## How many types of drift are there?

Sprayed herbicides can drift as *droplets*, as *vapours* or as *particles*.

*Droplet drift* is the easiest to control because under good spraying conditions, droplets are carried down by air turbulence and gravity, to collect on plant surfaces. Droplet drift is the most common cause of off-target damage caused by herbicide application.

For example, spraying fallows with glyphosate under the wrong conditions often leads to severe damage to near-by establishing crops.

*Particle drift* occurs when water and other herbicide carriers evaporate quickly from the droplet leaving tiny *particles* of concentrated herbicide. This can occur with herbicide formulations other than esters. Instances of this form of drift have damaged susceptible crops up to 30 km from the source.

*Vapour drift* is confined to volatile herbicides such as 2,4-D ester. Vapours may arise directly from the spray or evaporation of herbicide from sprayed surfaces. Use of 2,4-D ester in summer can lead to vapour drift damage of highly susceptible crops such as tomatoes, sunflowers, soybeans, cotton and grapes. This may occur hours after the herbicide has been applied.

Vapours and minute particles float in the airstream and are poorly collected on catching surfaces. They may be carried for many kilometres in thermal updraughts before being deposited.

Sensitive crops may be up to 10 000 times more sensitive than the crop being sprayed. Even small quantities of drifting herbicide can cause severe damage to highly sensitive plants.

## What factors affect the risk of herbicide spray drift?

Any herbicide can drift. The drift hazard, or off-target potential, of a herbicide in a particular situation depends on the following factors:

### *Volatility of the formulation applied*

Volatility refers to the likelihood that the herbicide will evaporate and become a gas. Esters volatilise (evaporate) more readily than amine formulations.

### *Formulation of the product*

Formulations such as emulsifiable concentrates have a tendency to produce more small droplets than a dry flowables.

### *Type of adjuvant*

Non-ionic surfactants and penetrants added to the spray solution will produce more small droplets than oils.

### *Susceptible crops*

Closeness of crops susceptible to the particular herbicide being applied, and their growth stage. For example cotton is most sensitive to Group I herbicides in the seedling stage

### *Method of application and equipment used*

Aerial application releases spray at ~3 m above the target and uses relatively low application volumes, while ground rigs should have lower release heights and generally higher application volumes, and a range of nozzle types. Misters produce large numbers of very fine droplets that use wind to carry them to their target.

### *Size of the area treated*

The greater the area treated the longer it takes to apply the herbicide. If local meteorological conditions change,

particularly in the case of 2,4-D ester, then more herbicide is able to volatilise.

### Amount of active ingredient (herbicide) applied

The more herbicide applied/ha the greater amount available to drift or volatilise.

### Efficiency of droplet capture

Bare soil does not have anything to catch drifting droplets as do crops, erect pasture species and standing stubbles.

### Weather conditions

Weather conditions during and shortly after application both affect drift.

## New regulations on use of 2,4-D and MCPA

A new label warning from the APVMA states that phenoxy herbicides can cause severe damage to susceptible crops such as cotton, grapes, tomatoes, oilseed crops and ornamentals.

It further states that the product is not to be used unless wind speed is more than three kilometres per hour and less than 15 kilometres per hour as measured at the application site.

Users are advised to apply with coarse to very coarse spray droplets.

## Minimising drift and maximising coverage

A significant part of minimising spray drift is the selection of equipment to reduce the number of small droplets produced. However, this in-turn may affect coverage of the target, and therefore the possible effectiveness of the pesticide application.

This aspect of spraying needs to be carefully considered when planning to spray.

As the number of smaller droplets decreases, so does the coverage of the spray.

A good example of this is the use of air-induction nozzles that produce large droplets that splatter. These nozzles may produce a droplet pattern and number unsuitable for targets such as seedling grasses. As the volume median diameter of the spray becomes coarser, spray application volumes need to be increased to compensate for the fewer droplets being produced.

## Use a low volatile formulation

Many ester formulations are highly volatile when compared with the non-volatile amine, sodium salt and acid formulations. Some low volatile ester formulations may have a proportion of high volatile esters present, so caution should be exercised when using these products.

## Reduce spray release height

- Operate the boom at the minimum practical height. Drift hazard doubles as nozzle height doubles. If possible, angle nozzles forward or back 30° to allow lower boom height with double overlap. Lower heights however, can lead to more striping, as the boom sways and dips below the optimum height.
- 110° nozzles produce a higher percentage of fine droplets than 80° nozzles. However they allow a lower boom height while maintaining the required double overlap.
- Operate within the pressure range recommended by the nozzle manufacturer. Production of driftable fine droplets increases as the operating pressure is increased. Lower volumes such as 30–40 L/ha produce a higher percentage of fine droplets than higher spray volumes at the same pressure and nozzle design.

Table 2. Nozzle selection guide for ground application.

Risk	High	Medium	Low
Distance downwind to susceptible crop	< 1 km	1–30 km	> 30 km
Preferred droplet size (BCPC) (to minimise risk)	Coarse	Medium	Fine
Volume median diameter (microns)	310	210	135
Pressure (bars) Δ	5.0–6.5	2.0–3.5	3.5
Flat fan nozzle size (equivalent)	11008	11004	11002
Recommended nozzles (Examples only)	<b>Raindrop</b> Whirljet® <b>Air induction</b> Yamaha® Turbodrop® Hardi Injet® Al Teejet® Lurmark Drift-beta®	<b>Drift reduction</b> DG TeeJet® Turbo TeeJet® Hardi® ISO LD 110 Lurmark® Lo-Drift	<b>Conventional</b> XR TeeJet® Hardi® S3110 Hardi® S4110 Hardi® ISO F series Lurmark® Fan Tip
CAUTION	Can lead to poor coverage and control of grass weeds. Requires higher spray volumes.	Suitable for grass control at recommended pressures. Some fine droplets.	High proportion of 'driftable' droplets. Temperature and humidity critical.

Volume Median Diameter (VMD): 50% of the droplets are less than the stated size and 50% greater.

Δ - NOTE – Refer to manufacturers' selection charts as droplet size will vary with recommended pressure. Always use the lowest pressure stated to minimise the number of fine droplets.

Adapted from P. Hughes, DPI&F, Queensland.

**Aircraft** application has an inherently greater risk than ground rig application. This is due to a number of factors, including lower volume application, small droplet sizes, height of application, and turning and wing-tip vortices. An aircraft should not be used to apply herbicide in areas where highly susceptible crops are growing nearby.

### Size of the area treated

When large areas are treated relatively large amounts of active herbicide are applied and the risk of off-target effects increases due to the length of time taken to apply the herbicide. Conditions such as temperature, humidity and wind direction may change during spraying.

Applying volatile formulations to large areas increases the chances of vapour drift damage to susceptible crops and pastures.

### What is your 'capture surface'?

Targets vary in their ability to collect or capture spray droplets. Well grown, leafy crops are efficient collectors of droplets. Turbulent airflow normally carries spray droplets down into the crop within a very short distance.

Fallow paddocks or seedling crops are poor catching surfaces. Drift hazard is far greater when applying herbicide in these situations or adjacent to these poor capture surfaces.

The type of catching surface between the sprayed area and susceptible crops should always be considered in conjunction with the characteristics of the target area when assessing drift hazard.

## Weather conditions to watch out for

### *Midday turbulence*

Up-drafts during the heat of the day cause rapidly shifting wind directions. Spraying should stop by 11 am during summer.

### *High temperatures*

Avoid spraying when temperatures exceed 28°C.

### *Humidity*

Avoid spraying under low relative humidity conditions i.e. when Delta T

(the difference between wet and dry thermometers) exceeds 10° C. Spraying when Delta T is between 8–10° is considered moderate risk.

High humidity extends droplet life and can greatly increase the drift hazard of fine droplets under inversion conditions. This results from the increased life of droplets smaller than 100 microns.

### *Wind*

**Avoid** spraying under still (stable) conditions.

**Ideal** safe wind speeds are 7–10 km/h, leaves and twigs are in constant motion – a light breeze.

Also **suitable** for spraying is 11–14 km/h if using low drift nozzles or higher volumes application (80–120 L/ha). Small branches move, dust is raised and loose paper moving – a moderate breeze.

### *Inversions*

The most hazardous condition for herbicide spray drift is an atmospheric inversion, especially when combined with high humidity.

- Do not spray when a temperature inversion exists.
- An inversion exists when temperature increases with altitude instead of decreasing. An inversion is like a cold blanket of air above the ground, usually less than 50 m thick. Air will not rise above this blanket; and smoke, dust or fine spray droplets and particles of spray deposited within an inversion will float until the inversion breaks down.
- Inversions usually occur on clear, calm mornings and nights. Windy or turbulent conditions prevent inversion formation. Blankets of fog, dust or smoke and the tendency for sounds and smells to carry long distances indicate inversion conditions.

Smoke generators or smoky fires can be used to detect inversion conditions. Smoke will not continue to rise but will drift along at a constant height under the inversion 'blanket'.

### **Helpful meteorological information**

Real time data needs to be collected in the paddock at the time of spraying. This can be done with:

- handheld units which measure temperature, Delta T and wind speed

- on-farm weather stations. Some can now be accessed by mobile phone.

### *Hourly data*

Hourly data from the Bureau of Meteorology (BOM) weather stations including temperature, Delta T, wind speed and direction is available for the previous 72 hours from:

<http://www.bom.gov.au/weather/nsw/nsw-observations-map.shtml> – click on the relevant town.

This data can help planning of spray activities and is useful for developing an understanding of the current daily patterns of meteorological conditions.

### *Meteograms™ from the BOM*

Meteograms™ provide 7 day forecasts of temperature, relative humidity, rainfall wind speed and wind direction.

Meteograms™ are very helpful in planning spray programs for periods of lowest drift risk and highest pesticide efficacy. They are available via subscription at the cost of \$100 per 12 months.



# Using adjuvants, surfactants and oils with herbicides

by Andrew Storrie and C. Leckie

Herbicides often need help to spread across the leaf and penetrate the leaf surface of weed targets to give best results.

Some herbicides have sufficient adjuvant and require no additional surfactants to perform well. However, some do, and this is usually detailed on the herbicide label.

**Always read the herbicide label before opening the container and heed the information printed there.**

An **adjuvant** is any additive to a herbicide that is intended to improve the effectiveness of the herbicide. There are many products that have been developed to help herbicides to contact the weed target, then remain and penetrate the weed leaf. Adjuvants can be classified as surfactants, crop oils, penetrants and acidifying buffering agents.

## Surfactants

Products that increase the spread of droplets, aiding the wetting of waxy or hairy leaf surfaces. Surfactants consist of three different types:

### *Anionic*

These have a negative charge and are not often used with herbicides.

### *Cationic*

These have a positive charge and are domestic detergents. Rarely used with herbicides.

### *Non-ionic*

These are the most commonly used agricultural surfactants. They are non-reactive (no electrical charge). They remain on the leaf once dry and allow 'rewetting' after rain, permitting additional herbicide uptake: examples are BS 1000<sup>®</sup> and Agral 600<sup>®</sup>.

## Crop oils

Most crop oils contain emulsifiers to allow them to mix with water. Some contain various levels of surfactants. Some claims regarding oil adjuvants

include reduced rainfall periods, more uniform droplet size (drift reduction), less spray evaporation and better penetration of herbicide into waxy leaves. Oils can be divided into two main groups:

### *Mineral oils*

These products are usually a blend of mineral oil and non-ionic surfactant. Products such as Ad-Here<sup>®</sup> and DC Tron<sup>®</sup> have low levels of surfactant, whilst Uptake<sup>®</sup> and Supercharge<sup>®</sup> have higher levels. These products have lower potential for crop phytotoxicity, as they are more refined.

### *Vegetable oils*

These contain a wide range of products. Products containing esterified vegetable oil and surfactants are the most commonly used. They have claims for superior wax-modifying characteristics and penetrating ability. They should be used strictly according to the label with selective herbicides. Hasten<sup>®</sup> and Kwickin<sup>®</sup> are examples of these products.

## Penetrants

These are specific compounds that help dissolve waxy cuticles.

## Acidifying buffering agents

These help lower the pH of the spray solution. This makes solutions more acidic. Most herbicides are most stable when the pH of the solution is between 6 and 7 (neutral or slightly acidic). These include products such as LI700<sup>®</sup> and Primabuff BB5<sup>®</sup>.

### *Compatibility agents*

Compatibility agents are materials that reduce the likelihood of antagonism from other agents in the spray solution. The most commonly used compatibility agent is ammonium sulfate. It is also used to neutralise the effect of hard water on amine formulations such as glyphosate. Examples of these products are Liaise<sup>®</sup> and Liquid Boost<sup>®</sup>.

Some products combine a number of the above roles, for instance Hot-up<sup>®</sup> contains a surfactant, a compatibility agent and an oil.

There is also a range of other adjuvants that are added to herbicides during formulation to improve efficacy, increase crop safety, or improve the ease of herbicide use. These include thickeners, spreaders, stickers, anti-foamers and safeners.

## Factors affecting adjuvant use

### *Crop safety*

Addition of an adjuvant can reduce herbicide selectivity and thereby increase crop damage. This is not an issue for fallow and pre-emergent herbicides.

### *Effectiveness or activity*

Adjuvants are usually added to increase the effectiveness of herbicides. However, use of the wrong type or rate can reduce effectiveness, such as decreasing herbicide retention on leaves.

### *Water hardness*

Hard water can lead to poor mixing of the chemical with water. This particularly occurs with emulsifiable concentrates. High levels of calcium and magnesium ions bind with amine formulations, causing them to be less soluble and therefore less effective.

### *Water temperature*

Low water temperature can lead to jelling in the tank. High-concentration herbicides might not mix and surfactants may perform poorly.

# Cleaning and decontaminating boomsprays

by Andrew Storrie and C. Leckie

The importance of cleaning and decontaminating spray equipment used for the applying herbicides cannot be over-stressed. Crops and pastures have been severely damaged or destroyed by spray equipment that was not thoroughly cleaned before use.

When growing canola, pulses or legume-based pastures in the rotation, decontamination of spray units must be carried out to ensure that there is no possibility of crop or pasture damage.

For example, if broadleaf herbicides, particularly sulfonylureas (such as Glean®, Logran®), have been used in the spray equipment at any time prior to grass herbicides such as Verdict®, particular care should be taken to follow the directions for cleaning and decontamination on the label of the relevant broadleaf herbicide.

**WARNING:** Grass control herbicides such as Verdict®, Fusilade®, Correct®, Select®, Targa® and Sertin® can be extremely damaging to winter cereal and summer crops.

Likewise, spray tank contamination with small quantities of sulfonyl urea herbicides such as Glean® and Logran® can be extremely damaging to crops like canola, pulse crops and legume pastures.

\*Nufarm Spraymate® Tank and Equipment Cleaner can also be used to decontaminate spraying equipment.

**Note:** Rinse water should be discharged into a designated disposal area.

## Cleaning and decontaminating boom sprays

Herbicide	Rate of agent/100 L water	Instructions for cleaning and decontamination
Glyphosate (Roundup®), Raptor®, Flame®, Spinnaker®	Clean water (*Spraymate®)	Rinse thoroughly several times with clean water before use.
Hormone-type, salt or amine formulations (2,4-D amine, MCPA amine, 2,4-DB, dicamba)	2 L household ammonia (*Spraymate®)	Thoroughly agitate and flush a small amount of solution through the system and let stand in sprayer overnight. Flush and rinse with clean water several times before use.
Hormone-type, ester formulations (2,4-D ester, MCPA ester)	500 g washing soda (crystalline sodium carbonate) + 4 L kerosene + 125 g powdered detergent (*Spraymate®)	Rinse the inside and outside of the tank and flush a small amount through the system for 15–20 minutes. Let stand for at least 2 hours or preferably overnight. Flush and rinse before use.
Atrazine, simazine	125 g powdered detergent (*Spraymate®)	Rinse with clean water before and after using the solution.
Sulfonyl urea herbicides (Glean®, Logran®, Ally®)	300 mL fresh household chlorine bleach containing 4% chlorine or 300 mL BC-45 Spray Equipment Cleaning Agent (*Spraymate®)	1. Drain and flush the tank, hoses, and boom with clean water for 10 minutes. 2. Fill the tank with clean water and add the chlorine bleach. Flush the boom and allow to stand for 15 minutes, then drain. 3. Repeat Step 2. 4. Nozzles, screens and filters should be removed and cleaned separately.
Broadstrike®, Eclipse®, Lontrel®	500 mL liquid detergent such as Surf®, Omo®, DynamoMatic®, or 500 g of the powder equivalent	Flush the system, then quarter-fill the tank with water and add the detergent. Start the pump and circulate for at least 15 minutes. Drain the whole system. Remove and clean the filters, screens and nozzles with clean water and allow to drain.
Herbicides for grass control in broadleaf crops and pastures such as Verdict®	500 mL liquid alkali liquid detergent such as Surf®, Omo®, DynamoMatic®, or 500 g of the powder equivalent	Before spraying cereals, maize, sorghum or other sensitive crops, wash the tank and rinse after use. Completely drain the tank and wash filters, screens and nozzles. Drain and repeat the procedure twice. To decontaminate, wash and rinse the system as above, quarter-fill the tank, add the detergent and circulate through the system for at least 15 minutes. Drain the whole system. Remove filters, screens and nozzles and clean separately. Finally, flush the system with clean water and allow to drain.

# Withholding periods

by Mark Scott

The withholding period is the minimum mandated interval that should elapse between the last application of a farm chemical to any crop, pasture, or animal and the harvesting, grazing, cutting or slaughtering or the collection of milk and eggs for human consumption.

It is part of the direction of use within the concept of Good Agricultural Practice in the use of agricultural chemicals. This period is assessed as being the time required for the level of residues to fall to or below the permitted level, which is known as **Maximum**

**Residue Limit (MRL)**. Observance of the withholding period stated on the registered label is a legal requirement.

## Withholding periods

Product	Active ingredient	Withholding period (days or weeks) before grazing or cutting for hay
Access®	triclopyr + picloram	Nil
Amitrole T®	amitrole + ammonium thiocyanate	Nil
Basta®	glufosinate	8 weeks
Baton®	2,4-D	7 days
Broadstrike®	flumetsulam	3 days – 8 weeks (see label)
Bromicide 200®	bromoxynil	14 days
Bromicide MA®	bromoxynil + MCPA	14 days
Brush-off®	metsulfuron-methyl	Nil (recommended not to graze for 7 days before treatment and for 7 days after treatment to allow adequate chemical uptake in target weeds.)
Casoron G®	dichlobenil	Nil
Cut-out®	metsulfuron-methyl + glyphosate	Nil
Daconate®	MSMA	5 weeks
Fusilade®	fluazifop-P	2–7 weeks (see label)
Garlon 600®	triclopyr	Nil
Graslan®	tebuthiuron	Nil
Grazon DS®	triclopyr + picloram	Nil
Jaguar®	bromoxynil + diflufenican	14 days
Kamba 500®	dicamba	7 days
Kamba M®	dicamba + MCPA	7 days
Lontrel®	clopyralid	1–12 weeks (see label)
MCPA 500®	MCPA	7 days
Oust®	sulfometuron-methyl	Nil
Primatol Z®	ametryn	No stated withholding period
Reglone®	diquat	1 day
Starane®	fluroxypyr	7 days
Tordon® 75-D	2,4-D + picloram	1–8 weeks (see label)
Tordon® Granules	picloram	Nil
Tussock®	flupropanate	4 months for blanket spraying, 14 days for spot spraying. Lactating cows or goats must not be grazed in treated areas.
Velpar L®	hexazinone	No stated withholding period
Verdict®	haloxyfop	1–4 weeks (see label)
Vigilant®	picloram	Nil

# Herbicide resistance

by Andrew Storrie

Herbicide resistance is the inherent ability of a weed to survive a herbicide that would normally control it. This is totally different from poor herbicide performance.

If herbicide resistance develops, other herbicides or other control methods may have to be used. These may be more expensive or less effective. Once developed, herbicide resistance will persist for many years.

Herbicides act by interfering with specific processes in plants. This is known as the herbicide's mode of action. Different herbicides may have the same mode of action.

