



Northern  
Territory  
Government

Northern Territory

# Weed Management Handbook



CHANGE  
YOUR  
WORLD.  
**CHARLES  
DARWIN  
UNIVERSITY**

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## About this Manual

This manual has been developed to provide detailed information about weed control in the Northern Territory.

**Weed Control Option Tables** are available for most problem weeds which detail herbicide recommendations and optimum treatment times. Other control methods, which when used in combination with herbicides can assist in more efficient weed eradication, have also been described.

It should be noted that this document has been designed to provide information for the control of weeds in non-crop situations.

The development of this manual aligns with priorities identified in the *Katherine Regional Weed Management Strategy and Action Plan 2005-2010* that was launched in September 2005 by the Katherine Regional Weed Advisory Committee. For further information go to [www.nt.gov.au/weeds](http://www.nt.gov.au/weeds)

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Users of agricultural (or veterinary) chemical products must always read the label and any Permit, before using the product and strictly comply with the directions on the label and any conditions of any Permit. Users are not absolved from compliance with the directions on the label or conditions of the Permit by reason of any statement made in or omission from this publication.

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**If you suspect poisoning, please contact the Poisons Information Centre Emergency on 13 11 26 (24-hour)**

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## Weeds in the Northern Territory

Weeds severely impact the Northern Territory's (NT) environmental, economic, social and cultural values.

Environmental values such as biodiversity and ecological function are impacted, through the invasion and replacement of native plant communities and wildlife habitat. Weed infestations can also harbour feral animals, and hinder their control.

Weed infestations can reduce the availability of traditional foods and other resources used by Indigenous people by displacing native plants and animals. Weeds can influence the social well being of Indigenous landowners by disrupting their spiritual and physical connections to country.

Weed populations can also result in restricted access to and recreational use of natural landscapes.

Hunting, fishing, camping and bushwalking can all be affected by weeds. Weed monocultures, such as those created by mimosa, significantly diminish the aesthetic values of the natural landscape.

Weeds in the NT cost land managers millions of dollars per year, through costs of control and lost production. The following information has been taken from the Pastoral Industry Survey NT 2004. It shows the spending, per station, in each of the major cattle producing regions of the NT.

**Table 1 – Average dollars spent in individual properties in each region on weed control in 2004**

Region	Average \$ spent per property	Minimum \$ spent per property	Maximum \$ spent per property
Alice Springs	1414	0	10 000
Top End	63 700	500	400 000
Katherine	7 918	0	150 000
Barkly	20 262	0	100 000

## Legislative Responsibilities

The NT *Weeds Management Act* applies to all owners, managers and occupiers of land, and all other land users in the NT. To view the complete *Weeds Management Act* (the Act) and the Weeds Management Regulations please go to <http://www.nt.gov.au/dcm/legislation/current.html>

Once a weed is declared in accordance with section 7 of the Act there is a requirement for all land holders, land managers and land users to comply with the declaration classification. There are three classification types in the NT, these being:

- Class A: To be eradicated.
- Class B: Growth and spread to be controlled.
- Class C: Introduction into the Territory is to be prevented.

All Class A and Class B weeds are also considered Class C. For information on the classification of individual species please refer to the Weed Control Options Tables or visit [www.nt.gov.au/weeds](http://www.nt.gov.au/weeds).

## Weed Prevention

Both owners and occupiers of land are required to take all reasonable measures to prevent their land being infested with a declared weed.

## Spread Prevention

All land users are required to prevent the spread of a declared or potential weed. This requirement applies on and off your own property.

## Advising of Outbreaks

Where a declared weed is identified in an area that it has previously not been found, the person responsible for the land has 14 days to notify the Weed Management Branch (NRETAS) of its presence – see contact details on the inside cover of this document.

## Weed Disposal

It is illegal to transport declared weeds. You should dispose of any weed material on site. Burning will destroy vegetative plant material and also render most seeds unviable. As some hard coated seeds may survive, on-site deep burial may also be required. On site burial of seeds, and/or plant material, is an effective option if material is placed at a depth sufficient to prevent emergence of vegetative shoots or seedlings.

## Compliance with a Weed Management Plan

The owner and occupier of land on which a declared weed or potential weed is present must comply with any relevant weed management plan approved by the Minister in accordance with section 10 of the Act.

## Monitoring by Government Officials

The Minister may appoint a Weed Management Officer or authorised person ('Officers'), who is empowered to investigate suspected breaches of the Act. Officers have a number of powers under the Act, including entering and searching properties, documenting findings and, if necessary, ordering the owner or occupier of the land to control or eradicate declared or potential weeds. They are also able to order the owner or person in control of vehicle, boat or animal to remove or destroy any weed material.

## Can I be Fined?

An individual who is found guilty of non-compliance with the Act may be subject to a penalty of between \$5,000 and \$50,000. A body corporate may be fined between \$25,000 and \$250,000. On-the-spot fines of up to \$200 for an individual or \$1000 for a body corporate may also be issued.

## Strategic and Planned Approaches to Weed Management

Different levels, types and locations of weed infestation require different levels of investment, in terms of financial input, human resources and time. This document aims to assist landholders to determine the most appropriate course of action for their property. Effective management should involve:

- preventing introduction;
- preventing or suppressing reproduction, including prevention of seed production and vegetative expansion;
- preventing spread through dispersal of propagules, including seeds and viable vegetative sections;
- eradicating new/isolated outbreaks, particularly those high in the catchment and close to water sources; and
- where eradication is not possible, containing established populations.

These can be achieved by:

- developing/implementing a property management plan which complements other plans within the catchment;
- developing a budget for your weed management control;
- planning to exploit any known weakness in the weed's life-cycle or ecology;
- integrating all appropriate control methods e.g. biological, chemical, and mechanical;
- integrate weed control with other management actions e.g. managing grazing regimes, fire and feral animals;
- implementing a rehabilitation program e.g. revegetation; and
- implementing a monitoring and evaluation program.

## Property Management Planning

Developing a property management plan for your property is about identifying and prioritising what needs to be achieved, within a set time frame. A plan should aim to systematically contain, reduce and in some instances, eradicate weed infestations, while protecting unaffected country. Ideally property management plans should take into consideration the weed's current distribution, the potential for spread (consider mechanisms for spread with respect to topography, proximity to water courses, proximity to access tracks/roads) and potential impacts on land use and other values such as biodiversity.

Property management plan templates are available from the Weed Management Branch (see contact details on the inside cover of this document). Weed Management Officers from the Weed Management Branch, NRETAS can provide assistance with the development of property management plans and can provide advice all facets of weed management, including control techniques, biological control, legislative responsibilities, monitoring, reporting and regional planning.

## Mapping

Any plan will need to address how big the problem is and where the problem is. Good plans should also take into consideration weed infestations in neighbouring areas and facilities.

The Weed Management Branch has produced *Guidelines for Weed Data Collection in the Northern Territory*. The guidelines describe what information to collect when mapping, controlling and monitoring weed infestations in the NT. The guidelines can be downloaded from [www.nt.gov.au/weeds](http://www.nt.gov.au/weeds). The NT guidelines are based on the national guidelines published in *A Field Manual for Surveying and Mapping Nationally Significant Weeds*, which can be viewed at <http://www.daff.gov.au/brs/land/weeds>.

The supply of weed data to the Weed Management Branch by individuals and groups using the NT Guidelines is important to increase our knowledge of weeds within the NT. The collection of data in accordance with the Guidelines for Weed Data Collection in the Northern Territory will result in improved and consistent data quality. Increased quality and quantity of weed infestation data across all parts of the NT is fundamental in planning and delivering strategic and coordinated weed management to protect the Territory's assets.

## Coordinated Management

As weeds do not recognise property, tenure or state boundaries, it is imperative that land owners work together to coordinate a systematic management approach across catchments to contain weed spread. The responsibilities of individual land owners should be determined and clearly communicated. Complementary property management plans should be developed, administered and evaluated.

## Monitoring and Evaluation

A property management plan should include realistic time frames and goals, recognising that achievements, particularly with regards to established populations, may only become evident in the long term. It is important to document weed occurrences and the control methods used so that success, or failure, can be critically analysed. Accurate records can enable a management program to be reworked or fine tuned depending on the need. Above all, continual maintenance is imperative otherwise reinfestation may only be one growing season away.

## Weed Management Plans

Section 10 of the NT *Weeds Management Act* determines that the Minister may approve species-specific Weed Management Plans for a range of purposes including:

- preventing entry of a species to the NT;
- managing a species within the NT; and/or
- managing a species within an area of the NT.

Weed Management Plans are currently being developed for a number of high priority species in the NT. Management requirements identified are consistent with those identified at the catchment, regional, NT and national levels. Information contained within this guide will assist in meeting requirements identified in statutory Weed Management Plans. Further information regarding the status and availability of these plans is available from NRETAS Weed Management Branch.

## Further Information and Resources

Detailed information regarding the management and identification of individual weed species are available from NRETAS Weed Management Branch. Examples of resources include WeedNotes, Weed Identification Tables and Best Practice Management Guides. Please visit the website <http://www.nt.gov.au/weeds> or email the Branch directly [weedinfo.nretas@nt.gov.au](mailto:weedinfo.nretas@nt.gov.au) for information.

## Prevention

The easiest and cheapest form of weed control is prevention. Weeds can invade through a number of mechanisms and pathways, but invasion can be combated by applying a few basic principles:

- know what weeds are in your region and ensure they are not inadvertently brought in via items contaminated with seed (e.g. vehicles, machinery, hand tools, soil, feed, mulch and livestock);
- be able to recognise existing and potential weeds which threaten the NT. Early identification of an outbreak can save thousands of dollars;
- use established roads and tracks and avoid weed-infested sites;
- if areas containing weeds are encountered, clean all equipment, vehicles and machinery prior to leaving;
- check boats, propellers and trailers before entering and leaving waterways;
- contact landowners before entering properties to see if they have any preventative measures in place;
- dispose of weed plant material and seeds by burning and/or burying at an appropriate depth;
- check the weed status of commercially available garden plants before planting on your property;
- never dispose of aquarium contents into drains or waterways; and
- most importantly, control any weed infestations before they spread.

*See Appendix A for information on the prevention of weed seed spread, including vehicle hygiene requirements.*



## Weed Control Methods

### Physical Removal

Hand-pulling, although laborious, is effective for recent outbreaks prior to seed set. All root material should be removed from the soil and the plant destroyed to prevent re-sprouting. Grubbing is similar to hand-pulling but employs tools such as mattocks and spades. Slashing by hand with a brush-cutter or using a tractor and blade can be an effective means of controlling weed growth and suppressing flower and seed development. Chaining woody weeds can remove the roots and provide efficient rows for burning. This option is best implemented at the end of the wet season when soil moisture is sufficient to allow efficient root removal. Blade-ploughing can be used to push over some woody shrubs and sever their roots underground. The cultivation method is designed to expose the roots and then bury the plant deep enough that it cannot re-sprout.