## Herbicide groups, resistance risk and mode of action

Active ingredient	Example trade name	Group	Risk	Mode of Action
Fluazifop-P	Fusilade®	A	High	Inhibitors of fat (lipid) synthesis ACCase inhibitor
Haloxyfop-R	Verdict® 520	A	High	Inhibitors of fat (lipid) synthesis ACCase inhibitor.
Flumetsulam	Broadstrike®	B	High	Acetolactate synthase (ALS) inhibitor
Metsulfuron-methyl	various	B	High	ALS inhibitor
Sulfometuron-methyl	Oust® and various	B	High	ALS inhibitor
Bromoxynil	various	C	Moderate	Inhibitor of photosynthesis at photosystem II
Bromoxynil + MCPA	various	C + I	Moderate/ low	Inhibitor of photosynthesis at photosystem II/ Disrupter of plant cell growth
Bromoxynil + diflufenican	Jaguar®	C + F	Moderate	Inhibitor of photosynthesis at photosystem II / Inhibitor of carotenoid biosynthesis
Hexazinone	Velpar L® and various	C	Moderate	Inhibitor of photosynthesis at photosystem II
Tebuthiuron	Graslan®	C	Moderate	Inhibitor of photosynthesis at photosystem II
Amitrole + ammonium thiocyanate	Amitrole T® and various	F	Moderate	Inhibitor of carotenoid biosynthesis
Oxyfluorfen	Goal®	G	Low	Inhibitor of protoporphyrinogen oxidase
2,4-D amine and ester	various	I	Low	Causes elongation of terminal growth and plant cellular division
2,4-D + picloram	Tordon® 75-D	I	Low	Disrupter of plant cell growth
2,4-DB	Buttress®	I	Low	Causes elongation of terminal growth and plant cellular division
Clopyralid	Lontrel® and various	I	Low	Disrupter of plant cell growth
Dicamba	Banvel®	I	Low	Disrupter of plant cell growth
Dicamba + MCPA	Banvel M®	I	Low	Disrupter of plant cell growth
Dichlorprop	Lantana 600®	I	Low	Disrupter of plant cell growth
Fluroxypyr	Starane®	I	Low	Disrupter of plant cell growth
MCPA	various	I	Low	Disrupter of plant cell growth
Picloram	Tordon® Granules, Vigilant®	I	Low	Disrupter of plant cell growth
Triclopyr	Garlon® 600	I	Low	Disrupter of plant cell growth
Triclopyr + picloram	Grazon® DS Access®	I	Low	Disrupter of plant cell growth
Dichlobenil	various	K	Low	Multiple sites of action
Diquat	Reglone®	L	Low	Inhibitor of photosynthesis at photosystem I
Glyphosate	various	M	Low	Inhibitor of EPSP synthase
Glyphosate + metsulfuron	Cut-out®	M + B	Low/High	Inhibitor of EPSP synthase and ALS-methyl inhibitor
Glufosinate-ammonium	Basta®/Finale®	N	Low	Inhibitor of glutamine synthetase



# Control techniques using herbicides

Line Drawings by Lyn Skillings, QLD Natural Resources and Mines.

Herbicides are commonly used for controlling weeds in agricultural and non-agricultural situations. Numerous forms of application techniques and equipment are available to apply herbicides. The option chosen will be determined by the size of the infestation, the available resources, access and personal preferences. The most commonly used application techniques are listed and described below. Always remember to read the respective herbicide label or pesticide permit before use.

## Foliar spraying

Foliar spraying is the use of herbicide diluted with water or diesel at a specific rate, and sprayed over the foliage to the point of runoff (until every leaf is wetted, but not dripping).

This method is most suited to shrubs, grasses and dense vines less than 6 m tall so that complete coverage is achieved. Advantages include quickness and economy. Disadvantages include the potential for spray drift and off-target damage.

Foliar spraying can be done a number of ways, depending on the size of the weed plant and/or the infestation.

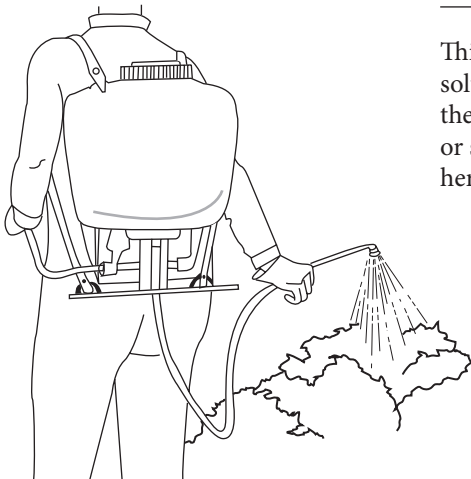


Figure 1: Foliar spraying using a knapsack.

Blanket spraying using a boom spray from a tractor or 4-wheel drive vehicle can be used to treat large areas completely infested with weeds, especially with selective herbicides. For large infestations that need targeted applications of herbicide, a hose and handgun can be used to spray solution from a herbicide tank and pump carried by a tractor or vehicle. Smaller infestations can be sprayed using a backpack/knapsack spray unit. Spot spraying is used to treat individual weed plants or areas that have only small clumps of weed infestations.

## Rope/wick applicators

This method of applying a herbicide consists of a wick or rope soaked in herbicide from a reservoir attached to a handle or pumped to the wick with 12-volt equipment. The wetted wick is used to wipe or brush herbicide over the weed. Commercially available equipment such as Weed Wand and Weed Wiper are used to kill weeds in this way.

It is sometimes necessary to provide some resistance for the wiper when the weed leaf or stem is soft. Stem swiping involves using a knife to provide resistance down the back of the stem or leaf, while wiping herbicide down the front.

## Basal bark application

This method involves mixing an oil soluble herbicide in diesel and spraying the full circumference of the trunk or stem of the plant. Diesel helps the herbicide move through the bark.

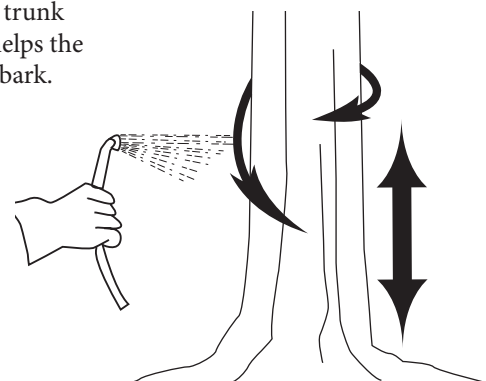


Figure 2: Basal bark application.

Basal bark spraying is suitable for thin-barked woody weeds and undesirable trees. Basal bark spraying is also an effective way to treat 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. It has the advantages of having little or no drift and it is a well targeted form of spraying. 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.

Refer to the product label for further details on application. Some species can only be treated up to 5 cm basal diameter, other species can be treated up to 10 cm basal diameter.

Do not use on if the basal diameter is greater than 10 cm.

Plants height at these stages should be between 30 to 100 cm. The larger the plant, the greater the area of bark that needs treating.

## Stem injection methods

These methods involve drilling or cutting through the bark into the sapwood tissue in the trunks of woody weeds and trees. Herbicide is immediately placed into the hole or cut. The aim is to reach the sapwood layer just under the bark (the cambium growth layer), which will transport the chemical throughout the plant.

It is essential to apply the herbicide **immediately** (within 15 seconds of drilling the hole or cutting the trunk), as stem injection relies on the active uptake and growth of the plant to move the chemical through its tissues.

### Stem injection – drill and fill method

This stem injection method is used for trees and woody weeds with stems or trunks greater than 5 cm in circumference. This method uses a battery-powered drill to make downward-angled holes into the sapwood approximately 5 cm apart. The placement of herbicide into the hole is usually made using a backpack reservoir and syringe that can deliver measured doses of herbicide solution.

Stem injection methods kill the tree or shrub where it stands, and only trees and shrubs that can be safely left to die and rot should be treated this way. If the tree or shrub is to be felled, allow it to die completely before felling.

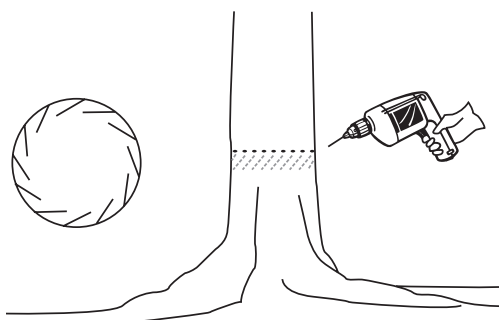


Figure 3: Stem injection, drill and fill method.

### Stem injection – axe cut method

This method involves cutting through the bark into the sapwood tissue in the trunk, and immediately placing herbicide into the cut. As with the drill and fill method, the aim is also to reach the tissue layer just under the bark (the cambium layer), which will transport the chemical throughout the plant.

The axe cut method can be used for trees and woody weeds with stems or trunks greater than 5 cm in circumference.

Using an axe or tomahawk, horizontal cuts are made into the sapwood around the circumference of the trunk at waist height. While still in the cut, the axe or tomahawk is leaned out to make a downward angled pocket, which will allow herbicide to pool. The herbicide is then immediately injected into the pocket. Cuts should be made no farther than 3 cm apart. This method – using an axe to make the cut – is often referred to as frilling or chipping.

It is important not to entirely ringbark the trunk, as this will decrease the uptake of the herbicide into the plant.

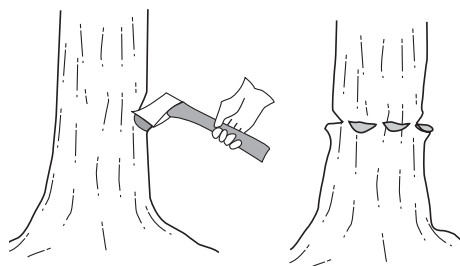


Figure 4: Stem injection, axe cut method.

## Tree spearing

Tree spearing is an alternative stem injection method to the use of an axe or drill. The method uses a specifically designed tree spear and technique. The spear is thrust into the tree at an angle of 30° to 40° from the vertical, opening a cut in the tree and applying the appropriate herbicide amount. Repeat the process, forming a row of cuts approximately 50 mm apart.

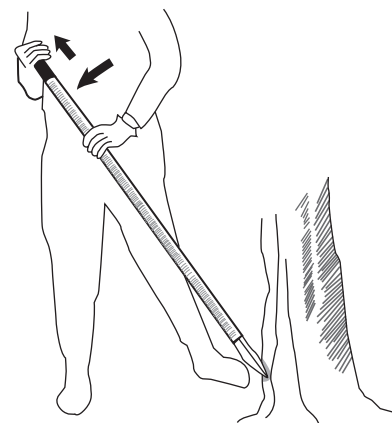
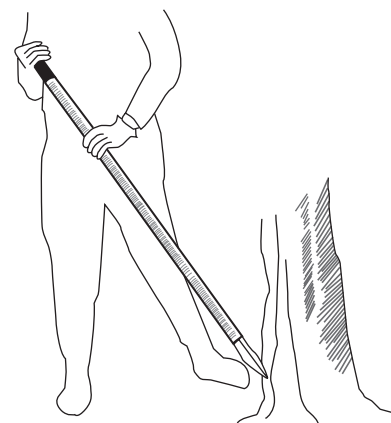


Figure 5: Stem injection, tree spearing.

## Cut stump

Here the plant is cut off completely at its base (no higher than 15 cm from the ground) using a chainsaw, axe, brushcutter or machete (depending on the thickness of the stem/trunk). A herbicide solution is then sprayed or painted on to the exposed surface of the cut stump emerging from the ground, with the objective of killing the stump and the root system.

It is imperative that the herbicide solutions are applied as soon as the trunk or stem is cut. A delay of more than 10 seconds for water-based herbicides and 1 minute for diesel soluble herbicides between cutting and applying the chemical will give poor results. Two operators working as a team can use this method effectively. The herbicide can be applied from a knapsack, or with a paintbrush, drench gun or a hand spray bottle. It is a good idea to use a brightly coloured dye in the solution to mark the stumps that have been treated.

This method has the appeal of removing the weed immediately, and is used mainly for trees and woody weeds.

Warning: Many species will sucker if treated by this method. For example, camphor laurel and paulownia.

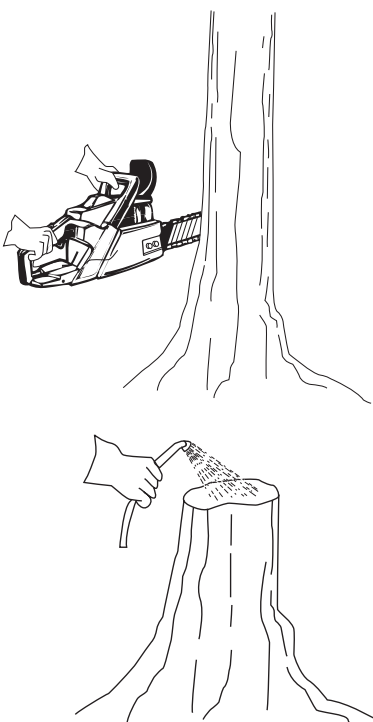


Figure 6: Cut stump method.

## Cut and swab

This method is similar to the cut stump method, but is suited to vines and multi-stemmed shrubs. Here, the plant stems are cut through completely, close to the ground. Herbicide is then applied immediately to the cut surface emerging from the ground, via spray or brush application.

In the case of Madeira vine and some other vines with aerial tubers, both ends of the cut stems must be treated with herbicide.

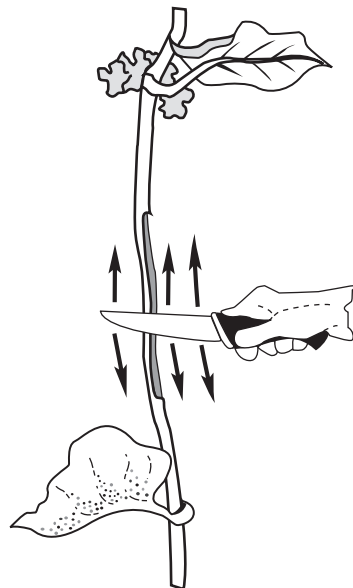


Figure 7a: Stem scrape method. A sharp knife is used to scrape the bark.

## Stem scrape

Stem scraping is used for plants and vines with aerial tubers. A sharp knife is used to scrape a very thin layer of bark from a 15–30 cm section of the stem (Figure 7a). Herbicide is then immediately applied to the exposed soft underlying green tissue (Figure 7b). In the case of Madeira vine, all tubers within reach should be collected, removed and composted or destroyed before you start the scraping.

This method is also called bark stripping or stem painting. With some woody weeds you can peel away the bark surface and paint the exposed wood or spray it with herbicide.

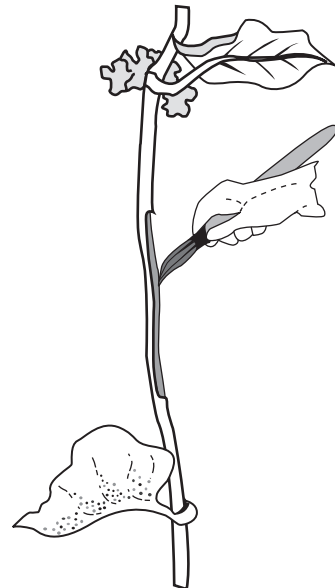


Figure 7b: Stem scrape method. Herbicide is applied to the green tissue.

# Weeds declared noxious in New South Wales

by Rod Ensbey and Stephen Johnson

The following weeds are currently declared noxious in New South Wales, as gazetted by Order number 20. All noxious weeds are divided into five Classes. To find the noxious weed and its category for your Local Control Authority area, consult:

[www.dpi.nsw.gov.au](http://www.dpi.nsw.gov.au)

## Schedule of Noxious Weeds

Common name	Botanical Name	Control Class
Anchored Water Hyacinth	<i>Eichhornia azurea</i>	C1
African Boxthorn	<i>Lycium ferocissimum</i>	C4
African Feather Grass	<i>Pennisetum macrourum</i>	C5
African Lovegrass	<i>Eragrostis curvula</i>	C4
African Olive	<i>Olea europaea</i> subspecies <i>cuspidata</i>	C4
African Turnip Weeds	<i>Sisymbrium runcinatum</i> <i>Sisymbrium thellungii</i>	C5
Alligator Weed	<i>Alternanthera philoxeroides</i>	C2, C3
Annual Ragweed	<i>Ambrosia artemisiifolia</i>	C5
Arrowhead	<i>Sagittaria montevidensis</i>	C5
Arundinaria Reed	<i>Arundinaria</i> spp.	C3
Artichoke Thistle	<i>Cynara cardunculus</i>	C5
Asparagus Fern	<i>Asparagus aethiopicus</i>	C4
Athel Pine	<i>Tamarix aphylla</i>	C5
Balloon Vine	<i>Cardiospermum grandiflorum</i>	C4
Bathurst Burr	<i>Xanthium spinosum</i>	C4
Bear-Skin Fescue	<i>Festuca gautieri</i>	C5
Bitou Bush	<i>Chrysanthemoides monilifera</i> subspecies <i>rotundata</i>	C2, C3, C4
Blackberry	<i>Rubus fruticosus</i> (spp. agg.)	C4
Black Knapweed	<i>Centaurea nigra</i>	C1
Black Willow	<i>Salix nigra</i>	C3
Blue Heliotrope	<i>Heliotropium amplexicaule</i>	C4
Blue Hound's Tongue	<i>Cynoglossum creticum</i>	C2
Boneseed	<i>Chrysanthemoides monilifera</i> subspecies <i>monilifera</i>	C2, C3, C4
Bridal Creeper	<i>Asparagus asparagoides</i>	C4, C5
Broad-Leaf Pepper tree	<i>Schinus terebinthifolius</i>	C3
Broomrapes	<i>Orobancha</i> spp. except <i>O. minor</i> and native <i>O. cernua</i> var. <i>australiana</i>	C1
Buffalo Burr	<i>Solanum rostratum</i>	C4
Burr Ragweed	<i>Ambrosia confertiflora</i>	C5
Cabomba	<i>Cabomba caroliniana</i>	C5
Californian Burr	<i>Xanthium orientale</i>	C4
Camel Thorn	<i>Alhagi maurorum</i>	C4
Camphor Laurel	<i>Cinnamomum camphora</i>	C4
Cape Broom	<i>Genista monspessulana</i>	C2, C3, C4
Cape Ivy	<i>Delairea odorata</i>	C4
Cape Tulips	<i>Moraea</i> spp.	C4
Castor Oil Plant	<i>Ricinus communis</i>	C3, C4
Cat's Claw Creeper	<i>Macfadyena unguis-cati</i>	C4
Cayenne Snakeweed	<i>Stachytarpheta cayennensis</i>	C5
Cherry Guava	<i>Psidium cattleianum</i>	C3

Common name	Botanical Name	Control Class
Chinese Celtis	<i>Celtis sinensis</i>	C3
Chinese Tallow Tree	<i>Triadica sebifera</i>	C3
Chinese Violet	<i>Asystasia gangetica</i> subspecies <i>micrantha</i>	C1
Chilean Needle Grass	<i>Nassella neesiana</i>	C3, C4
Clockweeds	<i>Gaura lindheimeri</i> <i>Gaura parviflora</i>	C5
Cineraria	<i>Cineraria lyratiformis</i>	C4
Climbing Asparagus Fern	<i>Asparagus plumosus</i>	C4
Cockle Burr	<i>Xanthium italicum</i>	C4
Cockspur Coral Tree	<i>Erythrina crista-galli</i>	C4
Columbus Grass	<i>Sorghum x almum</i>	C3, C4
Coolatai Grass	<i>Hyparrhenia hirta</i>	C3
Corn Sowthistle	<i>Sonchus arvensis</i>	C5
Creeping Knapweed	<i>Acroptilon repens</i>	C4
Crofton Weed	<i>Ageratina adenophora</i>	C4
Devil's Claw (Purple-flowered)	<i>Proboscidea louisianica</i>	C4
Devil's Claw (Yellow-flowered)	<i>Ibicella lutea</i>	C4
Dodder	All <i>Cuscuta</i> species except natives	C5
East Indian Hygrophila	<i>Hygrophila polysperma</i>	C1
Espartillo	<i>Achnatherum brachychaetum</i>	C5
Eurasian Water Milfoil	<i>Myriophyllum spicatum</i>	C1
European privet	<i>Ligustrum vulgare</i>	C4
Fine-Bristled Burr Grass	<i>Cenchrus brownii</i>	C5
Fireweed	<i>Senecio madagascariensis</i>	C4
Flax-Leaf Broom	<i>Genista linifolia</i>	C4
Fountain grass	<i>Pennisetum setaceum</i>	C5
Galenia	<i>Galenia pubescens</i>	C4
Gallons Curse	<i>Cenchrus biflorus</i>	C5
Giant Parramatta Grass	<i>Sporobolus fertilis</i>	C3, C4
Giant Rat's Tail Grass	<i>Sporobolus pyramidalis</i>	C3
Giant Reed/Elephant Grass	<i>Arundo donax</i>	C3, C4
Glaucous Star Thistle	<i>Carthamus glaucus</i>	C5
Golden Dodder	<i>Cuscuta campestris</i>	C4
Golden Thistle	<i>Scolymus hispanicus</i>	C5
Glory Lily	<i>Gloriosa superba</i>	C3
Gorse	<i>Ulex europaeus</i>	C2, C3
Green Cestrum	<i>Cestrum parqui</i>	C3
Grey Sallow	<i>Salix cinerea</i>	C3
Groundsel Bush	<i>Baccharis halimifolia</i>	C3
Harrisia Cactus	<i>Harrisia</i> spp.	C4
Hawkweeds	<i>Hieracium</i> spp.	C1
Hemlock	<i>Conium maculatum</i>	C4



Common name	Botanical Name	Control Class
Hoary Cress	<i>Cardaria draba</i>	C4
Honey Locust	<i>Gleditsia triacanthos</i>	C3
Horehound	<i>Marrubium vulgare</i>	C4
Horsetail	<i>Equisetum</i> spp.	C1
Hygrophila	<i>Hygrophila costata</i>	C2
Hymenachne	<i>Hymenachne amplexicaulis</i>	C1
Illyrian Thistle	<i>Onopordum illyricum</i>	C4
Italian bugloss	<i>Echium italicum</i>	C4
Johnson Grass	<i>Sorghum halepense</i>	C3, C4
Karoo Thorn	<i>Acacia karroo</i>	C1
Khaki Weed	<i>Alternanthera pungens</i>	C4
Kochia (other than Summer or Mock Cypress)	<i>Bassia scoparia</i> except subspecies <i>tricophylla</i>	C1
Kudzu	<i>Pueraria lobata</i>	C3
Lacy Ragweed	<i>Ambrosia tenuifolia</i>	C4
Lagarosiphon	<i>Lagarosiphon major</i>	C1
Lantana	<i>Lantana camara</i>	C3, C4, C5
Lantana (Creeping)	<i>Lantana montevidensis</i>	C3, C4, C5
Lippia	<i>Phyla</i> spp.	C4
Long-Style Feather Grass	<i>Pennisetum villosum</i>	C4
Long-leaf Willow Primrose	<i>Ludwigia longifolia</i>	C3, C4, C5
Ludwigia	<i>Ludwigia peruviana</i>	C3
Madeira Vine	<i>Anredera cordifolia</i>	C4
Mesquite	<i>Prosopis</i> spp.	C2
Mexican Feather Grass	<i>Nassella tenuissima</i>	C1
Mexican Poppy	<i>Argemone mexicana</i>	C5
Miconia	<i>Miconia</i> spp.	C1
Mimosa	<i>Mimosa pigra</i>	C1
Mintweed	<i>Saliva reflexa</i>	C4
Mistflower	<i>Ageratina riparia</i>	C4
Montbretia	<i>Crococsmia x crocosmiiflora</i>	C4
Morning Glory (Coastal)	<i>Ipomea cairica</i>	C4
Morning Glory (Purple)	<i>Ipomea indica</i>	C4
Mossman River Grass	<i>Cenchrus echinatus</i>	C5
Moth Vine	<i>Araujia sericifera</i>	C4
Mother-of-Millions	<i>Bryophyllum</i> spp. and hybrids	C3, C4
Mysore Thorn	<i>Caesalpinia decapetala</i>	C3
Nodding Thistle	<i>Carduus nutans</i>	C4
Noogoora Burr	<i>Xanthium occidentale</i>	C4
Ochna	<i>Ochna serrulata</i>	C4
Onion Grass	<i>Romulea</i> spp. except <i>R. rosea</i> var. <i>australis</i>	C5
Onion Weed	<i>Asphodelus fistulosus</i>	C4
Oxalis	<i>Oxalis</i> spp. except natives	C5
Parkinsonia	<i>Parkinsonia aculeata</i>	C2
Pampas Grass	<i>Cortaderia</i> spp.	C3, C4
Parthenium Weed	<i>Parthenium hysterophorus</i>	C1
Paterson's Curse	<i>Echium plantagineum</i>	C4
Pond Apple	<i>Annona glabra</i>	C1
Pellitory	<i>Parietaria judaica</i>	C4
Perennial Ragweed	<i>Ambrosia psilostachya</i>	C4
Perennial/Canada Thistle	<i>Cirsium arvense</i>	C4
Perennial Ground Cherry	<i>Physalis virginiana</i>	C3, C4
Prairie Ground Cherry	<i>Physalis viscosa</i>	C3, C4
Prickly Acacia	<i>Acacia nilotica</i>	C1

Common name	Botanical Name	Control Class
Prickly Pears (other than Indian fig)	<i>Cylindropuntia</i> spp., <i>Opuntia</i> spp. except <i>Opuntia ficus-indica</i>	C4
Privet (Broad-leaf)	<i>Ligustrum lucidum</i>	C4
Privet (Narrow-leaf/Chinese)	<i>Ligustrum sinense</i>	C4
Ragwort	<i>Senecio jacobaea</i>	C4
Red Rice	<i>Oryza rufipogon</i>	C5
Rhizomatous Bamboo	<i>Phyllostachys</i> spp.	C3, C4
Rhus Tree	<i>Toxicodendron succedaneum</i>	C4
Rubber Vine	<i>Cryptostegia grandiflora</i>	C1
Saffron Thistle	<i>Carthamus lanatus</i>	C4
Sagittaria	<i>Sagittaria platyphylla</i>	C4, C5
Salvinia	<i>Salvinia molesta</i>	C2, C3
Sand Oat	<i>Avena strigosa</i>	C5
Scotch/English Broom	<i>Cytisus scoparius</i>	C4
Scotch Thistle	<i>Onopordum acanthium</i>	C4
Senegal Tea Plant	<i>Gymnocoronis spilanthoides</i>	C1
Senna	<i>Senna pendula</i>	C4
Serrated Tussock	<i>Nassella trichotoma</i>	C3, C4
Siam Weed	<i>Chromolaena odorata</i>	C1
Sifton Bush	<i>Cassinia arcuata</i>	C4
Silk Forage Sorghum	<i>Sorghum</i> sp. hybrid cultivar	C3, C4
Silver-Leaf Nightshade	<i>Solanum elaeagnifolium</i>	C3, C4
Smooth-Stemmed Turnip	<i>Brassica barrelieri</i> subspecies <i>oxyrrhina</i>	C5
Soldier Thistle	<i>Picnomon acarna</i>	C5
Spanish Broom	<i>Spartium junceum</i>	C4
Spiny Burr Grasses	<i>Cenchrus incertus</i> <i>Cenchrus longispinus</i>	C4
Spiny Emex	<i>Emex australis</i>	C4
Spotted Golden Thistle	<i>Scolymus maculatus</i>	C4
Spotted Knapweed	<i>Centaurea maculosa</i>	C1
St. Barnaby's Thistle	<i>Centaurea solstitialis</i>	C4
St. John's Wort	<i>Hypericum perforatum</i>	C3, C4
Star Thistle	<i>Centaurea calcitrapa</i>	C4
Stemless Thistle	<i>Onopordum acaulon</i>	C4
Sweet Briar	<i>Rosa rubiginosa</i>	C4
Sweet Pittosporum	<i>Pittosporum undulatum</i>	C3
Taiwan Lily	<i>Lilium formosanum</i>	C4
Taurian Thistle	<i>Onopordum tauricum</i>	C4
Texas Blueweed	<i>Helianthus ciliaris</i>	C5
Tiger Lily	<i>Lilium formosanum</i>	C4
Trad/Wandering Jew	<i>Tradescantia albiflora</i>	C4
Tree-of-Heaven	<i>Ailanthus altissima</i>	C4
Turkey Rhubarb	<i>Acetosa sagittata</i>	C4
Tussock Paspalum	<i>Paspalum quadrifarium</i>	C3
Vipers bugloss	<i>Echium vulgare</i>	C4
Water Caltrop	<i>Trapa</i> spp.	C1
Water Hyacinth	<i>Eichhornia crassipes</i>	C2, C3, C4
Water Lettuce	<i>Pistia stratiotes</i>	C1
Water Soldier	<i>Stratiotes aloides</i>	C1
Wild Radish	<i>Raphanus raphanistrum</i>	C4
Willows (other than Weeping and two Pussy Willows)	<i>Salix</i> spp. except <i>S. babylonica</i> , <i>S. x calodendron</i> , <i>S. x reichardtii</i>	C5

Common name	Botanical Name	Control Class
Witchweeds	<i>Striga</i> spp. except native <i>S. parviflora</i>	C1
Yellow Bells	<i>Tecoma stans</i>	C3
Yellow Burrhead	<i>Limnocharis flava</i>	C1
Yellow Nutgrass	<i>Cyperus esculentus</i>	C5

## Weed control classes

The following weed control classes may be applied to a plant by a weed control order:

Control Class	Weed type	Example control requirements
Class 1	Plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also 'notifiable' and a range of restrictions on their sale and movement exist.
Class 2	Plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.	The plant must be eradicated from the land and the land must be kept free of the plant. The weeds are also 'notifiable' and a range of restrictions on their sale and movement exist.
Class 3	Plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.	The plant must be fully and continuously suppressed and destroyed.*
Class 4	Plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.*
Class 5	Plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.	There are no requirements to control existing plants of Class 5 weeds. However, the weeds are 'notifiable' and a range of restrictions on their sale and movement exist.

\* In some cases the following wording has also been inserted 'the plant may not be sold, propagated or knowingly distributed'.

All Class 1, 2 and 5 weeds are notifiable weeds. All outbreaks of these weeds must be reported to the local control authority within three days of discovery. They are also prohibited from sale or purchase in any area of NSW.

# Pesticide permits

by Rod Ensbey

Pesticide permits allow for the use of an off-label recommendation of a registered herbicide.

In making a decision whether or not to issue a permit, the Australian Pesticides & Veterinary Medicines Authority (APVMA) must balance the need for the permit against known and uncertain scientific and other factors.

This is particularly the case in respect of the stability and efficacy of a product for a particular purpose and the extent to which use of the product might jeopardise trade.

It is therefore important before using an active constituent or a chemical product under a permit issued by the APVMA that the users make their own judgement

as to the suitability, effectiveness and safety of the intended use and effect that use of the chemical may have on trade and do so at their own risk. It is also important for the user to obtain a copy and read the permit before use.

The following list comprises permits mentioned in this publication.

Weed	Permit	Active ingredient	Expiry date
Alligator weed	PER8674	Metsulfuron methyl	30-09-2010
	PER6709	Metsulfuron methyl	30-06-2008
	PER7360	Metsulfuron methyl	30-06-2008
	PER7249	Metsulfuron methyl	30-06-2009
	PER8211	Metsulfuron methyl	30-06-2010
	PER9138	Metsulfuron methyl	01-02-2009
	PER7033	Metsulfuron methyl	30-06-2009
Blue Heliotrope	PER 8443	Glyphosate	03-10-2009
	PER 8444	Metsulfuron methyl	03-10-2010
Bitou Bush	PER6387 (NPWS)	Glyphosate	31-12-2008
Broad Leaf Pepper tree	PER6411	Fluroxypyr	17-11-2008
Cactus	PER6500	Triclopyr	30-06-2008
		Triclopyr + Picloram	
Chinese Celtis		Glyphosate	
Chilean Needle Grass	PER7852	Glyphosate	30-09-2009
Chinese Tallow	PER9037	Metsulfuron methyl	19-01-2011
		Triclopyr + Picloram	
Chinese Violet	PER6964	Glyphosate	31-01-2009
	PER6748	Dicamba+MCPA	31-10-2008
Coolatai grass	PER7883	Glyphosate	30-09-2009
		Flupropanate	
Environmental Weeds	PER 9158	Glyphosate	31-03-2010
	PER 5206 (NPWS)	Metsulfuron Methyl & Glyphosate	31-03-2007
	PER8798	Triclopyr	13-10-2010

Weed	Permit	Active ingredient	Expiry date
Giant Parramatta grass	PER6675	Glyphosate	07-08-2008
Green Cestrum	PER7859	Triclopyr	30-06-2009
Horsetail	PER6169	Dichlobenil	31-03-2008
Hygrophila	PER7343	Glyphosate	30-06-2009
		Metsulfuron Methyl	
Kudzu	PER7278	Metsulfuron Methyl	30-06-2009
		Triclopyr + Picloram	
Lippa	PER6827	Various	30-09-2008
Ludwigia	PER 6199	2,4-D amine	31-01-2008
Long Leaf Willow Primrose	PER7344	Glyphosate	30-06-2009
Ludwigia	PER6199	2,4-D Amine	31-01-2008
	PER7381	2,4-D Amine	30-06-2009
Mesquite	PER7395	Picloram + Triclopyr	30-06-2009
Mimosa Bush	PER6326	Clopyralid	20-10-2008
Sagittaria	PER6875	Glyphosate	17-11-2008
	PER8480	Glyphosate	30-06-2008
Salvinia	PER 7000	Glyphosate	31-01-2008
	PER7784	Glyphosate	31-12-2007
	PER5283	Glyphosate	31-12-2007
Senegal Tea plant	PER 7343	Metsulfuron methyl Glyphosate	30-06-2008
Serrated Tussock	PER9198	Flupropanate	01-02-2009
Serrated Tussock	PER 6675	Glyphosate	07-08-2008
St Johns Wort	PER 5031	Fluroxypyr	31-03-2007

Some of the chemical use patterns quoted in this publication are approved under Permits issued by the APVMA and in force at the time the publication was prepared. Persons wishing to use a chemical in a manner approved under Permit should obtain a copy of the relevant Permit from the APVMA and must read all details, conditions and limitations relevant to that Permit, and must comply with the details, conditions and limitations prior to use.

NPWS – National Parks and Wildlife staff only.

# Noxious and environmental weed control

by Rod Ensbey and Annie Johnson

Registration of a pesticide is not a recommendation from NSW DPI for the use of a specific pesticide in a particular situation. Users must satisfy themselves that the pesticide they choose is the best one for the situation and weed. Users must also carefully study the container label before using any pesticide, so that specific instructions relating to the rate, timing, application and safety are noted. This publication is presented as a guide to assist users in planning their weed control.

**Only herbicides registered for use in non cropping areas are listed on the following pages. If there is any omission or error in this list of chemicals please notify the authors.**

## Product names and alternatives

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product does not imply endorsement by NSW DPI over any other equivalent product from another manufacturer.

Abbreviation	Details
/ha	per hectare (10 000 m <sup>2</sup> )
g (kg)	gram (kilogram)
L (mL)	litre (millilitre)
g/L (g/kg)	grams per litre (grams per kilogram)
m (m <sup>2</sup> )	metre (square metre)
Various trade names	There are a number of products on the market with this active ingredient registered for control of this weed..
Various trade names and formulations	There a number of products with this active ingredient, some with alternate formulations (concentration) registered for control of this weed. e.g. glyphosate 360 g/L, glyphosate 450 g/L. Alternate formulations will have a different application rate. Always check the label.
Various trade names for aquatic use only	Only use products with this active ingredient that are registered for use around aquatic areas e.g. Roundup® Biactive.

## African Boxthorn – *Lycium ferocissimum*

**Non-chemical option:** Pull out large old bushes when soil is wet (winter) and spray regrowth.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL per 100 L of water	Apply when bushes have good leaf cover, growth and <b>no leaf fall</b> .
	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L per 60 L of diesel	Apply as basal bark up to 5 cm basal diameter. Cut stump application for over 5 cm diameter.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	1.3 L per 100 L of water	Small bushes only. Spray soil to drip line. Thorough coverage is essential.
	<b>Glyphosate</b> 360 g/L Various trade names and formulations	0.7–1.0 L per 100 L	Low rate on young bushes, high water rate on mature bushes.
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate for 1.5 parts of water	Drill/axe cut or stem injection.
	<b>Triclopyr</b> 600 g/L Various trade names	1.0 L per 30 L of diesel	Cut stump/basal bark application.
	<b>Tebuthiuron</b> 200 g/kg Graslan®	2 g per m <sup>2</sup>	Estimate the area within 30 cm beyond the drip line of the target plant and calculate the amount of Graslan required. <b>Do not apply near desirable trees.</b>
	<b>Hexazinone</b> 250 g/L Various trade names	Undiluted (1–4 mL per spot)	Bushes up to 3 m tall. One spot per metre height. <b>Do not apply near desirable trees.</b>
	<b>Picloram</b> 20 g/kg Tordon® Granules	35–45 g per m <sup>2</sup>	Apply only when good rainfall is expected to wash herbicide into root zone.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).



## African Lovegrass – *Eragrostis curvula*

**Non-chemical option:** Pasture improvement and grazing management will reduce re-establishment. Minimal soil disturbance required.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names and formulations	1.0 L per 100 L of water	Actively growing plants.
<b>Sulfometuron-methyl</b> 750 g/kg Various trade names	40 or 80 g per 100 L of water 0.4 or 0.8 kg/ha	Spot spray. Spray to point of wet. Boom application.
<b>Flupropanate</b> 745 g/L Various trade names	200–300 mL per 100 L of water 2.0–3.0 L/ha	Spot spray application. Aerial and boom application. Apply January to June.
<b>Hexazinone</b> 250 g/L Various trade names	13.0–18.0 L/ha	Has residual activity. <b>DO NOT</b> apply if desirable plants are in close proximity.

## African Olive – *Olea europaea ssp. africana*

**Non-chemical options:** Hand remove seedlings.

Chemical and concentration	Rate	Comments
<b>Triclopyr</b> 600 g/L Various trade names	4.0 L per 60 L diesel	Basal bark application up to 5cm basal diameter or cut stump application over 5 cm.
PER 9158 <b>Glyphosate</b> 360 g/L Various trade names	100–130 mL per 10 L of water	Spray seedlings / coppice shoots.
	1 part glyphosate per 1.5 parts of water	Cut stump, stem scrape or injection, Saplings or large trees and shrubs.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3-5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Algae – *Cyanobacteria*

Chemical and concentration	Rate	Comments
<b>Copper</b> 107 g/L Coptrol®	0.56–8.4 L / 1000 m <sup>2</sup>	See label dilution rate table. Apply in bright sunlight and when algae is first evident.

## Alligator Weed – *Alternanthera philoxeroides*

A Class 2 notifiable noxious weed that must be reported to Local Control Authorities and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Biological control agents are effective in some core coastal wetland situations for the aquatic plant form. See the National Alligator Weed Control Manual and Agfact P7.6.46 *Alligator Weed* for further information.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	10 mL per 1 L of water	Spot spray. Actively growing from summer through winter, floating form only.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g per 100 L of water	<b>Apply in terrestrial situations only.</b> A minimum of 2 years' spraying is required to achieve complete control.
PER 7360 <b>Metsulfuron methyl</b> 600 g/kg Various trade names also PER 6709, 7249, 8211	10 g per 100 L of water	Spot spray application for restricted use in aquatic situations, under permit. See permits for details.

## Arundinaria – *Arundinaria* spp.

**Non-chemical options:** Physical removal gives best results.

	Chemical and concentration	Rate	Comments
PER 9158	<b>Glyphosate</b> 360 g/L	200 mL per 10 L of water	Spot spray. Spray regrowth up to 0.5 m only.
	Various trade names	1 part glyphosate in 1.5 parts water	Cut stump. Retreatment necessary.