*Note:* Disturbance of soil can facilitate weed growth, for this reason follow-up and regeneration work should form part of a management program. Physical removal should not be undertaken when a weed is actively producing seeds, as seeds are likely to spread and subsequently set in disturbed ground.

### Control Using Fire

Fire is most effective as part of an integrated management plan. In areas with a high fuel-load capable of sustaining a slow, concentrated fire, burning may be used to remove woody weed debris, destroy emergent seedlings and kill seeds. However it should be noted that cooler fires may actually scarify seed and therefore induce germination. Generally following an initial burn, fire should be excluded to provide other desirable plants with optimal conditions to establish and compete with any emerging weed seedlings. Poorly managed or unmanaged fires can increase weed establishment by burning hot and fast. These fires cause minimal damage to the soil-stored weed seed bank, but can significantly damage native vegetation, hence stimulating prolific post-fire weed regeneration.

*Note:* Any management incorporating burning should be in accordance with the *Bushfires Act*. Please phone Bushfires NT on 8922 0844 or 8976 0098 with any fire management/planning enquiries.

## Biological Control (Biocontrol)

When an exotic weed is introduced, it arrives without the enemies and natural plant competitors that are present in its native range. Biocontrol is a method of weed management that attempts to regain the ecological balance that a weed would have in its native range. Release of biological control agents, such as insects or plant diseases, can decrease weed infestations to manageable levels, enabling other forms of control to be implemented. Biocontrol is a long-term approach and agents are only released after rigorous scientific trial and research to ensure that they will not damage native. See Appendix B for additional information on specific biological control research and developments in the NT.

## Chemical Control

Herbicides are commonly used for controlling weeds in both agricultural and non-agricultural situations. Numerous forms of application techniques and equipment are available to apply herbicides. The options chosen should be determined by the size of the infestation, the available resources, access and personal preferences. Detailed information on herbicide control options and correct usage procedures is included in this document.

*Note:* Users of agricultural (or veterinary) chemical products must always read the label and any Permit, before using the product and strictly comply with the directions on the label and any conditions of any Permit.



## Integrated Weed Control

Integrated weed management combines the use of complementary weed control methods resulting in more effective, long term weed management outcomes. Integrated control requires planning, as often the timing of one control method can enhance the effect of another. An example of integrated weed management is the

- release of biological control agents to reduce vigour in a dense weed infestation **plus**
- use of herbicides to control satellite infestations of the weed elsewhere on the property **plus**
- management of a buffer zone around the dense infestation using physical/chemical control techniques **plus**
- reduction of grazing pressure in areas where weed eradication has been successful **plus**
- exclusion of grazing from areas with severe weed problems **plus**
- the implementation of preventative weed management strategies for the remainder of the property.

## Land Management

Degraded or disturbed land is known to be far more susceptible to weed invasion. For this reason weed control cannot be viewed in isolation from other land management practices.

- Large feral animals, such as buffalos and pigs, can facilitate weed seed spread and germination through behaviours, such as roaming, wallowing and rooting. An effective weed management program should incorporate a feral animal control or exclusion program.
- Fire can be used as an efficient management tool for weed control or, conversely, uncontrolled fire can reduce land condition and facilitate weed establishment and spread.
- The management of clean buffer zones around affected areas can assist in managing outbreaks and containing large infestations.
- Continued maintenance of fire breaks, fence lines and roads can decrease the probability of seed spread and the development of new weed infestations.
- Appropriate stocking rates on suitable native and introduced pastures will allow maximum pasture growth to compete with weed seedlings. Weeds will flourish on over-grazed country.
- Hygiene practices are vital in order to maximise the effort of control methods. Land managers should use weed-free seed and hay, clean machinery, maintain quarantine areas for cattle which may be carrying seed and, where possible, eradicate or isolate infestation sources on the property.

**Table 2 – Control Options**

Infestation level	Biological	Chemical	Mechanical	Physical
Low (Canopy cover between 1% - 10%)	Not suitable.	Spot spraying by hand with a registered herbicide.	Not suitable.	Hand grubbing (remove roots and burn plant).
Medium (Canopy cover between 11% - 50%)	Release of biological control agents.	Spot spraying by hand with a registered herbicide.	Chaining, rolling, raking or back-ploughing, then burning.	Follow up control of seedlings – could include physical removal.
High (Over 50% canopy cover)	Inspect infestation to see if and what biocontrol agents are already present. If necessary, release biological control agents and monitor their progress.	Aerial spraying with a registered herbicide.	Attack with chaining, rolling or raking. Use fire to kill any regrowth and break seed dormancy.	Follow up control of seedlings – could include physical removal.

## Using Herbicides Correctly

A person who uses a chemical product has a duty of care to ensure the use does not result in harm to the health of the general public, animals, the environment or domestic or export trade in agricultural produce.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) register pesticides and herbicides for use in Australian States and Territories according to the provisions of the *Agvet Code Act*. In addition,

the use of agricultural chemical products in the NT is controlled under the *Agricultural and Veterinary Chemical (Control of Use) Act*, including *Schedule 7 (Dangerous Poisons)* and *Restricted Chemical Products*. Herbicides must be used according to the directions for use on the APVMA registered label.