## Asparagus spp. ground, climbing and fern – *Asparagus aethiopicus*, *A. plumosus*, *A. africanus*

**Non-chemical options:** Mechanically remove rhizomes where possible.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L	200 mL glyphosate per 10 L of water	Spot spray application, best done between flowering and berries forming.
	Various trade names for aquatic use only	1–2 g metsulfuron methyl per 10 L of water	
	<b>Metsulfuron methyl</b> 600 g/kg	200 mL glyphosate plus	Gouge rhizome and paint.
	Various trade names	1.5 g metsulfuron methyl per 10 L of water	
		Undiluted glyphosate	

## Azolla – *Azolla filiculoides*

**Non-chemical options:** Small infestations can be mechanically removed.

	Chemical and concentration	Rate	Comments
	<b>Diquat</b> 200 g/L	400 mL per 100 L of water	Spray to wet all foliage thoroughly, add Agral 600. <b>Observe withholding period.</b>
	Various trade names	5.0–10.0 L/ha	
	<b>Calcium dodecyl benzene sulfonate</b> 300g/L	1 part per 19 parts kerosene (1.0 L of mixture /100 m <sup>2</sup> )	Sprinkle onto free floating plants and adjacent water surface lightly, just enough to change their normal colour.
	Immerse®		
	<b>Orange Oil</b>	1.0 L per 100 L of water	Spray on to free-floating plants.
	Water Clear®		

## Bathurst Burr – *Xanthium spinosum*

**Non-chemical options:** Slash before flowering. Maintain competitive pastures.

	Chemical and concentration	Rate	Comments
	<b>2,4-D amine</b> 500 g/L	1.0–1.4 L/ha	Boom application. Seedlings only, actively growing.
	Various trade names		
	<b>Dicamba + MCPA</b> 80 g/L + 340 g/L	60 mL per 15 L of water	Knapsack spray.
	Various trade names	190–270 mL per 100 L of water	High volume spot spray.
		2.8–4.0 L/ha	Boom spray. For use in grass pastures.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L	1.0 L/ha	Can be used in summer cereals.
	Tordon® 75-D		
	<b>Metsulfuron methyl</b> 600 g/L	5.0 or 7.5 g per 100 L of water	Apply to actively growing plants up to early flowering. Use higher rate when plants are beyond early flowering.
	Brushkiller 600® and some products		
	<b>Fluroxypyr</b> 200 g/L	75 mL per 100 L of water	Apply to actively growing plants.
	Various trade names		
	<b>Ametryn</b> 500 g/L	75 mL per 15 L of water	Knapsack spray. Spray plants to point of run off.
	Various trade names	550 mL per 100 L of water	High volume spray. Add wetter to mix. See label.
	<b>MSMA</b> 800 g/L	1.0 L per 100 L of water	Spot spraying
	Various trade names	10.0–12.0 L/ha	Boom spraying

## Balloon Vine – *Cardiospermum grandiflorum*

**Non-chemical options:** Seedlings can be manually removed.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	200 mL glyphosate per 10 L of water	Spot spray seedlings.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L of water.	Foliar application. Repeat treatments required.
		1 part glyphosate to 1.5 parts water	Cut and scrape application.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Bamboo – *Bambusa* spp.

**Non-chemical options:** Physical removal will give best results.

	Chemical and concentration	Rate	Comments
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water	Spot spray. Spray regrowth up to 0.5 m height only. Retreatment necessary.
		Undiluted	Cut stump application.
	<b>Glyphosate</b> 360 g/L Various trade names	10 mL per 1 L of water.	Foliar application between 1 and 2 m tall.
		1 part glyphosate to 6 parts water	Cut stump method.

## Bitou Bush/Boneseed – *Chrysanthemoides monilifera*

**Non-chemical options:** Hand removal of young plants, encourage native regeneration and integrate the use of biological control agents. Fire can be effective, where practical. For further information see the National Bitou Bush Control Manual.

	Chemical and concentration	Rate	Comments
	<b>Glyphosate</b> 360 g/L Various trade names	5 or 10 mL per 1 L of water	Handgun or knapsack. Spray to wet all foliage. Apply at peak flowering to actively growing bushes during winter. Do not apply during periods of drought stress. Use the higher rate for plants over 1.5 m.
PER 6387	<b>Glyphosate</b> 360 g/L Various trade names	2.0 L/ha	Aerial boom application
		0.5–1.0 L per 100 L of water	Aerial spot spray application.
	<b>Metsulfuron methyl + glyphosate</b> 63.2 g/kg + 760.5 g/kg Cut-out®	1 measured pack (95 g) per 100 L of water	Spray to wet all foliage thoroughly.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL per 100 L of water	Spray to wet all foliage thoroughly.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Black Willow – *Salix nigra*

**Non-chemical options:** Mechanical removal or use the cut-stump method of treatment.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access <sup>®</sup>	1.0 L per 60 L of diesel	Cut stump application method.
<b>Picloram</b> 45 g/kg Vigilant <sup>®</sup>	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Blackberry – *Rubus fruticosus* (agg.)

**Non-chemical options:** Slashing of juvenile bushes, use of goats will give some control. Biological control agents are also available. Improve pastures with a vigorous perennial species.

Chemical and concentration	Rate	Comments	
<b>Triclopyr + picloram</b> 200 g/L + 100 g/L Tordon <sup>®</sup> DSH	500 mL per 100 L of water	Late spring to autumn treatment. Use an adjuvant.	
<b>Glyphosate</b> 360 g/L Various trade names	10–13 mL per 1 L of water	Flowering to leaf fall. Use higher rate on old, dense infestations.	
<b>Glyphosate + metsulfuron methyl</b> 835 g/kg + 10 g/kg Trounce <sup>®</sup>	1 measured pack (173 g) per 100 L of water	Apply from flowering until before leaf yellowing. Do not apply to bushes with mature fruit.	
<b>Metsulfuron methyl + glyphosate</b> 63.2 g/kg + 760.5 g/kg Cut-out <sup>®</sup>	1 measured pack (95 g) per 100 L of water	Apply between January and April when bushes are actively growing. Do not apply to bushes with mature fruit.	
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g per 100 L of water	Apply when bushes are actively growing. Thoroughly wet all foliage and canes at commencement of flowering.	
<b>Metsulfuron methyl + picloram</b> 200 g/L + 240 g/L Crossbow <sup>®</sup>	30 g Part A plus 0.15 L part B per 100 L of water plus wetter.	Wet all foliage and canes. DO NOT apply to plants with mature fruit.	
<b>Hexazinone</b> 250 g/L Velpar L <sup>®</sup> and various trade names	Undiluted (4 mL per spot)	Bushes up to 1 m in height.	
<b>Picloram</b> 20 g/kg Tordon <sup>®</sup> Granules	35–45 g /m <sup>2</sup>	Apply granules over an area extending from main stem to 30 cm outside the drip line.	
<b>Triclopyr</b> 600 g/L Various trade names	170 mL per 100 L of water	Late spring to early autumn. Actively growing bushes. <b>Do not use under dry conditions.</b>	
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350 or 500 mL per 100 L of water	Late spring to early autumn when bushes are actively growing. Use the higher rate on plants which have been damaged by grazing stock or insects.	
<b>Picloram</b> 45 g/kg Vigilant <sup>®</sup>	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).	
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate to 1.5 parts water 1.0–2.0 g per 10 L of water	Cut and scrape application. Knapsack spot spray.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names		



## Black Knapweed – *Centaurea nigra*

**Non-chemical options:** Dig out single plants. Improve pastures with a vigorous perennial species.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	10 mL per 1 L of water	Spot spray on non-crop land – aquatic areas, dams, irrigation channels and banks.

## Blue Heliotrope – *Heliotropium amplexicaule*

**Non-chemical options:** Dig out single plants. Improve pastures with a vigorous perennial species. See the *Blue Heliotrope* Agfact P7.6.45 for further information.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL per 100 L of water	Apply at flowering in a minimum spray volume of 1250 L/ha.
<b>Dicamba</b> 500 g/L Various trade names	130 mL per 15 L of water 0.6 L per 100 L of water 8.8 L/ha	Knapsack spray. High volume spot spray. Boom spray. Apply to young, actively growing plants.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	1.0 L per 100 L of water	Grass pastures only. Spot spray. Apply to young actively growing plants.
<b>Fluroxypyr</b> 200 g/L Various trade names	1.0 L per 100 L of water	Spot spray. Apply during flowering.
<b>Tebuthiuron</b> 200 g/kg Graslan®	0.5 g/m <sup>2</sup>	<b>Do not use within 30 m of trees. Do not apply to areas greater than 0.5 hectares in size.</b>
<b>PER 8444</b> <b>Metsulfuron methyl</b> 600 g/L Various trade names	10 g per 100 L of water	Plus 0.1% surfactant. Spot spray. Apply when plants are actively growing spring to autumn.
<b>PER 8443</b> <b>Glyphosate</b> 360 g/L Various trade names	1.0 L per 100 L of water 2.0 L/ha	High volume/spot spray. Actively growing plants, late spring to autumn at commencement of flowering and before seed set.
<b>Glyphosate</b> 450 g/L Various trade names	1.6–2.0 L/ha	<b>Do not apply to stressed plants.</b>

## Bracken Fern – *Pteridium esculentum*

**Non-chemical options:** Manually remove small or individual plants

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names	1.5 L per 100 L of water 9.0 L/ha	Apply during autumn at full front expansion, while plants are actively growing. Repeat treatments necessary. Wiper application is also recommended. Add surfactant.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g per 100 L of water 60 g/ha	Spot spray. Boom spray. Spray after full front expansion. Avoid spraying when plants are in stress.
<b>Metsulfuron methyl + picloram</b> 200 g/kg + 240 g/L Crossbow®	30 g part A plus 150 mL of part B (see label)	Spray thoroughly to wet all foliage but not to cause run off.

## Bridal Creeper – *Asparagus asparagoides*

**Non-chemical options:** Dig out all tubers and burn. A biocontrol fungus is also available.

Chemical and concentration	Rate	Comments
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	5 g per 100 L of water	Spot spray.

## Branched Broomrape – *Orobanche ramosa*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244). *O. ramosa* is a parasite and is notifiable in all States.

**Non-chemical options:** Plant should be carefully removed with host plant and sealed in bag to avoid seed dispersal. Mark the site for further inspections at a later date.

There are no chemical registrations for control of the growth of this parasite. A permit exists for decontamination of spores on machinery and footwear.

## Broad Leaf Pepper Tree – *Schinus terebinthifolius*

**Non-chemical options:** Small seedling plants can be removed manually. See Agnote DPI 424, *Broad leaf pepper tree: identification and control*.

	Chemical and concentration	Rate	Comments
PER 6411	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate to 1 part water	Stem injection/cut stump application.
	<b>Fluroxypyr</b> 200 g/L Various trade names	35 mL per 1 L of diesel	Basal bark application.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Buffalo Burr – *Solanum rostratum*

**Non-chemical options:** Grub out single plants.

	Chemical and concentration	Rate	Comments
	<b>2,4-D ester</b> 600 g/L Various trade names and formulations	0.9–1.3 L/ha	Use in grass pastures only. Seedling to pre-flowering. Use higher rate as plants mature.

## Cabomba – *Cabomba* (spp.)

**Non-chemical options:** Physical removal is recommended where appropriate. Draining and drying in suitable situations can control plants. Contain infestations to avoid further spread. See Agnote DPI-330, *Identification and Management of Cabomba*.

There are no registered herbicides for this plant.

## Californian Burr and Cockle Burr – *Xanthium orientale* and *Xanthium italicum*

**Non-chemical options:** Slash before flowering. There are a number of biological control agents that work in selected areas and situations.

	Chemical and concentration	Rate	Comments
	<b>2,4-D amine</b> 500 g/L Various trade names and formulations	100–140 mL per 100 L of water 1.0–1.4 L/ha	Spot spray. Boom spray. Seedlings only.
	<b>2,4-DB</b> 400 g/L Various trade names	2.8–3.5 L/ha	Boom spray. Seedlings to young plants.
	<b>Ametryne</b> 500 g/L Various trade names	100 mL per 15 L of water 720 mL per 100 L of water	Knapsack spray. High volume spot spray. Add Plus 50 wetter. Use near 2,4-D susceptible crops

## Camel Thorn – *Alhagi pseudalhagi*

**Non-chemical options:** This is a difficult plant to control by mechanical means because of its growth habit.

There are no registered herbicides for this plant.

## Camphor Laurel – *Cinnamomum camphora*

**Non-chemical options:** Physical removal and treat the cut stump. See the *Camphor Laurel* Agfact P7.6.32 for further information.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350–500 mL per 100 L of water	Use higher rate on trees over 2 metres tall. Apply as a thorough foliage spray.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1 L per 60 L of diesel	Basal bark application for basal diameter less than 10 cm or cut stump application for greater than 10 cm.
<b>Triclopyr + picloram</b> 200 g/L + 100 g/L Tordon® DSH	1 part per 4 parts water (1–2 mL per cut)	Stem injection application.
<b>Triclopyr</b> 600g/L Various trade names	170 mL per 100 L of water 1 L per 60 L of diesel	Seedling to three metres tall. Basal bark or cut stump application.
<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate to 1 part water Undiluted	Stem injection for basal diameter up to 25 cm. Stem injection for basal diameter 25 cm to 60 cm.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Canna Lily – *Canna indica*

**Non-chemical options:** Small infestations can be manually removed

Chemical and concentration	Rate	Comments
PEP 5206 <b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	200 mL glyphosate per 10 L of water	Spot spray. Apply as foliar application. Spray regrowth after slashing.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	200 mL glyphosate plus 1.5 g metsulfuron methyl in 10 L of water
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump application. Apply a 3–5 mm layer of gel across the cut surface on the rhizome. (See label).

## Cape Broom – *Genista monspessulana*

**Non-chemical options:** Grazing, mechanical slashing and grubbing. If used as a hedge, must be prevented from flowering and fruiting.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	250 mL per 100 L of water or 350 mL per 100 L of water	Spring to mid summer prior to pod formation. Autumn to winter rate. Apply as a thorough foliage spray.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump application. Apply a 3–5 mm layer of gel across the cut surface on the rhizome. (See label).

## Cape Ivy – *Delairea odorata*

**Non-chemical options:** Runners can be rolled up and manually removed.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	200 mL per 15 L of water plus surfactant 1 part glyphosate to 1.5 parts water	Apply as foliar application. Scrape and paint stem. Take care not to sever stem.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L of water	Knapsack spray.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump application. Apply a 3–5 mm layer of gel across the cut surface on the rhizome. (See label).

## Cape Tulips – *Moraea* spp.

**Non-chemical options:** Cultivation is ineffective alone, renovate pastures after chemical treatment.

	Chemical and concentration	Rate	Comments
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	5 g/ha	Apply at bulb exhaustion, usually during July/early August. Repeat treatments may be required.
	<b>2,4-D ester</b> 600 g/L Various trade names and formulations	1.9–3.7 L/ha	Boom spray. Before flowering in grass pastures.

## Castor Oil Plant – *Ricinus communis*

**Non-chemical options:** Physical removal of mature plants.

	Chemical and concentration	Rate	Comments
	<b>2,4-D amine</b> 625 g/L Various trade names	340 mL per 150 L of water 3.4 L/ha	Spot spray application. Boom application. Spray at young seedling stage.
	<b>Triclopyr</b> 600 g/L Various trade names	1.0 L per 60 L of diesel	Cut stump/basal bark application.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Cat's Claw Creeper – *Macfadyena unguis-cati*

**Non-chemical options:** Difficult to manually control because of the root and rhizome system.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	200 mL per 15 L of water plus surfactant	Use surfactant in warmer areas. Pull down vine and spray. Cut stump/stem scrape application. Best during summer and autumn.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	1 part glyphosate to 1.5 parts water 200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L water	Knapsack spray.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Cherry Guava – *Psidium cattleianum*

**Non-chemical options:** Physical removal gives best results.

Chemical and concentration	Rate	Comments
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Chilean Needle Grass – *Nassella neesiana*

**Non-chemical options:** Good grazing management combined with a pasture improvement program is required for most effective control.

Chemical and concentration	Rate	Comments	
<b>Flupropanate</b> 745g/L Taskforce® and various trade names	0.1–0.3 L per 100 L of water. 1.5–3.0 L/ha	Boom application. Apply to actively growing plants.	
PER 4843	<b>Glyphosate</b> 360g/L Various trade names	150 mL glyphosate plus 200 mL flupropanate per 100 L of water	Spot spray application in spring and autumn. Spray til runoff.
	<b>Flupropanate</b> 745g/L Various trade names		

## Chinese Celtis – *Celtis sinensis*

**Non-chemical options:** Hand-pull young plants. See Agnote DPI-425, *Celtis: Identification and control*.

Chemical and concentration	Rate	Comments	
PER 6411	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate to 1 part of water	Stem injection application. Best during summer.
	<b>Fluroxypyr</b> 200 g/L Various trade names	35 mL per 1 L of diesel	Basal bark application.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).	

## Chinese Tallow – *Sapium sebiferum*

**Non-chemical options:** Seedlings and small trees may be manually removed.

Chemical and concentration	Rate	Comments	
PER 9037	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	1 g per 100 mL of water (2 mL per cut)	Stem injection.
	<b>Triclopyr + picloram</b> 200 g/L + 100 g/L Tordon® DSH	1 part Tordon® per 1.5 parts of water	Stem injection technique as per label.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).	



## Chinese Violet – *Asystasia gangetica* subspecies *micrantha*

**Non-chemical options:** Seedlings and small trees may be manually removed. See Weed Alert *Chinese Violet* from NSW DPI.

	Chemical and concentration	Rate	Comments
PER 6748	<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Banvel® M and various trade names	100 mL per 15 L of water (1 L/10 m <sup>2</sup> ) 6.5 L/ha	Spot spray application. Apply to actively growing weeds before seed set on the plants.
PER 6964	<b>Glyphosate</b> 360g/L Various trade names	1.0–2.0 L per 100 L of water	High volume foliar application.

## Cineraria – *Cineraria lyrata*

**Non-chemical options:** Mechanical control is the best means of control.

There are no herbicides currently registered for this plant.

## Cockspur Coral Tree – *Erythrina crista-galli*

**Non-chemical options:** Physical removal and treat stump.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L of water	Knapsack spot spray.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	1.0–2.0 g metsulfuron methyl per 10 L of water	Knapsack spot spray.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Columbus Grass – *Sorghum × almum*

**Non-chemical options:** Summer cultivation before heading will give some control.

	Chemical and concentration	Rate	Comments
	<b>Glyphosate</b> 450 g/L Various trade names and formulations	10 mL per 1 L of water	Apply at early flowering to actively growing plants.
	<b>Sulfometuron methyl</b> 750 g/kg Various trade names	40 or 80 g per 100 L of water	Apply evenly to the foliage of the weeds present. Spray to point of wet.
	<b>Flupropanate</b> 745 g/L Various trade names	1.0 L per 100 L of water	Apply when actively growing.

## Coolatai Grass – *Hyparrhenia hirta*

**Non-chemical options:** Individual plants can be hand pulled.

	Chemical	Rate	Comments
PER 7883	<b>Glyphosate</b> 360 g/L Various trade names	200 mL glyphosate in 10 L of water	Spot spray application. Can be used 2–3 times from September to May.
	<b>Flupropanate</b> 745g/L Various trade names	200 mL glyphosate plus 20 mL flupropanate per 10 L of water	Spot spray application between July and October. Only use the tank mix once per season.

## Cotoneaster – *Cotoneaster glaucophyllus*, *Cotoneaster pannosus*

**Non-chemical options:** Seedlings and small plants can be hand pulled. Ensure all roots are removed

	Chemical and concentration	Rate	Comments
PER 9158	<b>Glyphosate</b> 360g/L Various trade names	1 part glyphosate per 1.5 parts of water	Cut stump or drill/axe cut/inject.
PER 8798	<b>Triclopyr</b> 600 g/L Various trade names	5 L in 60 L of diesel.	Basal bark spraying or stem injection.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Crofton Weed – *Ageratina adenophora*

**Non-chemical options:** Well-managed and improved pastures will assist control. See the *Crofton weed* Agfact P7.6.36 for further information

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350 mL per 100 L of water	Spring to autumn. Spray all foliage to point of run-off. Actively growing plants.
	<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Banvel® M and various trade names	190–270 mL per 100 L of water 2.8–4.0 L/ha	Spray during active growth. For use in grass pastures.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL per 100 L of water	For use in grass pasture when weed is actively growing.
	<b>Glyphosate</b> 360 g/L Various trade names	500 mL per 100 L of water	Actively growing plants with full foliage.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	15 g per 100 L of water	Add surfactant. Thoroughly wet all foliage to point of run-off up to bud stage to prevent seed set.
	<b>Fluroxypyr</b> 200 g/L Various trade names	500 mL per 100 L of water	Apply to actively growing seedlings and young plants up to flowering.

## Cumbungi – *Typha* spp.

**Non-chemical options:** Small infestations can be mechanically removed.

	Chemical and concentration	Rate	Comments
	<b>Glyphosate</b> 360 g/L Various trade names	13 mL per 1 L of water	Spot spray application. Apply to actively growing plants at early flowering.
	<b>Amitrole</b> 250 g/L Various trade names	2.3 L per 100 L of water	Spot spray application. Apply during flowering between January and May.
	<b>2,2-DPA</b> 750 g/kg Propon®	1.0–2.0 kg per 100 L of water	Hand gun, spot spray application. For use in irrigation channels and bore drains.

## Devil's Claw – *Proboscidea louisianica*, *Ibicella lutea*

**Non-chemical options:** Mechanical removal or hoe single plants before pods form.

	Chemical and concentration	Rate	Comments
	<b>2,4-D ester</b> 600 g/L Various trade names and formulations	0.9 L/ha	Spray before pods form.

## Dodder – *Cuscuta* spp.

**Non-chemical options:** Quarantine the infestation and burn; maintain a grass pasture for a minimum period of 5 years to exhaust seed supply in the soil.

	Chemical and concentration	Rate	Comments
PER 4640	Diquat 200 g/L Reglone®	1 mL per 1 L of water	Spot spray. Spray at least 1 m radius around infestation.
		1.5–3.0 L/ha	Boom spray.
PER 4641	Glyphosate 360 g/L Various trade names	10 mL per 10 L of water	Spot spray. Spray at least 1 m radius around infestation.
		0.5–9.0 L/ha	Boom spray. Non-selective. Will damage other desirable plants. Re-treat as required.
	Metsulfuron methyl 600 g/kg Various trade names	1 g per 100 L of water	Apply as a spot spray to point of run before flowering.

## Duckweed – *Lemna minor*

**Non-chemical options:** Small infestations can be mechanically removed.

	Chemical and concentration	Rate	Comments
	Diquat 200 g/L Reglone®	400 mL in 100 L of water 5.0–10.0 L/ha	Spray to wet all foliage thoroughly, add Agral 600. <b>Observe withholding period.</b>
	Orange Oil Water Clear®	1.0 L per 100 L of water	Spray on to free-floating plants.

## Elodea – *Elodea canadensis*

**Non-chemical options:** Small infestations can be mechanically removed.

	Chemical and concentration	Rate	Comments
	Copper 110 g/L Cupricide® 110	0.5–1 mL of Copper	Follow label directions

## Fireweed – *Senecio madagascariensis*

**Non-chemical options:** Pasture improvement and proper grazing management will assist with control. See the *Fireweed* Agfact P7.6.26 for further information.

	Chemical and concentration	Rate	Comments
	Bromoxynil 200 g/L Various trade names	1.4 L/ha	Boom spray. Seedling application.
		2.8 L/ha	Boom spray. Early flowering application. In Pastures. Apply with low volume boom spray during autumn/winter when weeds are young and actively growing. <b>Do not cut or graze with stock for 14 days.</b>
	MCPA + diflufenican 250 g/L + 25 g/L Various trade names	1.0 L/ha	Suppression only. Best applied up to the four-leaf stage when the plant is actively growing.

## Fishbone Fern – *Nephrolepis cordifolia*

**Non-chemical options:** Dig out, burn. This plant has rhizomes, which are a means of spread.

	Chemical and concentration	Rate	Comments
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	100 mL glyphosate per 10 L of water	Add surfactant and apply as a spot spray.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	1.0–2.0 g metsulfuron methyl per 10 L of water + non ionic surfactant	Knapsack spot spray.
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	200 mL glyphosate per 10 L of water	Knapsack spot spray.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	1.0–2.0 g metsulfuron methyl per 10 L of water	
		200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L of water	

## Galenia – *Galenia pubescens*

**Non-chemical options:** A perennial prostrate or semi-prostrate plant that is difficult to control.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL per 100 L of water  5 L/ha	Fresh spring/summer growth. High volume spot spray, treat to visual wetness.  Boom spray. Apply in 2000 L water /ha. Rough mine sites require adequate equipment.

## Galvanised Burr – *Sclerolaena birchii*

**Non-chemical options:** Deep cultivation to bury the seed, with pasture improvement and grazing management, will give control.

	Chemical and concentration	Rate	Comments
	<b>Dicamba</b> 500 g/L Various trade names and formulations	130 mL per 15 L of water 600 mL per 100 L of water 8.8 L/ha	Knapsack spot spray. High volume spot spray. Boom spray. Use a minimum of 1500 L water /ha. Add a surfactant.
	<b>2,4-D amine</b> 500 g/L Various trade names and formulations	400 mL per 100 L of water	Apply to young, actively growing plants.
	<b>Dichlorprop</b> 600 g/L Lantana 600®	1.0 L per 100 L of water	Apply to young, actively growing plants.

## Giant Parramatta Grass – *Sporobolus fertilis*

**Non-chemical options:** Pasture improvement and proper grazing management will assist control. See *Giant Parramatta Grass control* Agnote DPI 354.

	Chemical and concentration	Rate	Comments
	<b>Flupropanate</b> 745 g/L Various trade names	200 mL per 100 L of water 2.0 L/ha	High volume spot spray. Boom spray. Best results during late winter and early spring when desirable species are semi-dormant. <b>Four-month withholding period for blanket spray application.</b>
PER 6675	<b>Glyphosate</b> 360 g/L Various trade names	1.0 L per 2 L of water	Wick wiper application. Apply when plant is actively growing.
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	10–15 mL per 1 L of water 6.0 L/ha	Spot spray. Apply when plants are actively growing. Boom application for pasture replacement/improvement and best done as a split treatment.
	<b>2,2-DPA</b> 740 g/kg Propon® and various trade names	1.0 kg per 100 L of water 5–10 kg/ha	Spot spray application. Boom spray application. Apply when plants are actively growing.

## Giant Rat's Tail Grass – *Sporobolus pyramidalis*

**Non-chemical options:** Pasture improvement and proper grazing management will assist control. See Agnote, *Giant Rat's Tail Grass Identification and Control*.

	Chemical and concentration	Rate	Comments
	<b>Flupropanate</b> 745 g/L Various trade names	200 mL per 100L of water 2.0 L/ha	Spot spray application. Boom spray. Best results during late winter and early spring when desirable species are semi-dormant. <b>Four month withholding period for blanket spray application.</b>
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	10–15 mL per 1 L water 6.0 L/ha	Spot spray. Apply when plants are actively growing. Boom application for pasture replacement/ improvement and best done as a split treatment. Apply when plants are actively growing.

## Giant Reed/ Elephant Grass – *Arundo donax*

**Non-chemical options:** Physical removal of small infestations is possible.

	Chemical and concentration	Rate	Comments
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	200 mL in 10 L of water 1 part glyphosate to 1.5 parts of water	Spot spray. Cut stump application.
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	Undiluted 200 mL per 10 L of water	Cut and paint stump. Spot spray. Spray regrowth.



## Glory Lily – *Gloriosa superba*

**Non-chemical options:** Physical removal for small infestations.

	Chemical and concentration	Rate	Comments
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water 1 part glyphosate to 1.5 parts of water	Spot spray. Spray regrowth. Cut stump/ scrape stem application.
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	200 mL glyphosate per 10 L of water	Knapsack spot spray, newly emerging plants. Spot spray application.
PER 5206	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L of water	

## Gorse – *Ulex europaeus*

**Non-chemical options:** Physical removal of large bushes. See *National Gorse Control Manual* for further information.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	250 or 350 mL per 100 L of water	Apply to actively growing plants. Use higher rate on bushes over 1.5 m high or as an autumn treatment.
		500 mL per 100 L of water	Winter treatment.
	<b>Triclopyr + picloram</b> 200 g/L + 100 g/L Tordon® DSH	375 mL per 100 L of water	September to March.
	<b>Triclopyr</b> 600 g/L Various trade names	170 or 340 mL per 100 L water	Add non-ionic surfactant. Spring to mid-summer, higher rate on older bushes.
	<b>Picloram</b> 45 g/kg	Undiluted	Cut stump application.
	<b>Glyphosate + metsulfuron methyl</b> 835 g/kg + 10 g/kg Trounce®	1 measured pack (173 g) in 100 L of water	Apply to bushes up to 2 m high when actively growing.
	<b>Metsulfuron methyl + glyphosate</b> 63.2 g/kg + 760.5 g/kg Cutout®	1 measured pack (95 g) in 100 L of water	Apply to bushes up to 2 m high when actively growing.
	<b>Glyphosate</b> 360 g/L Various trade names	1.0 L per 100 L of water	Add Pulse (wetting agent), apply to actively growing bushes. Spray to wet all foliage.
	<b>Metsulfuron methyl</b> 600 g/L Brushoff® <b>Glyphosate</b> 360 g/L Various trade names	10 g metsulfuron methyl plus 200 mL glyphosate in 100 L of water	Thorough spray for penetration and coverage of the whole bush. The use of an organosilicone penetrant is essential.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	15 g per 100 L of water	Apply to bushes up to two metres tall. Ensure thorough spray penetration and coverage of whole plant.
	<b>Metsulfuron methyl + picloram</b> 200 g/L + 240 g/L Crossbow®	30 g Part A plus 0.15 L Part B per 100 L water	Apply to plants less than 2 m tall. Add Pulse at 200 mL /100 L.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Green Cestrum – *Cestrum parqui*

**Non-chemical options:** A toxic plant in both the green and dead state. Physical removal is difficult because of the persistent regrowth from roots. See the *Cestrum Agfact* P7.6.44 for further information.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL per 100 L of water	Apply from late spring to early autumn. Any regrowth and seedlings must be resprayed when 1 m high.
	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L per 60 L of diesel	Basal bark application.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL per 100 L of water	Actively growing bushes in full leaf.
	<b>Amitrole + ammonium thiocyanate</b> 250 g/L + 220 g/L Various trade names	1.1 L per 100 L of water	Active growth, before flowering.
	<b>Triclopyr</b> 600 g/L Various trade names	170 mL per 100 L of water	Retreat regrowth the next season.
PER 7859	<b>Triclopyr</b> 600 g/L Various trade names	1.0 L per 30 L of diesel	DO NOT over treat as excessive run-off might affect adjacent trees and shrubs through root absorption.
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate to 1.5 parts water 100 mL per 10 L of water	Cut, scrape and paint. Spot spray.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Groundsel Bush – *Baccharis halimifolia*

**Non-chemical options:** Small plants can be manually removed, ensuring total root elimination. See the *Groundsel bush Agfact* P7.6.35 for further information.

	Chemical and concentration	Rate	Comments
	<b>2,4-D amine</b> 500 g/L Various trade names	400 mL per 100 L of water 300 mL per 15 L of water	Spray actively growing bushes. Thorough coverage. Cut stump application.
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	250 or 350 mL per 100 L of water	Use lower rate on bushes 1–1.5 m high in spring and summer; use higher rate on bushes over 1.5 m high in the autumn.
	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L per 60 L of diesel	Basal bark/cut stump application.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL per 100 L of water	Thorough coverage required on active growth.
	<b>Triclopyr</b> 600 g/L Various trade names	160 mL per 100 L of water 320 mL per 100 L of water	Seedlings 1 to 2 m tall. Bushes over 2 m tall.
	<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Various trade names	60 mL per 15 L of water 190–270 mL per 100 L of water 2.8–4.0 L/ha	Knapsack spray. High volume. In pastures. Use higher rate on larger bushes. Boom spray.
	<b>Glyphosate</b> 360 g/L Various trade names	700 mL to 1.0 L per 100 L of water	Actively growing bushes. <b>Do not apply during winter or summer drought stress.</b>
	<b>Clopyralid</b> 300 g/L Various trade names	330 or 350 mL per 100 L of water	Active growth, lower rate on seedlings, higher rate on bushes over 2 m high.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Hardhead Thistle (Creeping/Russian knapweed) – *Acroptilon repens*

**Non-chemical options:** Avoid cultivation, as it will increase plant populations from root pieces. See the Weed Alert

Chemical and concentration	Rate	Comments
<b>Dicamba</b> 500 g/L Various trade names	130 mL per 15 L of water 600 mL per 100 L of water 8.8 L/ha	Knapsack spray. High volume spot spray. Boom spray. Spray at flowering, using a minimum water rate of 1500 L/ha.
<b>Amitrole + ammonium thiocyanate</b> 250 g/L + 220 g/L Various trade names	1.1 L per 100 L of water	Actively growing plants before flowering.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	1.3 – 2.0 L per 100 L of water	Spot spray.

## Harrisia Cactus – *Harrisia* spp.

**Non-chemical options:** The use of the biological mealy-bug agent is recommended.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L per 60 L of diesel	Foliar application.
<b>Dichlorprop</b> 600 g/L Lantana 600®	1.0 L per 60 L of water	Good soil moisture essential and spray at fruiting.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	1.3-2.0 L per 100 L water	Spot spray.

## Hawkweeds – *Hieracium* spp.

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

There is no registered herbicide control for this plant.

## Hemlock – *Conium maculatum*

**Non-chemical options:** A toxic plant; avoid feeding animals fodder that may contain the plant.

Chemical and concentration	Rate	Comments
<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Various trade names	80 mL per 15 L of water 350 mL per 100 L of water 5.2 L/ha	Knapsack spray. High volume spot spray. Boom spray rate. Young active growth, repeat treatments may be necessary.
<b>2,4-D ester</b> 800 g/L Various trade names	0.7–1.4 L/ha	Spray from multiple leaf to rosette stage. See APVMA use restrictions on this product. May to September only.

## Hoary Cress – *Cardaria draba*

**Non-chemical options:** Because of the plant's root system, cultivation only aids its spread.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 500 g/L Various trade names and formulations	1.8–2.1 L/ha	In pastures. Boom spray. Spray at rosettes to pre-flowering.
<b>Dicamba</b> 500 g/L Various trade names	6 mL dicamba plus 12 mL 2,4-D amine per 15 L of water	Knapsack spray.
<b>2,4-D amine</b> 625 g/L Various trade names and formulations	50 mL dicamba plus 60 mL 2,4-D amine per 100 L of water	High volume spot spray.
	280 mL dicamba plus 640 mL 2,4-D amine /ha	Boom spray. For use in grass pastures. Add surfactant.
<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Various trade names	100 mL per 15 L of water. 470 mL per 100 L of water	Knapsack spray. High volume spot spray.
	4.0–7.0 L/ha	Boom spray. For use in grass pastures.
<b>Glyphosate</b> 360 g/L Various trade names	5 mL per 1 L of water 1.5 L/ha	Knapsack spot spray. Boom spray. July to September, late rosette to flowering.

## Honey Locust – *Gleditsia trianthos*

**Non-chemical options:** Mechanical control is possible but will require follow up treatments.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1 L per 60 L of diesel	Basal bark application for basal diameter less than 5 cm or cut stump application for above 5 cm.
<b>Fluroxypyr</b> 200 g/L Various trade names	500 mL per 100L of water 1.5 mL per 100 L of water 3.0 mL per 100 L of water 5.0 mL per 100 L of water 5 L per 100 L of diesel	Foliar application, up to 2 m in height. Plants up to 10 cm basal diameter. Plants 10–20 cm basal diameter. Plants above 20 cm basal diameter. Cut stump application.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Horehound – *Marrubium vulgare*

**Non-chemical options:** Cut, stack and burn small areas. Establish a vigorous pasture and use good grazing management.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 500 g/L Various trade names and formulations	700 mL – 2.1 L/ha	Spray at seedling stage.
<b>Dicamba</b> 500 g/L Various trade names	<b>Seedlings only</b> 10 mL per 15 L of water 40 mL per 100 L water 280–560 mL/ha	Knapsack spray. High volume spot spray. Boom spray.
	<b>Young, mature plants</b> 18 mL per 15 L of water 76 mL per 100 L of water 0.56–1.1 L/ha	Knapsack spray. High volume spot spray. Boom spray.
<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Various trade names	100 mL per 15 L of water 470 mL per 100 L of water 4.0–7.0 L/ha	Knapsack spray. High volume spot spray. Boom spray. In grass pastures.
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350 mL in 100 L of water	Apply as a foliar spray pre-flowering.

## Horsetail – *Equisetum* spp.

Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Physical removal because of the deep root system is ineffective.

	Chemical and concentration	Rate	Comments
PER 6169	Dichlobenil 67.5 g/kg	18 g /m <sup>2</sup>	Spread granules evenly over the soil in area to be treated. Granules must be watered immediately after application.
	Various trade names		

## Hudson Pear – *Cylindropuntia rosea*

**Non-chemical options:** Small plants can be mechanically removed. The use of Cochineal agents is preferred where suitable.

	Chemical and concentration	Rate	Comments
PER 6500	Triclopyr + picloram 300 g/L + 100 g/L	1 L per 100 L of water	Spot spray application, add 0.5 % Uptake spray oil.
	Various trade names		
	Triclopyr 600 g/L	1 L per 75 L of diesel	Spot spray application.
	Various trade names	3 L per 100 L of water	Add 0.5% Uptake spray oil.

## Hygrophila – *Hygrophila costata*

**Non-chemical options:** Small plants or infestations can be dug up, bagged and removed. See Weed Alert brochure for further details.

	Chemical and concentration	Rate	Comments
PER 7343	Glyphosate 360 g/L	1.0 L per 100 L of water	Spray when plants are actively growing, re-treatments may be necessary. Do not spray directly onto waters surface or non-target species.
	Various trade names for aquatic use only		
	Metsulfuron methyl 600 g/kg	5–10g per 100 L of water	Minimise off target damage and water pollution by spraying towards the bank. Do not apply more than 3 times a year.
	Various trade names		

## Illyrian Thistle – *Onopordum illyricum*

**Non-chemical options:** Establish a strong, perennial pasture. Grub single plants, removing 50 mm of the root. Biological control agents are available.

	Chemical and concentration	Rate	Comments
	Dicamba 500 g/L Various trade names	<b>Seedlings only</b>	
		10 mL per 15 L of water	Knapsack spray.
		40 mL per 100 L water	High volume spot spray.
		280–560 mL/ha	Boom spray.
		<b>Young, mature plants</b>	
		18 mL per 15 L water	Knapsack spray.
76 mL per 100 L of water	High volume spot spray.		
		0.56–1.1 L/ha	Boom spray.



## Japanese Sunflower – *Tithonia diversifolia*

**Non-chemical options:** Seedling and individual plants can be physically removed.

Chemical and concentration	Rate	Comments
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g in 100 L of water	Apply to actively growing plants after full leaf expansion but before seed set. Add surfactant.
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350 mL in 100 L of water	Apply as a foliar spray pre-flowering.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Johnson Grass – *Sorghum halepense*

**Non-chemical options:** Cultivation is ineffective because of rhizome segmentation. This only increases spread.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names and formulations	1.0 L per 100 L of water	Spot spray.
	6.0 L/ha	Boom spray. Actively growing plants at early head stage. Wiper equipment.
	1.0 L glyphosate per 2 L of water	
<b>Glufosinate ammonium</b> 200g/L Basta® and Finale®	300–500 mL per 100 L of water	Spot spray.
	3.0–5.0 L/ha	Boom spray. Actively growing at early flowering.
<b>Sulfometuron methyl</b> 750 g/kg Various trade names	40 or 80 g per 100 L of water	Spot spray. Apply evenly to the foliage of the weeds present. Spray to point of wet.
	0.4–0.8 kg/ha	Boom spray.
<b>MSMA</b> 800 g/L Various trade names	1.0 L per 100 L of water	Spot spraying.
	10–12 L/ha in 500 L of water	Boom spraying.
<b>Flupropanate</b> 745 g/L Various trade names	200 mL per 15 L of water	Knapsack spray.
	1.0 L per 100 L of water	High volume spot spray.
	12.0–22.0 L/ha	Boom spray.

## Karoo Thorn – *Acacia karroo*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

There are no registered herbicides for the control of this plant.

## Khaki Weed – *Alternanthera pungens*

**Non-chemical options:** Improve lawns and turf density to create competition, grub at least 50 mm of the root.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 500 g/L Various trade names and formulations	1.4–2.8 L/ha	Seedlings only.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL in 100 L of water	Active growth in full leaf.
<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Various trade names	100 mL per 15 L of water	Knapsack spray.
	470 mL in 100 L of water	High volume spot spray
	4.0–7.0 L/ha	Boom spray. In grass pastures. Second treatment may be necessary four weeks later.
<b>Amitrole + ammonium thiocyanate</b> 250 g/L + 220 g/L Various trade names	1.1 L in 100 L of water	Spot spray. Actively growing plants.