The following demonstrates a typical product label format. **It is illegal not to follow the label's instructions.**

### MAIN PANEL

SIGNAL HEADING (*poisons schedule*)  
TRADE NAME/DISTINGUISHING NAME  
ACTIVE CONSTITUENT(S)  
(*chemical ingredient, concentration and formulation*)  
MODE OF ACTION  
(*eg: Group C Herbicide – see next page*)  
STATEMENT OF CLAIMS FOR USE  
(*purpose for which product is registered*)  
PROHIBITION AND RESTRICTION STATEMENTS (*eg: do not apply by air*)  
NET CONTENTS (*volume of container*)

### ANCILLARY PANEL/S

#### DIRECTIONS FOR USE:

Restraints

Crop Pest State Rate Comments

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

OTHER LIMITATIONS (*eg: where the herbicide can be used, who the herbicide can be used by*)

WITHHOLDING PERIOD (*minimum interval that should elapse between herbicide application and harvesting, grazing, cutting, slaughtering or the collection of milk and eggs for human consumption*)

#### GENERAL INSTRUCTIONS

Mixing and application – (*eg: mix only with clean water, pre-dissolve and agitate*)

COMPATIBILITY (*may provide examples of chemicals which should not be mixed together*)

PROTECTION OF WILDLIFE, FISH, CRUSTACEAN AND THE ENVIRONMENT (*eg: some chemicals may not be registered for use in specific areas, such as watercourses*)

STORAGE AND DISPOSAL (*See appendix F for information on drumMUSTER and ChemClear*)

SAFETY DIRECTIONS (*this will include necessary personal protective equipment – PPE*)

FIRST AID (*Appropriate actions and contact details will be provided*)

EMERGENCY INFORMATION (*will include contact number*)

REFERENCE TO MSDS (*material safety data sheet, this supplements information on the label*)

#### COMPANY WARRANTY STATEMENT

COMPANY NAME, ADDRESS AND AUSTRALIAN COMPANY NUMBER

Batch No: Date of manufacture: Expiry date (*for veterinary and some agricultural products*)

Dangerous good symbol (*if required*).

A permit allows a person or organisation to use an agricultural chemical product in situations that would otherwise be in contravention of the *AgVet Code Act* or the *Agricultural and Veterinary Chemical*

(*Control of Use*) Act. Permits can be issued for minor use, emergency use and research purposes. See the APVMA website for further details <http://www.apvma.gov.au/index.asp>

## Herbicide Toxicity

A herbicide can be defined as a chemical substance used to destroy or inhibit the growth of plants, especially weeds. Herbicides need to be biologically active or toxic, to be effective against the plants that they are intended to kill. In addition to the active ingredient, herbicide formulations may contain other chemicals, such as surfactants and carriers, which may also be toxic. Herbicides can have both immediate (acute) effects and chronic (long-term) effects on the health of people who are exposed to them. Correct administration procedures must be implemented to avoid adverse health effects.

### Acute Toxicity

Poisonings resulting from acute exposure to herbicides can result in a symptoms varying from fatigue, headache, sweating and dizziness to numbness, changes in heart rate, difficulty in breathing and excessive salivation. Advanced poisoning cases may result in convulsions and coma which could lead to death.

### Chronic Toxicity

The effect of long-term exposure to a chemical/s is referred to as chronic toxicity. Effects of chronic toxicity due to long term herbicide exposure include:

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

**Table 3 – Poisons Schedule**

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

## Routes of Exposure

Chemicals can enter the human body through the skin, lungs, mouth and eyes. Extreme care should be taken to prevent exposure to herbicides, the following should be considered:

- The exposure risk is highest when handling the concentrated version of a product. The most hazardous phase of application is mixing and loading the concentrated product.
- A respirator may be required when mixing/loading or applying herbicides 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) and if application carries the risk of inhaling the spray mist.
- Ingestion or swallowing is a risk to users who don't wash their hands after handling chemicals, particularly before eating and drinking. Smoking during chemical preparation and application is not recommended for this reason.

The acute or immediate toxicity of herbicide is required by law to be communicated in the Poisons Schedule (or poison warnings) which appear on the label of a product. Herbicides are classified into four categories on the basis of their potential toxicity to the user. Each schedule has a corresponding signal heading, which appears in large contrasting lettering on the label of the pesticide product. The Poison Schedule will largely determine the safety directions and first aid instructions that appear on the label. **If you suspect poisoning, contact the Poisons Information Centre, emergency phone 13 11 26 (24-hour).**



## Re-entry Intervals

Once applied, herbicides can remain on sprayed plants in the form of foliar aerosol particles. These residues can readily be dislodged and absorbed through the skin. The re-entry interval is the time that must lapse between applying the herbicide and re-entry into the sprayed area in order to avoid post application exposure (unless the personal protective equipment specified for re-entry on the label is worn). Re-entry intervals appear on the labels of products that have been subject to a technical review by the APVMA. If a re-entry period is not specified on the label, the general rule is to wait 24 hours after application or until the plants are dry, whichever is the longer. Sprayed areas should never be re-entered when the plants are wet i.e. from dew or light rain, irrespective of the time elapsed, unless appropriate personal protective equipment is worn.

## Withholding Periods

The withholding period is the minimum mandated interval that should elapse between the last application of herbicide to any crop, pasture or animal and the harvesting, grazing, cutting, slaughtering or the collection of milk and eggs for human consumption. Observance of the withholding period stated on the registered label is a legal requirement and is part of the direction of use.

## Modes of Action

Modes of action refer to how different groups of herbicide kill plants. Understanding how herbicides work is useful for selecting the correct products, correct application time and method and preventing herbicide resistance problems (Barrett, M. and Reed, G., 1997). For further information see Appendix E.

Plants are complex organisms with defined structures in which many vital processes occur in well ordered sequences. Plants are made up of organs (roots, leaves etc), which consist of tissues (photosynthetic, meristematic and structural tissue etc), that in turn are made up of cells. Within these cells metabolic processes such as photosynthesis, protein synthesis and respiration occur. Other processes include cell growth and differentiation, seed formation, translocation of molecules and transpiration. Herbicides are designed so that they disrupt one or more of these processes and kill the plant.