## Kochia – *Kochia scoparia*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

There is no registered herbicide control for this plant.

## Kudzu – *Pueraria lobata*

**Non-chemical options:** Continual grazing or cutting can kill the plant. Manual removal is difficult because of the existence of a large underground tuber.

	Chemical and concentration	Rate	Comments
PER 7278	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g per 100 L of water	Spot spray. Foliar application near riparian areas and native vegetation. Apply to actively growing plants in mid to late spring. Add surfactant.
	<b>Triclopyr</b> 600 g/L Various trade names	50 mL per 15 L of water 330 mL per 100 L spray volume	Spot spray (knapsack). High volume spot spray.
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL per 100 L of water	Apply as a foliar spray in spring or autumn. For use in open pasture situation.

## Lacy Ragweed – *Ambrosia tenuifolia*

**Non-chemical options:** A perennial plant reproducing from seed and root, making physical removal unpractical. In some situations, biological agents may give some control.

	Chemical and concentration	Rate	Comments
	<b>Dicamba</b> 500 g/L Various trade names	130 mL per 15 L of water 600 mL per 100 L of water 8.8 L/ha	Knapsack spot spray. High volume spot spray. Use a minimum of 1500 L /ha of water. Add a surfactant.

## Lagarosiphon – *Lagarosiphon major*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** A submerged aquatic plant that is difficult to control using chemicals. The use of mechanical control, where practicable, is recommended.

## Lantana – *Lantana camara*

**Non-chemical options:** Manual control can be effective by slashing, burning or manual removal, integrated together with pasture improvement. Biological control research is continuing. See the National Lantana Manual and Agfact P7.6.42 *Lantana* for further information.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350 or 500 mL per 100 L of water	Wet thoroughly, use higher rate on large bushes, 1–2 m tall. Low rates for bushes up to 1 m tall. Apply from summer to autumn.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L per 60 L of diesel	Basal bark or cut stump application.
<b>Glyphosate + metsulfuron methyl</b> 835 g/kg + 10 g/kg Trounce®	1 measured pack (173 g) per 100 L of water	Apply when actively growing, thoroughly wet all foliage and stems. <b>Do not apply during stress periods.</b>
<b>Metsulfuron methyl + glyphosate</b> 63.2 g/kg + 760.5 g/kg Cutout®	1 measured pack (95 g) per 100 L of water	Apply when actively growing, thoroughly wet all foliage and stems. <b>Do not apply during stress periods.</b>
<b>Glyphosate</b> 360 g/L Various trade names	1.0 L per 100 L of water	Actively growing with full foliage. <b>Avoid summer stress.</b>
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL per 100 L of water	High volume spot spray. Thoroughly wet foliage and soil around the base of plant during March to May.
<b>Dichlorprop</b> 600 g/L Lantana 600®	1.0 L per 200 L of water	Spot spray application, completely wet all leaves and stems.
<b>Triclopyr</b> 600 g/L Various trade names	1.0 L per 60 L of diesel	Basal bark application for basal diameter less than 5 cm or cut stump application above 5 cm.
<b>Metsulfuron methyl</b> 600 g/kg Brushoff® <b>Glyphosate</b> 360 g/L Various trade names	10 g metsulfuron methyl plus 200 mL glyphosate per 100 L of water	Apply to bushes up to 2 m high. Thoroughly wet all foliage and stems. Add organosilicone penetrant.
<b>Fluroxypyr</b> 200 g/L Various trade names	500 mL or 1.0 L per 100 L of water	Apply to actively growing bushes from October to April. Use lower rate on seedlings or bushes to 1.2 m high, higher rate on bushes over 1.2 m.
<b>Fluroxypyr + aminopyralid</b> 140 g/L + 10 g/L Hotshot®	500 mL per 100 L of water 700 mL per 100 L of water	Seedlings and regrowth 0.5–1.2 m height. Mature plants and regrowth 1.2–2.0 m. Apply to actively growing plants.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g per 100 L of water	Apply to bushes up to two metres tall. Spray to wet all foliage and stems. Re-treatment will be necessary.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Leucaena – *Leucaena leucocephala*

Non-chemical options: Small plants can be mechanically removed.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of diesel	Cut stump/basal bark application.

# Lantana — a Weed of National Significance

Improve your grazing investment by controlling lantana...  
...and save a piece of the environment at the same time.

Lantana can be simple to control —

- ⊗ It has a range of control options that can be integrated to improve outcomes.
- ⊗ A variety of herbicides are available for different situations.
- ⊗ Lantana is usually shallow rooted and is easily removed from the soil.
- ⊗ Lantana's seed bank is short lived (3–4 years), so control programs are reduced.
- ⊗ Lantana is easy to identify, reducing mistaken treatment of other plants.



Controlling lantana —

- ⊗ Develop a management plan to guide your efforts.
- ⊗ Spray herbicides in the right season (check labels).
- ⊗ Control small manageable sections before moving onto larger areas.
- ⊗ Integrate control options such as fire, mechanical options and herbicides to obtain a better result.
- ⊗ Always follow up your initial effort and treat seedlings and regrowth.
- ⊗ Acquire appropriate permits before using fire, off-label herbicides or damaging remnant vegetation.

Did you know?

- ⊗ Ornamental lantana can also spread by producing seed
- ⊗ Buying or trading lantana is against the law

Download information publications —

- ⊗ Lantana control manual
- ⊗ Using herbicides on lantana
- ⊗ Information sheets
  - Poisoning
  - Flower identification guide
  - Biological control agents
- ⊗ National lantana strategic plan

[www.weeds.org.au](http://www.weeds.org.au)

[www.nrw.qld.gov.au/pests](http://www.nrw.qld.gov.au/pests)



## Lippia – *Phyla* spp.

Commonly used as a lawn species; this practice should be discouraged.

**Non-chemical options:** Pasture improvement and grazing management. See Agfact P7.6.52 *Lippia* for detailed management information. Also the Agnote DPI-384 *Using herbicides in a lippia management program*.

	Chemical and concentration	Rate	Comments
	<b>Dichlorprop</b> 600 g/L Lantana® 600	5 mL per 1 L of water 1.0 L per 200 L of water or 5.0–7.0 L/ha	Knapsack rate. Completely wet plants. Boomspray using high water volumes. Minimum application of 100 L/ha. For best results spray at flowering when there is good soil moisture.
PER 6827	<b>2,4-D amine</b> 625 g/L Various trade names and formulations	1.7–3.1 L/ha plus 1% crop oil	Pastoral land situation. Apply when Lippia is in a fresh condition, mid-flower, with good soil moisture present.
	<b>Glyphosate</b> 450 g/L Various trade names	2.4 to 5.4 L of glyphosate plus 15 to 30 g metsulfuron methyl plus 1.8 L of 2,4-D amine and 1% crop oil /ha OR	Fallow land situation. Apply when Lippia is actively growing, mid-flower, with good soil moisture.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	2.6 L to 5.4 L of glyphosate plus 15 to 30 g of metsulfuron methyl and 1% crop oil /ha OR	
	<b>2,4-D amine</b> 300 g/L Various trade names and formulations	2.6 to 5.4 L of glyphosate plus 1.8L of 2,4-D amine /ha	

## Long Leaf Willow Primrose – *Ludwigia longifolia*

**Non-chemical options:** Small plants may be manually removed, taking care not to spread seed. For further information see the *Long Leaf Willow Primrose*, Weed Alert.

	Chemical and concentration	Rate	Comments
PER 7344	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	1.0 L per 100 L of water Undiluted	Spot spray application. Scrape and paint.

## Long-style Feather Grass – *Pennisetum villosum*

**Non-chemical options:** Cultivate and establish pasture cover to provide competition and prevent invasion.

There are no registered herbicides for this plant.



## Ludwigia – *Ludwigia peruviana*

**Non-chemical options:** Small plants can be manually removed. Dense stands can be slashed and burnt. Take care not to spread the seed.

	Chemical and concentration	Rate	Comments
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only.	10 mL in 1 L of water	Actively growing at or beyond the early bloom stage of growth but before autumn change of colour. Thorough coverage is necessary for best results.
PER 6199 & 7381	<b>2, 4-D amine</b> 500 g/L Various trade names These are limited use permits.	125 mL in 100 L of water	Apply as direct application to foliage, minimising runoff from leaf surface. <b>Do not apply as a broadcast spray over water.</b>
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Madeira Vine – *Anredera cordifolia*

**Non-chemical options:** Small seedlings and tubers can be manually removed, bagged and composted.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	Undiluted	Stem scraping application.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	200 mL glyphosate per 10 L of water	Spot spray for seedling control. Add a surfactant.
		200 mL glyphosate plus 1.5 g metsulfuron methyl in 10 L of water	Spot spray for seedling control.
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate per 1.5 parts water	Cut stump or stem-scraping application.
		200 mL glyphosate per 10 L of water	Spot spray for seedling control. Add a surfactant.
	<b>Fluroxypyr</b> 200 g/L Various trade names	500 mL in 100 L of water	Apply at times of active growth. Avoid drift on to desirable plants.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Mesquite – *Prosopis* spp.

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Blade ploughing and fire on dense infestations. Grazing management and grubbing to prevent reinfestation. See national Mesquite control manual for further information.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Grazon® and various trade names	350 mL in 100 L of water	Controls seedlings, plants in full leaf and flowering before podding. Thoroughly wet all foliage, stems and soil around the base of the plants. Add a wetting agent to increase efficacy. <b>Do not spray plants bearing pods.</b>
PER 7395	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access® and various trade names	1.0 L in 60 L of diesel	Basal bark application of plants up to 5 cm in diameter. Cut stump for plants over 5 cm.
	<b>Triclopyr</b> 600 g/L Various trade names	1.0 L in 60 L of diesel	Basal bark application for plants up to 20 cm diameter. Cut stump for plants over 20 cm diameter.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Miconia – *Miconia* spp.

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Physical removal gives best results. See NSW DPI *Weed Alert* brochure for further information

	Chemical and concentration	Rate	Comments
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Mintweed – *Salvia reflexa*

**Non-chemical options:** To prevent invasion, maintain a strong, competitive pasture.

	Chemical and concentration	Rate	Comments
	<b>2,4-D amine</b> 500 g/L Various trade names	140 mL in 100 L of water 1.4 L/ha	Actively growing seedlings.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	300 mL Tordon® plus 375 mL 2,4-D amine /ha	Tank mix for effective control.
	<b>2,4-D amine</b> 500 g/L Various trade names		
	<b>MCPA amine</b> 500 g/L Nufarm MCPA 500® and various trade names	2.0 L/ha	Actively growing seedlings.
	<b>Glyphosate</b> 360 g/L Various trade names	75–100 mL per 15 L of water 500–700 mL per 100 L of water 2.0–3.0 L/ha	Knapsack spray. High volume spot spray. Boom spray. Apply to actively growing plants.
	<b>MCPA + Dicamba</b> 340 g/L + 80 g/L Banvel® M and various trade names	60 mL per 15 L of water 190–270 mL per 100 L of water 2.8–4.0 L/ha	Knapsack spray. High volume spot spray. Boom spray. Use higher rate on larger plants.
	<b>Glufosinate ammonium</b> 200 g/L Basta® Finale®	45–75 mL per 15 L of water 300–500 mL per 100 L of water 3.0–5.0 L/ha	Knapsack spray. High volume spot spray. Boom spray. Actively growing plants.

## Mimosa – *Mimosa pigra*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI, phone 1800 680 244.

There are no registered herbicides for this plant in NSW.

## Mimosa Bush – *Acacia farnesiana*

**Non-chemical options:** Small plants can be mechanically removed.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L per 60 L of diesel	Cut stump/basal bark application.
PER 6326	<b>Clopyralid</b> 300g/L Various trade names	500 mL per 100 L of water	High volume foliar application. Apply to actively growing plants in full leaf. Add a surfactant.

## Mistflower – *Ageratina riparia*

**Non-chemical options:** Improved pastures well-managed by grazing.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350 mL per 100 L of water	Spring to autumn on actively growing bushes.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL per 100 L of water	Actively growing bushes.
	<b>Metsulfuron methyl</b> 600 g/L Various trade names	5 g per 100 L of water	Apply when bush is actively growing and before flowering.
	<b>Fluroxypyr</b> 200 g/L Various trade names	500 mL per 100 L of water	Actively growing seedlings and young bushes before flowering.
	<b>Glyphosate</b> 360 g/L Various trade names	5 mL per 1 L of water 1.0 L per 9 L water (3 mL per m <sup>2</sup> )	Actively growing bushes with full foliage. Low volume application.

## Montbretia – *Crocsmia x crocosmiiflora*

**Non-chemical options:** A member of the bulb group of plants. Physical removal will be difficult because of the number of bulblets attached to the main bulb.

	Chemical and concentration	Rate	Comments
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	1.0 L in 70–100 L of water 1 part glyphosate per 1 part of water	Spray between flowering and fruiting. Weed wand application.

## Morning Glory – *Ipomoea cairica*/*Ipomoea indica*/*Ipomoea alba*

**Non-chemical options:** Small seedlings can be manually removed. Vines and runners can be collected and destroyed.

	Chemical	Rate	Comments
PER 5206 & 9158	<b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water 1 part glyphosate per 1.5 parts water	Spot-spray for seedling control. Stem scraping application.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Moth Vine – *Araujia sericifera*

**Non-chemical options:** Physical removal of young plants; bag and remove any fruit.

	Chemical	Rate	Comments
PER 9158	<b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water 1 part glyphosate per 1.5 parts water	Spot spray for seedling control. Cut stump /Stem scraping application.
	<b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water Undiluted	Treat seedling plants. Stem scraping application
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Mother of Millions – *Bryophyllum* spp.

**Non-chemical options:** For best results maintain strong pasture competition.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL per 100 L of water	Apply at flowering, add a surfactant.
	<b>2,4-D amine</b> 500 g/L Various trade names	500 mL per 100 L of water	Thorough, even coverage of leaves and plantlets is necessary. Add a wetting agent.
	<b>Fluroxypyr</b> 200 g/L Starane 200®	600 mL per 100 L of water	Actively growing seedlings and young plants before flowering.

## Murraya – *Murraya paniculata*

**Non-chemical options:** Seedlings may be manually removed.

	Chemical	Rate	Comments
PER 9158	<b>Glyphosate</b> 360g/L Various trade names	100 mL per 10 L of water 1 part glyphosate per 1.5 parts water	Foliar application for seedlings/ coppice shoots. Stem injection / cut stump application, saplings to large shrubs.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Mysore Thorn – *Caesalpinia decapetala*

**Non-chemical options:** Physical removal of small seedling plants.

	Chemical and concentration	Rate	Comments
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g per 100 L of water	Spray to thoroughly wet all foliage, but not to cause run off. Apply to actively growing plants before flowering. Add wetting agent.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Nodding Thistle – *Carduus nutans*

**Non-chemical options:** Good perennial pastures with sound grazing management.

Chemical and concentration	Rate	Comments
<b>MCPA</b> 500 g/L Various trade names	250 mL MCPA per 150 L of water 2.5 L MCPA /ha	Spot spray. Boom spray. Spray at early rosette stage; re-treatment is required.
<b>Clopyralid</b> 300 g/L Various trade names	250 mL clopyralid per 100 L of water 50 or 70 mL clopyralid plus 1.0–1.5 L of MCPA /ha	Spray at rosette to pre-flowering. Boom spray. Spray at rosette to pre-flowering.
<b>2,4-D ester</b> 600 g/L Various trade names and formulations	1.3–1.9 L/ha	Spray rosettes to pre-flowering. For use in grass pastures.

## Noogoora Burr – *Xanthium occidentale*

**Non-chemical options:** Noogoora burr in the seedling form is toxic to livestock. Hoeing, chipping or slashing will give control.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 500 g/L Various trade names	1.0–1.4 L/ha	Seedlings only.
<b>MCPA amine</b> 500 g/L Various trade names	1.0–2.0 L/ha	Spray young seedlings only.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	7.5 g per 100 L of water	Apply to actively growing plants. <b>Do not apply to plants under stress.</b>
<b>Ametryne</b> 500 g/L Viking® and various trade names	75 mL per 15 L of water 720 mL per 100 L of water	Knapsack spray. Hand spraying. Add Plus 50 wetter. <b>Use near 2,4-D susceptible crops.</b>
<b>MCPA + dicamba</b> 340 g/L + 80 g/L Various trade names	60 mL per 15 L of water 190–270 mL per 100 L of water 2.8–4.0 L/ha	Knapsack spray. High volume spot spray. Boom spray. For use in grass pastures.
<b>Fluroxypyr</b> 200 g/L Various trade names	75 mL per 100 L of water	Apply to actively growing plants. Seedlings and young plants to 40 cm high.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	1.0 L/ha	Can also be used in summer cereals.

## Ochna – *Ochna serrulata*

**Non-chemical options:** Small seedlings can be manually removed.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water Undiluted	Spot spray. Apply to seedlings/ coppice shoots and shrubs. Scrape stem, cut, scrape, paint. Cut stump sapplings. Stem injection large trees and shrubs.
	<b>Metsulfuron methyl</b> 600g/kg Various trade names	1.0–2.0 g per 10 L of water	Spot spray application.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).



## Oleander – *Nerium oleander*

**Non-chemical options:** Manually remove plants with care, as all parts are highly toxic to both humans and livestock.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of diesel	Basal bark application plants up to 5 cm basal diameter. Cut stump application plants over 5 cm.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Onion Weed – *Asphodelus fistulosus*

**Non-chemical options:** Good pasture management will combat invasion by onion weed.

Chemical and concentration	Rate	Comments
<b>Amitrole + ammonium thiocyanate</b> 250 g/L + 220 g/L Amitrole T® and various trade names	1.1 L per 100 L of water	Active growth before flowering. Repeat treatments will be required.

## Pampas Grass – *Cortaderia* spp.

**Non-chemical options:** Mechanical removal, wherever possible, is best.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names	1.0 or 1.3 L per 100 L of water	Actively growing plants, before flowering, spring to autumn. Use higher rate on plants over 1 m high.

## Parthenium Weed – *Parthenium hysterophorus*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Clean all vehicle and machinery. Competitive crops and pastures. Do not spread the seed if removing by hand.

See the National *Parthenium weed* Control Manual and Agfact P7.6.15 *Parthenium weed* for further information.

Chemical and concentration	Rate	Comments
<b>Dicamba</b> 500 g/L Various trade names	40 mL per 100 L of water 600 mL/ha	Spot spray. Boom spray. Apply to young, actively growing plants.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	125 mL per 100 L of water 3.0 L/ha	Spot spray. Rosette stage when plants are actively growing. Boom application.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	5 g per 100 L of water	Thoroughly wet all foliage to the point of run-off.
<b>Hexazinone</b> 250 g/L Various trade names	70 mL per 100 L of water	Apply uniformly over the area. When spraying single plants treat soil for 1 m around. <b>Do not use near desirable trees.</b>
<b>Atrazine</b> 900 g/kg Various trade names	3.3 L/ha	Protects against emerging seedlings.

## Parkinsonia (Jerusalem Thorn) – *Parkinsonia aculeata*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244)

**Non-chemical options:** Mechanical removal or grubbing gives effective control. See National Control Manual for integrated control methods.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of diesel	Basal bark or cut stump application.
<b>Hexazinone</b> 250 g/L Various trade names	4 mL per spot 1 mL per spot	One spot per bush up to 5 m tall. One spot per bush up to 1 m tall. Do not use near desirable plants.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Parrots Feather – *Myriophyllum aquaticum*

**Non-chemical options:** Physical removal is recommended where appropriate. Draining and drying in suitable situations can control plants. Contain infestations to avoid further spread.

There are no registered herbicides for this plant.

## Paterson's Curse, Viper's Bugloss & Italian Bugloss – *Echium* spp.

**Non-chemical options:** Control can be achieved by using spray graze, pasture improvement and good grazing management practices and by the use of biological control agents. See the Primefact 109 *Paterson's Curse*.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 625g/L Various trade names and formulations	170–220 mL in 150 L of water 1.7–2.2 L/ha	Spot spray. Young rosettes. Boom spray.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	150 mL in 100 L of water	Spot spray. Rosettes to pre-flowering.
<b>Glyphosate</b> 360 g/L Various trade names	500–700 mL in 100 L of water 2.0–3.0 L/ha	Spot spray. Actively growing plants. Boom application
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	5 g in 100 L of water 10–15 g/ha	Apply to rosettes after full leaf expansion but before head emergence. <b>Do not spray after emergence of first flowers, as seed set has occurred.</b>
<b>MCPA</b> 500g/ L Various trade names	1.0–1.5 L/ha	Apply at early rosette stage
<b>Dicamba</b> 500g/ L Various trade names	280 mL per 100 l of water. 4.0 L/ha	Spot spray. Boom spray. Apply prior to flowering. Add wetting agent.

## Pellitory – *Parietaria judaica*

**Non-chemical options:** Hand removal before flowering. Flowering plants can cause respiratory problems in humans.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names	1.0 L in 100 L of water	Apply to actively growing plants before flowering. Re-treatments may be required to control seedlings.

## Perennial Ragweed – *Ambrosia psilostachya*

**Non-chemical options:** Physical removal is not totally effective because of the root system.

Chemical and concentration	Rate	Comments
<b>Dicamba</b> 500 g/L Various trade names	600 mL in 100 L of water 8.8 L/ha	Spot spray. Active growth, small rosettes. Boom application.

## Perennial Thistle or Canada Thistle – *Cirsium arvense*

**Non-chemical options:** Cultivation is ineffective in controlling this plant because of the perennial root system.

Chemical and concentration	Rate	Comments
<b>Dicamba</b> 500 g/L Various trade names and formulations	280 mL per 100 L of water 4.0 L/ha	Spot spray. Young, actively growing plants. Boom spray.
<b>2,4-D amine</b> 500 g/L Various trade names and formulations	320–380 mL per 100 L of water 3.2–3.8 L/ha	Spot spray. Boom spray. Rosettes to early budding stage.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL per 100 L of water	Spot spray. Spray at budding stage.

## Prairie Ground Cherry – *Physalis viscosa*

**Non-chemical options:** Cultivation is ineffective because of the perennial root system.

Chemical and concentration	Rate	Comments
<b>Amitrole + ammonium thiocyanate</b> 250 g/L + 220 g/L Amitrole T® and various trade names	1.1 L in 100 L of water	Spot spray. Active growth before flowering.

## Prickly Acacia – *Acacia nilotica*

A Class 1 notifiable noxious weed in some council areas that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Mechanical or chain removal in both directions.

Chemical and concentration	Rate	Comments
<b>Triclopyr</b> 600 g/L Various trade names	1.0 L in 120 L of diesel	Basal bark/cut stump application.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of diesel	Basal bark/cut stump application.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Prickly Pears

**Non-chemical options:** The use of cochineal and cactoblastis biological control agents suited to the variety of pear is the best management practice, where appropriate.

### Common Pest Pear – *Opuntia stricta*

Chemical and concentration	Rate	Comments
<b>Triclopyr</b> 600 g/L Garlon 600® and various trade names	1.0 L in 75 L of distillate. 3.0 L in 100 L of water	Apply as a thorough foliar spray.
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Grazon® DS	500 mL in 100 L of water	Apply as a thorough foliar spray.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of distillate	Foliar application; thoroughly wet plants.

## Prickly Pears cont.

### Smooth Tree Pear – *Opuntia vulgaris*

Chemical and concentration	Rate	Comments
<b>Triclopyr</b> 600 g/L Various trade names	1.0 L per 75 L of distillate	Apply thoroughly as a foliar spray.
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL per 100 L of water	Common pear and smooth tree pear, with active phyllode (leaf) growth.

### Tree Pear – *Opuntia tomentosa*

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access <sup>®</sup>	1 L per 60 L of diesel	Apply thoroughly as a foliar spray.

### Tiger Pear – *Opuntia aurantiaca*

Chemical and concentration	Rate	Comments
<b>Triclopyr</b> 600 g/L Various trade names	3.0 L per 100 L of water 1.0 L per 75 L of distillate	Apply thoroughly as a foliar spray.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access <sup>®</sup>	1.0 L per 60 L of diesel	Apply thoroughly as a foliar spray.

## Privet – *Ligustrum* spp.

**Non-chemical options:** Small plants and seedlings can be manually controlled.

Chemical and concentration	Rate	Comments
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	10 g per 100 L of water	Apply to bushes up to 3 m high; complete coverage is essential.
<b>Metsulfuron-methyl + glyphosate</b> 63.2 g/kg + 760.5 g/kg Cut-out <sup>®</sup>	1 measured pack (95 g) per 100 L of water	Apply to bushes up to 3 m high, in full leaf and actively growing; complete coverage is essential.
<b>Triclopyr</b> 600 g/L Various trade names	1.0 L per 12 L of diesel	Basal bark/cut stump application.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access <sup>®</sup>	1.0 L per 30 L of diesel	Basal bark/cut stump application.
<b>Glyphosate</b> 360 g/L Various trade names	Undiluted (1–2 mL per cut)	Stem injection technique, as per label.
<b>Picloram</b> 45 g/kg Vigilant <sup>®</sup>	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Ragwort – *Senecio jacobaea*

**Non-chemical options:** Physical removal of single plants.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 500 g/L Various trade names and formulations	1.4–4.8 L/ha	Boom spray. Rosette growth stage.
<b>MCPA</b> 340 g/L Various trade names	190–270 mL per 100 L of water 2.8–4.0 L/ha	Spot spray. Boom spray. Apply at the young growth stage.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	300 mL per 100 L of water 3.5 L/ha	Spot spray application. Boom application, rosettes to cabbage stage.
<b>Dicamba</b> 500 g/L Various trade names	280 mL per 100 L of water 4.0 L/ha	Spot spray application. Boom application, actively growing rosettes.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	5 g per 100 L of water 15 g/ha	Spot spray application. Boom application, actively growing rosettes to cabbage stage.
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	350 mL per 100 L of water	Spot spray. Apply to actively growing plants.

## Rhizomatous bamboo – *Phyllostachys* spp.

**Non-chemical options:** Physical removal will give best results.

Chemical and concentration	Rate	Comments
PER 5206 <b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water	Spot spray application.
	1 part glyphosate to 1.5 parts of water	Cut stump application.

## Rhus Tree – *Toxicodendron succedaneum*

The sap from the tree can cause health problems in humans; even the smoke from burning is toxic.

**Non-chemical options:** When manually removing this tree avoid contact with the sap. Do not mulch or chip for garden use. For further information see Agfact P7.6.41 *Rhus – an urban weed*.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names	Undiluted (1–2 mL per cut)	Stem injection technique, as per label.
	1 part glyphosate to 1 part water	Cut stump application.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Rubbervine – *Cryptostegia grandiflora*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Seedling plants may be manually removed.

Chemical and concentration	Rate	Comments
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	15 g per 100 L of water	Hand gun application. Do not apply to bushes more than 3 m tall. Apply October to April, ensuring thorough spray coverage of all foliage.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L per 60 L of diesel	Basal bark and cut stump application.
<b>Triclopyr</b> 600 g/L Various trade namers	1.0 L per 60 L of diesel	Basal bark and cut stump application.



## Saffron Thistle – *Carthamus lanatus*

**Non-chemical options:** Control can be obtained by slashing, spray topping or pasture improvement.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 625 g/L Various trade names and formulations	110–170 mL 2,4-D amine per 150 L of water	Spot spray application. Boom application, apply when in rosette stage.
<b>Dicamba</b> 500 g/L Various trade names	1.1–1.7 L 2,4-D amine /ha 250 mL dicamba plus 640 mL of 2,4-D amine /ha	Apply when in rosette stage.
<b>MCPA</b> 500 g/L Various trade names	1.4–2.5 L MCPA /ha	Boom spray. Apply when in rosette stage. Use higher rate for larger weeds.
<b>Clopyralid</b> 300 g/L Various trade names	50 or 70 mL clopyralid plus 1.0–1.5 L MCPA /ha 250 mL clopyralid per 100 L water	Boom spray. Actively growing rosettes; use higher rate on mature plants. Spot spray.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	300 mL/ha	Boom spray application for young rosette or seedling plants.
<b>Glyphosate</b> 360 g/L Various trade names	500–700 mL per 100 L of water 2.0–3.0 L/ha	High volume spot spray. Boom application. Apply to actively growing rosettes.

## Sagittaria – *Sagittaria* spp.

**Non-chemical options:** Isolated plants can be manually removed.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only Also PER 8480	1.0 L per 100 L of water	Spot spray application. Direct spray onto weed mats in infested areas. Do not broadcast spray over the water.

## Salvinia – *Salvinia molesta*

A Class 1 notifiable noxious weed (except in coastal areas) that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Physical removal of small infestations, the use of biological control agents where appropriate, and reduction of nutrient inflows will all help with control. See Agfact P7.6.13 *Salvinia*, for further information

Chemical and concentration	Rate	Comments
<b>Diquat</b> 200 g/L Reglone®	400 mL per 100 L of water 5.0–10.0 L/ha	Spray to wet all foliage thoroughly, add Agral 600. <b>Observe withholding period.</b>
<b>Diquat</b> 20 g/L Vegetrol®	4.0 L per 100 L of water 50–100 L/ha	Thoroughly wet foliage. Best if water is clean; use higher rate if dense weed or dirty water. <b>Observe withholding period.</b>
<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only (also PER 7784, 5283, 4278)	1.0 L per 100 L of water	Overall spray. Follow directions on specific permits.
<b>Calcium dodecyl benzene sulfonate</b> 300g/L Immerse®	1 part per 19 parts kerosene (1 L of mixture per 100 m <sup>2</sup> )	Do not use in potable water. Do not spray on solid mats. Plants must be floating in water with a visible water surface between plants.
<b>Orange Oil</b> Water Clear®	1.0 L per 100 L of water	Spray on to free-floating plants.

## Scotch/English Broom – *Cytisus scoparius*

**Non-chemical options:** The use of goats as a grazing management tool or the use of biological control agents offers other means of control.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Grazon® DS and various trade names	250 or 350 mL per 100 L of water	Lower rate when actively growing mid-summer to pod formation. Higher rate for autumn-winter treatment.
<b>Triclopyr</b> 600 g/L Various trade names	170 mL per 100 L of water	Late spring to early autumn. Actively growing bushes. <b>Do not use under dry conditions.</b>
<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	100–130 mL per 10 L of water	Foliar spot spray application.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Scotch Thistle – *Onopordum acanthium*

**Non-chemical options:** Establish a strong, perennial, grass-based pasture. Grub single plants, removing at least 50 mm of root. There are also biological control agents available.

Chemical and concentration	Rate	Comments
<b>MCPA</b> 500 g/L Various trade names	1.0–1.5 L MCPA plus 50 or 70 mL clopyralid /ha	Boom spray application on actively growing rosettes. Use higher rate on mature plants.
<b>Clopyralid</b> 300 g/L Various trade names		
<b>Glyphosate</b> 360 g/L Various trade names	1.0–1.5 L/ha	Boom spray. Apply when actively growing.

## Senegal Tea Plant – *Gymnocoronis spilanthoides*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Do not attempt control on your own, as it can spread very easily from dislodged fragments. Contact your local weed control authority.

Chemical and concentration	Rate	Comments
PER 7343	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	5–10 g per 100 L of water Spot spray application. Do not spray directly onto water or non-target species.
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	1 L per 100 L of water Foliar application spot spray.

## Senna – Winter & Smooth – *Senna pendula* var. *glabrata* and *Senna floribunda*

**Non-chemical options:** Young seedlings can be manually removed. Seed pods should be collected and removed from the site.

Chemical	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate per 1.5 parts water Stem injection/cut stump application.
	<b>Metsulfuron methyl</b> 600 g/kg Various trade names	200 mL glyphosate per 10 L water Spot spray application. 1.0–2.0 g metsulfuron methyl per 10 L water 200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L water
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Serrated Tussock – *Nassella trichotoma*

**Non-chemical options:** The establishment of perennial pasture together with good grazing management will assist control. Grub out single plants.

	Chemical and concentration	Rate	Comments
	<b>Flupropanate</b> 745 g/L Taskforce® and various trade names	2.0 L/ha 150–200 mL per 100 L of water	Boom and aerial application. Spot spray, from September to May. <b>Four-month withholding period for blanket application.</b>
PER 9198	<b>Flupropanate</b> 745 g/L Taskforce® and various trade names	1.5–2.0 L/ha	Boom and aerial application. June to August inclusive. <b>Four-month withholding period for blanket application.</b>
		150–200 mL per 100 L of water	Spot spray treatment.
		500 mL per 10 L of water	Wick wiping application. September to March. <b>Read permit 9198 for critical comments.</b>
PER 6675	<b>Glyphosate</b> 360 g/L Various trade names	1 L per 2 L of water	Wick wiping application.
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	0.7–1.3 L to 100 L of water	Spot spray application.
		4.0–6.0 L/ha 0.75–1.25 L/ha	Boom spray. Apply to actively growing, stress-free plants. Spray topping application. Apply to actively growing, stress-free plants.

## Siam Weed – *Chromolaena odorata*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Mechanical removal of isolated plants. Slashing and burning offer temporary control but are usually followed by rapid regrowth. See Weed Alert *Siam Weed* for further information.

	Chemical and concentration	Rate	Comments
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Sifton Bush – *Cassina arcuata*

**Non-chemical options:** Slashing, physical removal and chaining will aid control. Soil disturbance adds to the spread of sifton bush.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Grazon® DS and various trade names	500 mL in 100 L of water	Bushes need to be actively growing for optimum effect.
	<b>Glyphosate</b> 360 g/L Various trade names	1.0 or 1.3 L in 100 L of water	Apply when actively growing. Ensure complete coverage; use higher rate on bushes over 1 m high.

## Silverleaf Nightshade – *Solanum elaeagnifolium*

**Non-chemical options:** The use of strong, competitive crops or pastures will give some control. Quarantine the infestation and prevent seeding. Cultivation is ineffective as it aids the spread from root pieces. Sheep can carry the seed in their digestive tract for periods of 7 days or more without affecting the germination capability. See Primefact No. 237 *Silverleaf nightshade* for more information.

Chemical and concentration	Rate	Comments
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL in 100 L of water  15.0 L/ha	Spot spray. Spray to wet thoroughly. Extend treated areas beyond the last plant for 1 m. Boom spray. Apply at early flowering before berry set.
<b>Glyphosate</b> 360 g/L Various trade names	2.0 L in 100 L of water	Apply at early flowering to berry set stage, spray thoroughly to wet. Use only with good soil moisture conditions.
<b>Fluroxypyr</b> 200g/L Various trade names	750 mL/ha	Add Uptake Spraying Oil at 1 L/ha. Follow-up treatment is critical.

## Singapore Daisy – *Wedelia trilobata*

**Non-chemical options:** Small infestations can be manually removed.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names	100 mL per 10 L of water	Spot spray. Foliar application.
<b>Glyphosate</b> 360 g/L Various trade names	200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L water	Spot spray application.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names		

## Spiny Burr Grass – *Cenchrus incertus/Cenchrus longispinus*

**Non-chemical options:** A strong, competitive summer pasture in northern areas and Consol lovegrass in southern areas will give effective control. Ensure equipment hygiene is used to prevent seed dispersal and also quarantine the infestation.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names	75–100 mL per 15 L of water 500–700 mL in 100 L of water 2.0–3.0 L/ha	Knapsack spray. High volume spot spray. Boom spray. Actively growing plants before seeding. Non-selective. Application in non-crop areas and roadsides.
<b>MSMA</b> 800g/L Various trade names	1.0 L in 100 L of water	Spot spray application. <b>Do not cut or graze effected area for 5 weeks.</b>

## Spear Thistle – *Cirsium vulgare*

**Non-chemical options:** Hoe or chipping can remove small infestations

Chemical and concentration	Rate	Comments
<b>2,4-D Amine</b> 500 g/L Various trade names	1.1–1.6 L/ha	Boom spray. For pastures not containing legumes. Spray young rosettes.
<b>MCPA</b> 500 g/L Various trade names	1.5–2.0 L/ha	Boom spray. Apply to rosettes actively growing; use higher rate on larger plants.

## Spiny Emex – *Emex australis*

**Non-chemical options:** An autumn/winter growing plant mainly associated with winter crops; dig out single plants or encourage a dense, winter-based pasture for competition

Chemical and concentration	Rate	Comments
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	300 mL per 100 L of water	Spot spray. For use in grass pastures.
<b>Glyphosate</b> 360 g/L Various trade names	500–700 mL per 100 L of water 2.0–3.0 L/ha	Spot spray. Boom spray. Young, actively growing plants.
<b>Metsulfuron methyl</b> 600 g/kg Various trade names	5–10 g/ha	Add surfactant, apply to young actively growing plants. Use higher rate to control dense stands.

## Spotted Golden Thistle – *Scolymus maculata*

**Non-chemical options:** Encourage a dense, improved pasture.

Chemical and concentration	Rate	Comments
<b>2,4-D ester</b> 600 g/L Various trade names and formulations	3.7 L/ha	Boom spray in grass pastures. Apply to actively growing rosettes.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	300 mL in 100 L of water 3.5 L/ha	Spot spray. Boom spray. Apply to seedling and rosette stages.

## Spotted Knapweed – *Centaurea maculosa*

**Non-chemical options:** Hoe or chip, removing at least 50 mm of the root; improve the pasture stand.

There are no herbicides registered for this plant.

## Star Thistle – *Centaurea calcitrapa*

**Non-chemical options:** Hoe or chip, removing at least 50 mm of the root; improve the pasture stand.

Chemical and concentration	Rate	Comments
<b>2,4-D ester</b> 600 g/L Various trade names and formulations	3.7 L/ha	Seedling to rosette stage.
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	300–500 mL in 100 L of water 3.5–7.5 L/ha	Spot spray. Seedling to rosette stage. Use higher rate on older rosettes.
<b>Dicamba</b> 500 g/L Various trade names	40–76 mL in 100 L of water 0.56–1.1 L/ha	Spot spray. Seedlings to young, mature rosettes. Boom application.

## Stemless Thistle – *Onopordum acaulon*

**Non-chemical options:** Establish a strong, perennial, grass-based pasture. Grub single plants, removing 50 mm of root. There are also biological control agents available.

Chemical and concentration	Rate	Comments
<b>2,4-D ester</b> 600 g/L Various trade names and formulations	2.8–3.7 L/ha	For use in grass pastures. Spray rosette to flowering.
<b>Dicamba</b> 500 g/L Various trade names	40–76 mL in 100 L of water 0.56–1.1 L/ha	Spot spray. Seedlings to young mature plants; use lower rate on seedlings and higher rate on young, mature plants. Boom application.

## St Barnaby's Thistle – *Centaurea solstitialis*

**Non-chemical options:** Encourage strong, legume-based pasture to provide competition. Slashing, if timed right, is effective.

Chemical and concentration	Rate	Comments
<b>2,4-D ester</b> 600 g/L Various trade names and formulations	1.3–1.9 L/ha	Boom spray. Seedlings to rosette stage.
<b>Glufosinate ammonium</b> 200 g/L Basta® Finale®	150–500 mL in 100 L of water 1.5–5.0 L/ha	Spot spray. Boom spray. Actively growing rosettes.

## St John's Wort – *Hypericum perforatum*

**Non-chemical options:** The use of perennial pastures and grazing management, together with the use of biological control agents, will offer some control.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 600 g/L Various trade names	500 mL in 100 L of water 2.0–4.0 L/ha	Late spring to early summer, during flowering to early seed set. Apply November to January, use higher rate on dense infestations. Boom spray.
<b>Fluroxypyr</b> 200 g/L Various trade names	500 mL in 100 L of water 3.0 L/ha	Spring to mid summer application. Boom application. Observe withholding period.
<b>Glyphosate</b> 360 g/L Various trade names	3.0 L/ha	Apply November to May, flowering to post-flowering.
<b>2,4-D ester</b> 600 g/L Various trade names and formulations	3.7–5.3 L/ha	For use in grass pastures, before flowering, when the plants are less than 40 cm high.
<b>Glyphosate + metsulfuron methyl</b> 835 g/kg + 10 g/kg Trounce®	1 measured pack (173 g) in 100 L of water	Actively growing from spring to summer.
<b>Glyphosate</b> 360 g/L Various trade names <b>Metsulfuron-methyl</b> 600 g/L Various trade names	200 mL glyphosate plus 10 g metsulfuron-methyl in 100 L of water	Spray to wet, but not to cause run-off.