In simple terms, the following describe the various modes of action:

- growth regulators;
- amino acid synthesis inhibitors;
- lipid synthesis inhibitors;
- seedling growth inhibitors;
- photosynthetic inhibitors;
- cell membrane disrupters; and
- pigment inhibitors.

### Example:

Tebuthiuron (e.g. Graslan®) is a herbicide that interferes with photosynthetic processes. Products such as Graslan® are applied to the soil and therefore require adequate soil moisture to allow uptake and transfer from the plant roots, through the stem and ultimately to the sites where photosynthesis occurs. If adequate soil moisture is not available, the effectiveness of control efforts will be reduced. Persistence of the product within the soil profile is dependent upon factors such as the application rates and soil pH. The mobility of the product within the soil profile, and availability of the product to the plant will also be affected by soil characteristics such as organic matter content and soil profile structure.

## Herbicide Resistance

Herbicide resistance is the ability of a plant to survive, grow and reproduce after exposure to a dose of a particular herbicide that would normally be lethal. In certain plant populations herbicide resistance may occur naturally or may be a result of genetic engineering.

Herbicide resistance may emerge as a problem due to the continual use of a particular herbicide, or group of herbicides with the same mode of action, on a population of plants. When resistant individuals within a population survive and reproduce, the population may become dominated by individuals able to survive the particular herbicide, or group of herbicides with the same mode of action.

The development of herbicide resistance can be reduced by minimising use of “high resistance risk” herbicides (e.g. group A and B herbicides) and ensuring that herbicides with the same mode of action are not used repeatedly on the same population of weeds.

# Herbicide Control Techniques

## Foliar Spraying

Foliar spraying is the use of herbicide diluted with water, at a specific rate, and sprayed over the foliage to the point of runoff (until every leaf is wet but not dripping). Spraying should be undertaken when a plant is actively growing to maximise the effectiveness of the herbicide. Foliar spraying can be efficient and cost effective; however there may be 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.



**Plate 1 - Foliar spraying of gamba grass**

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 spray unit. Spot spraying is used to treat individual weed plants or areas that have only small clumps of weed infestations.

### Reducing herbicide spray drift

When applying herbicides the aim is to maximise the amount reaching the target and to minimise the amount reaching off-target areas. 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.

- **Particle drift** occurs when water and other herbicide carriers evaporate quickly from the droplet leaving tiny particles of concentrated herbicide.
- **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.

Any herbicide can drift. The drift hazard, or off-target potential of herbicide, in particular situations 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 dry flowables.
- **Type of adjuvant:** non-ionic surfactants and penetrants added to the spray solution will produce smaller droplets than oils.

In areas where there is a range of land uses, there is potential for conflicts to arise. People using herbicides have a moral and legal responsibility to prevent drift and/or contamination which may impact on health, the environment or neighbouring crops.

### Before Spraying

- determine the most appropriate method of application and equipment for the situation;
- always check for sensitive areas in the vicinity, such as houses, schools, crops and riparian areas;
- check for predicted weather conditions, only proceed if these are favourable;
- notify neighbours of your spraying intentions; and
- prepare to record all necessary details of the herbicide usage.

## 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, herbicide and water rates, and operating details;
- 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 at their coolest;
- 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 e.g. keep a boom width from the downwind edge of the sprayed area; and
- if sensitive crops are in the area, use herbicide which is the least damaging.

## Unfavourable Weather Conditions

Unfavourable weather conditions include:

- midday turbulence: up-drafts cause rapidly shifting wind directions (spraying should stop by 11 am);
- high temperatures, particularly when using herbicides which are highly volatile or susceptible to drift;
- low humidity;
- high humidity – this extends droplet life and can greatly increase the drift hazard of fine droplets;
- still (stable) conditions;
- high winds; ideal safe wind speeds are 7–10 km/h; and
- periods during, before or immediately after rain; excess water will reduce the effectiveness of your application.

*For information on spray equipment calibration refer to Appendix C.*

## Rope/wick Applicators

This method of applying herbicide consists of a wick (or rope) soaked in herbicide from a reservoir (usually attached to handle). Herbicide is pumped to the wick with 12-volt equipment. The saturated wick is used to wipe or brush herbicide over the weed. Commercially available equipment such as Weed Wand and Weed Wiper can be 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. 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. It may be necessary to go higher on bigger trees.



**Plate 2 - Basal bark herbicide application to young mimosa**

Basal bark spraying is a very effective control method, and a good way to tackle inaccessible areas such as steep banks. It is a well targeted form of spraying, having little or no drift. This method will usually destroy 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. As a general rule, the larger the plant, the greater the area of bark that needs treating. The basal bark technique can become less effective in some species once the basal diameter is greater than 5-10 cm.

## 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.

### 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, therefore 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.

### 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.

## Tree Spearing

An alternative stem injection method involves using 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.

## Cut Stump

Here the plant is cut off completely at the base (no higher than 15 cm from the ground) using a chainsaw, axe, brush-cutter or machete (depending on the thickness of the stem/trunk). The 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. For this reason two operators working as a team can use this method effectively. The herbicide can be applied from a backpack, 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. Many species will sucker if not treated using this method.



**Plate 3 – Cut stump technique – herbicide application to mimosa**

## Using Adjuvants, Surfactants and Oils with Herbicides

Some herbicides need assistance to spread across and penetrate the leaf surface of target weeds. An adjuvant is an additive to herbicide, intended to improve its effectiveness. Adjuvants can be classified as surfactants, crop oils, penetrants and acidifying buffering agents.

### Surfactants or 'Wetting Agents'

These are products that increase the spread of droplets, aiding the wetting of waxy or hairy leaf surfaces. The most commonly used agricultural surfactants are non-ionic, these remain on the leaf once dry and allow 'rewetting' after rain, permitting additional herbicide uptake.

### Crop Oils

Most crop oils contain emulsifiers which allow them to mix with water. Some contain various levels of surfactants. Some claims regarding oil adjuvants include reduced rain-fast periods, more uniform droplet size (drift reduction), less spray evaporation and better penetration of herbicide into waxy leaves.

Mineral oils are usually a blend of mineral oil and non-ionic surfactant. Products such as Ad-Here® have low levels of surfactant, whilst Uptake® and Supercharge® have higher levels. These products have lower potential for crop injury or damage due to chemical treatment, as they are more refined.

Vegetable oils 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® is an example of this product type.

### Penetrants

These are specific compounds that help dissolve waxy cuticles.

### Acidifying Buffering Agents

These help lower the pH of the spray solution, making solutions more acidic. Most herbicides are most stable when the pH of the solution is between 6 and 7 (neutral or slightly acidic).

### 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. An example of this product is Liquid Boost®. Some products combine a number of the above roles, for instance Hot-up® contains a surfactant, a compatibility agent and 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

Adjuvants are usually added to increase the effectiveness of herbicides. However, use of the wrong type or rate can reduce effectiveness. It should also be noted that the addition of an adjuvant can reduce herbicide selectivity. This is not an issue for fallow and pre-emergent herbicides. 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.

## Records of Use

All users of agricultural chemical products in the NT are required to keep detailed records of use for a minimum of two years and include:

- name and address of person who used the product;
- name of the product;
- rate and amount used;
- method of application;
- expiry date of the product;
- date and time the product was used;
- exact location of where the product was used;
- date and time of when the product was used;
- type of crops, pastures or plants in the area;
- temperature and wind speed/direction;
- name of target pest or disease; and
- withholding period.

Go to <http://www.nt.gov.au/drdpifr> for more information.

## Disposal of Excess Chemicals and Used Chemical Containers

Empty chemical containers and any unused chemicals must be disposed of in an environmentally responsible manner. For information on how to responsibly dispose of chemicals please refer to Appendix F.

## Chemical Handling Training

It is strongly recommended that all persons using herbicides complete a chemical safety training course. Chemical handling training is a legislative requirement for schedule 7 chemicals. Training in the safe and effective use of chemicals is provided by various registered training organisations. Please refer to Appendix D for information on courses relevant to chemical application in the NT. The APVMA website has further details at <http://www.apvma.gov.au/index.asp>



## Weed Control Option Tables

This publication is presented only as a guide to assist in planning weed control. The following must be taken into consideration when planning your weed management program.

Users of Agricultural (or veterinary) chemical products must always read the label and any Permit, before using the product and strictly comply with the directions on the label and any conditions of any Permit. Users are not absolved from compliance with the directions on the label or conditions of the Permit by reason of any statement made in or omission from this publication.

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 the NT Government Department of Natural Resources, Environment, The Arts and Sport over any other equivalent product from another manufacturer.

Any management incorporating burning must be in accordance with the *Bushfires Act*. Please phone Bushfires NT on 8922 0844 or 8976 0098 with any fire planning/management queries.

**Table 4 – Abbreviations and Terms**

Abbreviations and terms	Definitions
/ha	per hectare (10 000m <sup>2</sup> )
ml / l	millilitres per litre
m <sup>2</sup>	metres squared
g / kg	grams per kilogram
g / l	grams per litre
Various trade names	A number of products can be purchased that contain this active ingredient for control of this weed.
Various trade names and formulations	A number of products can be purchased that contain this active ingredient, some with different concentration formulations, registered for control of this weed.

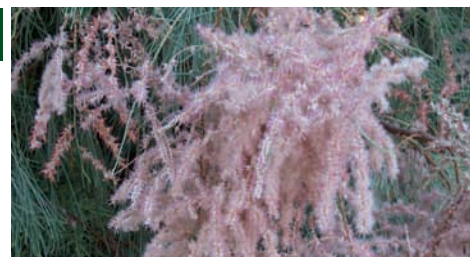
*Note: Rates are given for water unless otherwise stated*

### Athel pine – *Tamarix aphylla* (Class B/C)

At the time of writing there were no herbicides registered for use on athel pine by members of the public.

Permits can be obtained for specific herbicides for use by Departmental employees and contractors under their instruction. Please contact the Weed Management Branch for further information.

**Non-chemical applications:** Seedlings can be removed by hand. Large trees can be removed by ripping and bulldozing. The root system must be removed. Where appropriate, a suitable pasture may be sown to out-compete any regrowth.



### Barleria – *Barleria prionitis* (Class A/C)

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Fluroxypyr 200 g/L</b> Various trade names	500 ml / 100 L or 3 L / ha (boom)	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Easily removed by hand and burnt.