## Sweet Briar – *Rosa rubiginosa*

**Non-chemical options:** The use of mechanical removal, grubbing or grazing with goats gives control.

Chemical and concentration	Rate	Comments
<b>Triclopyr + picloram</b> 300 g/L + 100 g/L Various trade names	500 mL in 100 L of water	Full-leaf to ripe fruit prior to leaf fall. Use higher rate on bushes over 1.5 m high.
<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of diesel	Basal bark/cut stump application.
<b>Triclopyr</b> 600 g/L Various trade names	1.0 L in 30 L of diesel	Basal bark/cut stump application
<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL in 100 L of water	Full leaf as an overall spray.
<b>Metsulfuron-methyl + picloram</b> 200 g/kg + 240 g/L Crossbow®	30 g part A plus 150 mL part B in 100 L of water	Foliar application. Apply when bushes are actively growing.
<b>Glyphosate</b> 360 g/L Various trade names	1.5–2.0 L in 100 L of water	Spray to wet all foliage, from late flowering to leaf fall. Use higher rate on bushes over 1.5 m high.
<b>Metsulfuron methyl</b> 600 g/L Various trade names	10 g in 100 L of water	Apply to actively growing bushes to point of run. <b>Do not apply after end of February.</b>
<b>Glyphosate + metsulfuron methyl</b> 835 g/kg + 10 g/kg Trounce®	1 measured pack (173 g) in 100 L of water	Apply as close to the flowering period as possible.
<b>Metsulfuron-methyl + glyphosate</b> 63.2 g/kg + 760.5 g/kg Cut-out®	1 measured pack (95 g) in 100 L of water	Apply as close to the flowering period as possible.
<b>Hexazinone</b> 250 g/L Various trade names	Undiluted (4 mL per spot)	One spot per metre of height. <b>Do not apply near desirable trees.</b>
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Sweet Pittosporum – *Pittosporum undulatum*

**Non-chemical options:** Physical removal is best.

Chemical and concentration	Rate	Comments
PER 9158 <b>Glyphosate</b> 360 g/L Various trade names	100 mL in 10 L of water	Foliar seedling treatment.
	1 part glyphosate per 1.5 parts of water	Cut stump/basal bark application.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Tiger Lily – *Lilium formosanum*

**Non-chemical options:** Physical removal will be difficult because of bulb-like underground parts of the plant.

Chemical and concentration	Rate	Comments
PER 5206 <b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate per 1 part water	Wick wiper application.
	200 mL glyphosate per 10 L of water	Spot spray application between flowering and fruiting.
	200 mL glyphosate plus 1.5 g metsulfuron methyl per 10 L of water	Spot spray application between flowering and fruiting.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump application. Apply a 3–5 mm layer of gel across the cut surface on the rhizome (see label).

## Tobacco Bush – *Solanum mauritianum*

**Non-chemical options:** Seedlings can be manually removed.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	350 mL in 100 L of water 1.0 L in 60 L of diesel	Foliar application from spring to autumn. Cut stump application.
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	200 mL glyphosate per 10 L of water 1 part glyphosate per 1.5 parts of water	Foliar application for seedlings. Cut stump/injection application.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Tree of Heaven – *Ailanthus altissima*

**Non-chemical options:** Mechanical removal of mature trees, unless wet, will cause suckering from the broken roots.

	Chemical and concentration	Rate	Comments
	<b>Triclopyr</b> 600 g/L Various trade names	1.0 L in 60 L of diesel	Basal/bark, cut-stump application.
	<b>2,4-D + picloram</b> 300 g/L + 75 g/L Tordon® 75-D	650 mL in 100 L of water	Foliar application, apply at full leaf.
	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of diesel	Basal bark/cut stump application. Dormant species, not to be treated in winter.
	<b>Metsulfuron methyl</b> 600 g/L Various trade names	10 g metsulfuron methyl plus 200 mL glyphosate in 100 L of water	Apply to actively growing trees to point of run. Ensure all daughter plants are controlled.
	<b>Glyphosate</b> 360 g/L Various trade names		
	<b>Metsulfuron-methyl + glyphosate</b> 63.2 g/kg + 760.5 g/kg Cut-out®	1 measured pack (95 g) in 100 L of water	Apply when trees are in full leaf and actively growing; ensure all daughter plants are treated. November to January.
	<b>Hexazinone</b> 250 g/L Various trade names	4 mL per spot, one spot per metre of height	For use on bushes up to 3 m tall. <b>Do not apply near desirable trees.</b>
	<b>Metsulfuron methyl</b> 600 g/L Various trade names	10 g in 100 L of water	Apply to actively growing trees. Avoid spraying when stressed, when leaf fall has commenced, or after the end of February.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Turkey Rhubarb – *Acetosa sagittata*

**Non-chemical options:** Grub out single plants, prevent plants from seeding.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Metsulfuron methyl</b> 600 g/L Various trade names	1.0–2.0 g per 10 L of water	Spot spray.

## Tussock Paspalum – *Paspalum quadrifarium*

**Non-chemical options:** Grub out single tussocks, slash to prevent seeding.

There are no herbicides registered for this plant.

## Umbrella Tree – *Schefflera actinophylla*

**Non-chemical options:** Seedlings can be manually removed.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	1 part glyphosate per 1.5 parts water 200 mL per 10 L of water	Stem injection/cut stump application. Foliar application for seedlings
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Wandering Jew – *Tradescantia albiflora*

**Non-chemical options:** Small infestations can be manually removed and composted.

	Chemical and concentration	Rate	Comments
PER 5206	<b>Glyphosate</b> 360 g/L Various trade names	200 mL per 10 L of water	Treat in winter or early spring. For best results, add a surfactant. Apply two sprays, 6–8 weeks apart. Repeat treatments are essential.
	<b>Fluroxypyr</b> 200 g/L Starane 200®	150 mL in 10 L of water	Foliar application. Re-treatment necessary. Young plants up to and including flowering.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted (16 g/m <sup>2</sup> )	Use a long-handled paint roller or similar making sure the foliage has been completely flattened during application. (See label).

## Water Hyacinth – *Eichhornia crassipes*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** If practicable, small infestations can be manually removed. Care needs to be taken not to spread the weed further.

	Chemical and concentration	Rate	Comments
	<b>Diquat</b> 200 g/L Reglone®	400 mL per 100 L of water 5.0 to 10.0 L/ha	Add Agral 600 wetter; use clean water for best results. <b>Observe withholding period.</b>
	<b>Diquat</b> 20 g/L Vegetrol®	4.0 L per 100 L of water 50–100 L/ha	Apply as an overall spray. Thoroughly wet foliage. Best if clean water is used; higher rate if dense weed or dirty water. <b>Observe withhold period.</b>
	<b>Amitrole</b> 250 g/L Various trade names	280 mL to 100 L of water	Apply prior to flowering.
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only.	1.0–1.3 L in 100 L of water 6.0–9.0 L/ha	Apply when actively growing, at or beyond the early bloom stage. Use higher rate on dense infestations.
	<b>2,4-D acid</b> 300 g/L Affray 300®	1.0 in 200 L of water	Avoid causing submersion of sprayed plants.

## Water Lilies – *Nymphaea* spp.

**Non-chemical options:** Small infestations can be manually removed

	Chemical and concentration	Rate	Comments
	<b>Diquat</b> 200 g/L Reglone®	400 mL per 100 L of water 5.0–10.0 L/ha	Add Agral 600 wetter; use clean water for best results. <b>Observe withholding period.</b>
	<b>Diquat</b> 20 g/L Vegetrol®	4.0 L per 100 L of water 50–100 L/ha	Apply as an overall spray. Thoroughly wet foliage. Best if clean water is used; higher rate if dense weed or dirty water. <b>Observe withholding period.</b>
	<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	10 mL to 1 L of water	Re-treat unaffected plants.

## Water Lettuce – *Pistia stratiotes*

A Class 1 notifiable noxious weed that must be reported to LCAs and NSW DPI (phone 1800 680 244).

**Non-chemical options:** Physical removal of small infestations can be effective. For further information see Primefact 251 *Water Lettuce* from NSW DPI.

Chemical and concentration	Rate	Comments
<b>Diquat</b> 200 g/L Reglone®	400 mL per 100 L of water 5.0–10.0 L/ha	Add Agral 600 wetter, use clean water for best results. <b>Observe withholding period.</b>
<b>Diquat</b> 20 g/L Vegetrol®	4.0 L per 100 L of water 50–100 L/ha	Apply as an overall spray. Thoroughly wet foliage. Best if clean water is used; higher rate if dense weed or dirty water. <b>Observe withholding period.</b>
<b>Glyphosate</b> 360 g/L Various trade names for aquatic use only	1.0–1.3 L in 100 L of water	Best results are obtained from mid-summer through to winter. Use higher rate on dense infestations.
<b>2,4-D acid</b> 300 g/L AFFRAY 300®	1.0 in 200 L of water	Avoid causing submersion of sprayed plants. Coverage: 200 L spray solution per 1000 square metres.
<b>Calcium dodecyl benzene sulfonate</b> 300g/L Immerse®	1 part in 19 parts kerosene (1 L of mixture / 100 m <sup>2</sup> )	Do not use in potable water. Do not spray on solid mats. Plants must be floating in water with a visible water surface between plants.

## Whorled Pigeon Grass – *Setaria verticillata*

**Non-chemical options:** Slashing to prevent seed set and grazing management will aid control.

There are no herbicide registrations for this plant.

## Wild Radish – *Raphanus raphanistrum*

**Non-chemical options:** Maintain a well-balanced pasture with good grazing management.

Chemical and concentration	Rate	Comments
<b>2,4-D amine</b> 500 g/L Various trade names	100–140 mL in 100 L of water 1.7–2.1 L/ha	Apply to rosettes before flowering.
<b>2,4-D amine</b> 625 g/L Various trade names	1.4–1.7 L/ha	Apply up to young rosette stage.
<b>MCPA amine</b> 500 g/L Various trade names	1.0 L/ha	Apply to rosettes before flowering.

## Willows – *Salix* spp.

**Non-chemical options:** Mechanical removal is best, ensuring that all of the root system is removed. For further information see the national Willows Control Manual.

Chemical and concentration	Rate	Comments
<b>Glyphosate</b> 360 g/L Various trade names	1.0–1.3 L in 100 L of water Undiluted (1–2 mL per cut)	Spray to wet all foliage. Use the higher rate for trees 1–2 m high. Stem injection.
<b>Triclopyr + picloram</b> Access®	1.0 L in 15 L of diesel	Cut stump application. Need to treat all stems.
<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

## Yellow Bells – *Tecoma stans*

**Non-chemical options:** Small trees and seedlings may be manually removed

	<b>Chemical and concentration</b>	<b>Rate</b>	<b>Comments</b>
	<b>Triclopyr + picloram</b> 240 g/L + 120 g/L Access®	1.0 L in 60 L of diesel	Basal bark/cut stump application.
PER 5206	<b>Glyphosate</b> 360g/ L Various formulations and trade names Permit ??	1.0 L in 50 L of water 1 part per 1.5 parts of water	Spray seedlings. Stem injection or cut stem application.
	<b>Picloram</b> 45 g/kg Vigilant®	Undiluted	Cut stump/stem injection application. Apply a 3–5 mm layer of gel for stems less than 20 mm. Apply 5 mm layer on stems above 20 mm (see label).

# Gas gun application

## Metsulfuron methyl 600 g/L

Various trade names

Weed	Rate	Comment
Bitou/Boneseed	1 g/L + organosilicone penetrant	Spray as close as possible to the flowering stage.
Blackberry	1 g/L + organosilicone penetrant	Thoroughly wet all foliage and canes. Commence application at flowering, as this indicates good growing conditions.
Privet	1 g/L + organosilicone penetrant	Spray only bushes up to 3 m high, when in full leaf and actively growing. Thorough coverage is essential.
Sweet briar	1 g/L + organosilicone penetrant	Apply during the flowering period. Ensure thorough coverage of all leaves and stems.
Tree of heaven	1 g/L + organosilicone penetrant	Apply when bushes are in full leaf and actively growing. The use of an organosilicone penetrant will aid in leaf wetting and extend the area covered.

## Triclopyr 600 g/L

Various trade names

Weed	Rate	Comment
Blackberry	280 L per 10 L of water	Good control will be achieved, similar to high volume application, where bush size enables good coverage of entire bush. The use of a marking agent is recommended to check on coverage.

## Triclopyr + picloram 300 g/L + 100 g/L

Various trade names

Weed	Rate	Comment
Blackberry	335 mL per 10 L of water	Apply to actively growing bushes
Crofton weed, Camphor laurel, Mistflower, St. John's wort, Sweet briar and Tobacco bush	500 mL per 10 L of water	Apply to actively growing bushes

## Glyphosate 360 g/L

Various trade names and formulations

Weed	Rate	Comment
Bitou/Boneseed	1 part per 29 parts water or 1 part per 19 parts water	Ensure spray contacts all foliage. Use the higher rate on bushes over 1.5 m.
Groundsel bush	1 part per 9 parts water	Apply 2 × 5 mL doses per 0.5 m of bush height. Ensure that spray contacts all foliage.
Lantana	1 part per 9 parts water	Apply 2 × 2 mL doses per 0.5 m of bush height. Ensure that spray contacts all foliage.
Sifton bush	1 part per 9 parts water	Apply 40 mL dose per 0.5 m of bush height. Ensure that spray contacts all foliage.
Sweet briar	1 part per 9 parts water	Apply 2 × 5 mL doses per 0.5 m of bush height. Ensure that spray contacts all foliage.



# Appendix 1: Boom spray calibration methods

## Calibration Calculation (Boom Sprays)

All sprayers need to be calibrated regularly to work efficiently and economically. Regular calibration ensures the right amount of chemical will be applied to the target without costly wastage. The following templates will enable you to calculate how much chemical and water to use.

### Part A: General Information

Item of equipment to be calibrated.	
Spray tank capacity (litres).	L ⑤
Area to be sprayed.	ha ⑦
Chemical used.	

### Part B: Recording

What is the minimum desired water application rate (if any)?	L/ha
What chemical rate is to be used?	L/ha ④
Select an appropriate ground speed.	gear rpm
Record spray operation pressure.	kPa or bar
Record nozzle type and size.	type size
Record minimum boom height above target.	cm

### Part C: Measuring

Record the output from every nozzle for 1 minute.								
1 ____	2 ____	3 ____	4 ____	5 ____	6 ____	7 ____	8 ____	Total spray output ① (add all nozzles)
9 ____	10 ____	11 ____	12 ____	13 ____	14 ____	15 ____	16 ____	
17 ____	18 ____	19 ____	20 ____	21 ____	22 ____	23 ____	24 ____	
Replace nozzles that vary by more than $\pm 10\%$ from stated output.								L/min
Record actual effective spray width (metres)								m ②

## Calibration Calculation (Boom Sprays) (continued)

### Part D: Calculating

<b>Actual ground speed*</b>	$\frac{\text{Distance covered (m)} \times 3.6}{\text{Time taken (seconds)}}$	$\frac{( ) \times 3.6}{( )}$	= _____ km/h ③
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\* Determine actual ground speed by measuring a set distance, say 100 metres, under similar conditions to the area to be sprayed and timing how long it takes using the pre-determined gears and revs.

<b>① Total spray output</b> L/min	<b>② Effective spray width</b> m	<b>③ Actual ground speed</b> km/h
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<b>Water application rate</b>	$\frac{\text{①} \times 600}{\text{②} \times \text{③}}$	$\frac{( ) \times 600}{( ) \times ( )}$	$= \frac{( )}{( )}$	L/ha ⑥
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What adjustments could you make to your equipment if the water application rate were outside the range recommended on the label?

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<b>Chemical rate</b> L/ha ④	<b>Spray tank capacity</b> L ⑤
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How much chemical to mix in each tank?	$\frac{\text{④} ( ) \times \text{⑤} ( )}{\text{⑥} ( )}$ = _____ L
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How many tank loads are needed for the job?	$\text{⑦} \text{ (ha)} \times \text{⑥} \text{ (L/ha)}$ = _____ L ⑧ of spray mix	$\text{⑧} \text{ (L)} \div \text{⑤} \text{ (L)}$ = _____ tanks
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## Calibration Calculation (Knapsack Sprayer)

### Step 1

Part A	What is the desired water application rate? (From the product label.)	L ____ / ____
Part B	Select appropriate chemical rate (from the label).	mL ____ / ____
Part C	Record the nozzle type and size (from the equipment).	Type Size
Part D	Is there a required operating pressure? If so, what is it?	Yes      No kPa or Bar ____
Part E	Tank size of equipment.	____ L
Part F	Hand-held height above target should be recorded.	____ cm above target

### Step 2

Part G	Measure out an area $10\text{ m} \times 1\text{ m}$ (this is $10\text{ m}^2$ ). This is an area of 1/1000th of a hectare ( $1\text{ ha} = 100\text{ m} \times 100\text{ m}$ ).	
Part H	Using the required pressure (or a constant pressure), time how long it takes to spray this area. (Walk at a comfortable pace, ensuring complete coverage.)	Time in seconds
Part I	Spray into a measuring jug for the same time it took to cover the $10\text{ m} \times 1\text{ m}$ area. Record this output.	____ L
Part J	You can now multiply this figure by 10, which will give a water application rate per $100\text{ m}^2$ .	$10 \times$ ____ L = ____ / $100\text{ m}^2$
Part K	OR you can now multiply this figure by 1000 to give a water application rate/ha.	$1000 \times$ ____ /L = ____ /ha

### Step 3

Part L	Does this water application rate comply with the chemical label requirements?	Yes      No
Part M	If not, suggest a way to change this rate to meet the requirements on the label. ..... .....	

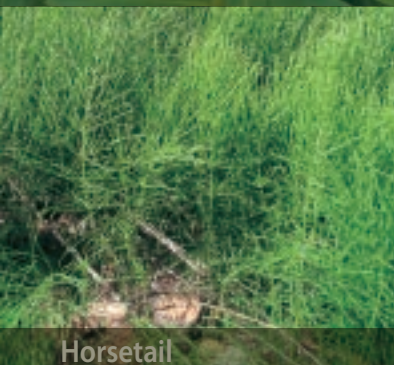


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# Have you seen these noxious aquatic weeds in your area?



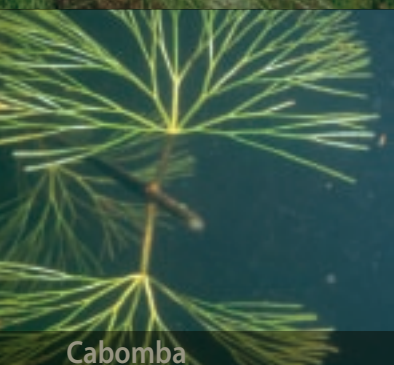
Alligator Weed



Horsetail



Lagarosiphon



Cabomba



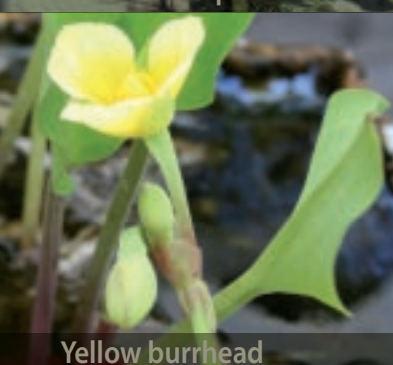
Water Caltrop



Hymenachne



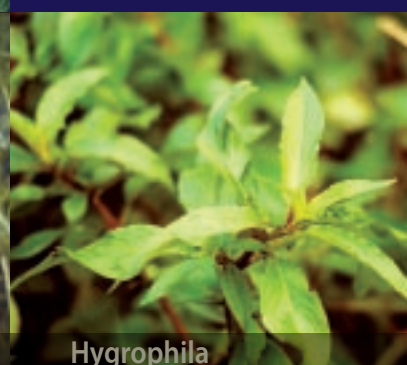
Senegal Tea Plant



Yellow burrhead



Eurasian water milfoil



Hygrophila

**Early detection and intervention is the most cost effective form of aquatic weed management.**

For information about aquatic weeds, Early Detection Surveys and identification Workshops contact

Grafton DPI on (02) 6640 1600 or your Local Council Weeds Officer.



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