### Bellyache bush – *Jatropha gossypifolia* (Class B/C)

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Fluroxypyr 200 g/L</b> Various trade names	500 ml / 100 L or 3 L / ha (boom)	<b>Seedling (individuals or infestation):</b> Foliar spray – apply when actively growing
	3 L / 100 L (diesel)	<b>Adult (individuals):</b> Cut stump or basal bark
	500 ml / 100 L or 3 L / ha (boom)	<b>Adult (infestation):</b> Foliar spray
<b>Metsulfuron-methyl 600 g/L</b> Various trade names	10g / 100 L	<b>Seedling (individuals or infestation):</b> Foliar spray - apply when actively growing, need wetting agent
	10g / 100 L	<b>Adult (infestation):</b> Foliar spray

**Non-chemical applications:** Chain, slash or rake. Fire can be used as part of an integrated control program to kill young Bellyache bush seedlings and improve access for other control methods. Follow up control may require hand removal.

## Burrs – Bathurst burr – *Xanthium spinosum* (Class B/C) and Noogoora burr – *Xanthium occidentale* (Class B/C)

### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Bathurst burr



Noogoora burr



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	180 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	15 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>MCPA 340 g/L + Dicamba 80 g/L</b> Various trade names	190 - 270 ml / 100 L or 2.8-4 L / ha (boom)	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – use higher rates on larger plants

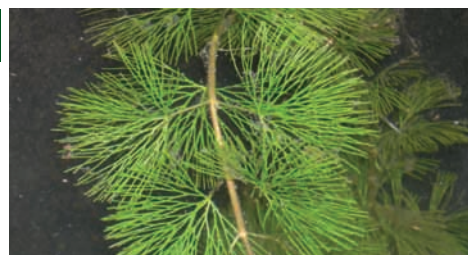
**Non-chemical applications:** Mow, slash, grub and burn plants to prevent burr formation.

## Cabomba – *Cabomba* spp. (Class A/C)

\* Report this plant to the Weed Management Branch immediately if found

There are no registered chemicals for the control of cabomba.

**Non-chemical applications:** Remove small infestations by hand pulling. Ensure all of the plant is removed and destroyed.



## Caltrop – *Tribulus cistoides* and *Tribulus terrestris* (Class B/C)

### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L or 1.1-2.4 L / ha (boom)	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Metsulfuron-methyl 600 g/L</b> Various trade names	10g / 100L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing, need wetting agent

**Non-chemical applications:** Grub plants out by hand and burn.

**Candle bush – *Senna alata* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Fluroxypyr 200 g/L</b> Various trade names	200 ml / 100 L or 3 L / ha (boom)	<b>Seedling (individuals or infestation) + adult (infestation):</b> Foliar spray – add uptake spraying oil
	1.5 L / 100 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 10 cm stem diameter treat up to 45 cm from ground
	1.5 L / 100 L (diesel)	Cut stump > 10 cm stem diameter

**Non-chemical applications:** Isolated plants can be dug out and roots removed.**Castor oil plant – *Ricinus communis* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling (individuals or infestation) + adult (infestation):</b> Foliar spray – apply when actively growing
<b>Triclopyr 600 g/L</b> Various trade names	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter

**Non-chemical applications:** Individual plants or small infestations may be removed by cultivation or hand-pulling.



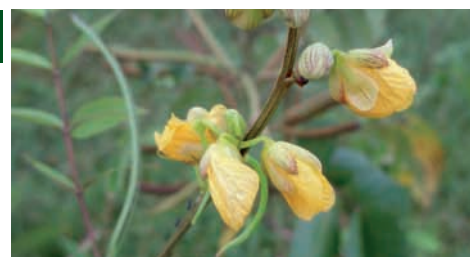
**Chinee apple – *Ziziphus mauritiana* (Class A/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	350 ml / 100 L or 3 L / ha (boom)	<b>Seedling (individuals and infestation):</b> Foliar spray, apply when actively growing + non-ionic wetting agent
<b>Triclopyr 600 g/L</b> Various trade names	1 L / 60 L (diesel)	<b>Seedling (individuals):</b> Basal bark < 5 cm stem diameter
	1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Cut stump > 5 cm stem diameter
<b>Fluroxypyr 200 g/L</b> Various trade names	3 L / 100 L (diesel)	<b>Seedling (individuals):</b> Basal bark < 15 cm stem diameter, treat up to 45 cm from ground
	3 L / 100 L (diesel)	<b>Adult (individuals or infestation):</b> Cut stump > 15 cm stem diameter
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel)	<b>Seedling (individuals):</b> Basal bark < 15 cm stem diameter
	1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Cut stump > 15 cm stem diameter

**Non-chemical applications:** Mechanical control or burning can be used to improve access to infested areas for follow up chemical control.

**Coffee senna – *Senna occidentalis* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Triclopyr 200 g/L and Picloram 100 g/L</b> Tordon DS®	375 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing, need non-ionic wetting agent
<b>Dicamba 500 g/L</b> Various trade names	500 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray, surfactant may be required
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	200 ml / 100 L or 3 L / ha (boom)	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – need non-ionic wetting agent: do not apply to podding plants

**Non-chemical applications:** Can be controlled by cultivation.

### Common and creeping lantana – *Lantana camara* and *Lantana montevidensis* (Class B/C)



#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Fluroxypyr 200 g/L</b> Various trade names	500 ml – 1 L / 100 L or 3 L / ha (boom)	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – use higher rate on plants over 1.2 m, apply when actively growing
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	350– 500 ml (750) / 100 L or 3 L / ha (boom)	<b>Seedling (individuals and infestation)</b> Foliar spray – use higher rate on plants > 1 m (highest for harder to kill varieties), apply when actively growing, need non-ionic wetting agent
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel)	<b>Seedling (individuals):</b> Basal bark < 15 cm stem diameter
	1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Cut stump > 15 cm stem diameter
<b>Triclopyr 600 g/L</b> Garlon® 600	1 L / 60 L (diesel)	<b>Seedling (individuals)</b> Basal bark < 5 cm stem diameter
	1 L / 60 L (diesel)	<b>Adult (individuals or infestation)</b> Cut stump > 5 cm stem diameter

**Non-chemical applications:** Stick-raking, bulldozing, ploughing and grubbing. Fire can be used prior to mechanical or herbicide control or as follow-up.

### Devil's claw – *Martynia annua* (Class A/C)



#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>MCPA 340 g/L + Dicamba 80 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Small plants can be removed by hand, larger plants can be slashed close to the ground.

**Flannel weed – *Sida cordifolia* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	15 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Metsulfuron-methyl 600 g/L</b> Various trade names	10g / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray - apply when actively growing, need wetting agent

**Non-chemical applications:** Repeated slashing and cultivation; vigorous pasture competition.**Gamba grass – *Andropogon gayanus* (Class A/C and Class B/C) (Refer to [www.nt.gov.au](http://www.nt.gov.au) for details)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

Effective chemical control of gamba grass relies on spraying the entire plant. For optimal uptake of the herbicide and high mortality rates gamba grass should be sprayed when actively growing and young (leaves should be at least 40 cm long). Spraying plants prior to reaching full height and becoming rank will reduce time and herbicide requirements. Gamba grass is particularly sensitive to herbicide when flowering. To treat larger areas, start at the edges and work inwards, gradually reducing infestation size.

**Non-chemical applications:**

**Physical:** Individual plants can be removed by hand or by using a mattock. Ensure the entire root mat is removed. Excess soil should be shaken or kicked off root system to ensure regrowth does not occur from the root mat.

**Burning:** Burning is best performed during the wet season where low intensity 'cooler' fires are achievable. This reduces the risk of damaging competitive species and assists in improving access for slashing or spraying. Fire may have the ability to carry seed in hot air currents, therefore avoid using fire as a control method while plants are seeding. Plants may need to be treated with herbicide prior to burning to create enough dry matter to carry a fire. Check with the Bushfires NT about permit requirements prior to lighting any fires.

**Slashing:** Slashing will not eradicate gamba grass, but it can reduce the biomass, prevent seeding, create an opportunity for more desirable species to establish and provide improved access to control by other means. Slash young plants prior to seed production from January to March. Ensure equipment and machinery is cleaned prior to moving to new sites.

**Grazing:** In areas within the Class B/C declaration zone gamba grass may continue to be used in established pasture areas, however there is a requirement to disallow any further spread. Gamba being used as a pasture should be grazed with enough stock to keep grass height below 90 cm. Above this height tussocks may be avoided by stock and allowed to produce vast quantities of seed. After lightly grazing pasture in the early wet season, a stocking density of 4-5 head per hectare is required to control growth for the remainder of the wet season. Increase grazing pressure if the grass nears 90 cm. Gamba grass is not recommended for cattle production on smaller properties as it requires high stocking densities to keep it low and palatable.

**Grader grass – *Themeda quadrivalvis* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Small infestations should be controlled manually, preferably before seeding, and burnt on site. If seed is present, burn it inside a drum to generate enough heat to kill the seeds.

**Hyptis – *Hyptis suaveolens* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	15 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Manually remove all plant material; slash to encourage competition from desirable species.

**Khaki weed – *Alternanthera pungens* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>MCPA 340 g/L + Dicamba 80 g/L</b> Various trade names	350 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray

**Non-chemical applications:** Grub at least 5 cm of the root; vigorous pasture competition.



**Lion's tail – *Leonotis nepetifolia* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** New infestations should be removed manually prior to seeding.**Mesquite – *Prosopis* spp. (Class A/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	350 ml / 100 L	<b>Seedling (individuals and infestation):</b> Foliar spray – need non-ionic wetting agent - do not spray plants bearing pods
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter

**Non-chemical applications:** Hand grubbing for light infestations or small, dense areas. Blade ploughing or other mechanical control aimed at removing as much of the root system as possible.**Mexican poppy – *Argemone ochroleuca* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>MCPA 340 g/L + Dicamba 80 g/L</b> Various trade names	350 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray

**Non-chemical applications:** Remove by hand grubbing. Take extra precautions to stop seed spread if removal is required once the plants are already seeding.

## Mimosa – *Mimosa pigra* (Class A/C and Class B/C) (Refer to [www.nt.gov.au](http://www.nt.gov.au) for details)



### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

FOLIAR SPRAY	JAN	FEB	MAR	APR	MAY	JUN
	JUL	AUG	SEP	OCT	NOV	DEC

BASAL BARK	JAN	FEB	MAR	APR	MAY	JUN
	JUL	AUG	SEP	OCT	NOV	DEC

PELLET GRANULAR	JAN	FEB	MAR	APR	MAY	JUN
	JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Tebuthiuron</b> Various trade names	1g / m2	<b>Seedling or adult (individuals or infestation):</b> Granulated herbicide - ground applied Do not use within 30 m of desirable trees or apply to continuous area > 0.5 ha Use higher rate on dense growth or heavy clay soils Do not use if fire is eminent Apply when there is soil moisture or prior to rain
<b>Fluroxypyr 200gm/L</b> Various trade names	300ml / 100L	<b>Seedling or adult (individuals or infestation):</b> Foliar application when actively growing Wetting agent Uptake® required - 500ml / 100L
	3L / 60L water / ha	<b>Seedling or adult (infestations):</b> Aerial control
	1:60 (diesel)	<b>Seedling or adult:</b> Basal bark or cut stump application method Foliar application when actively growing
<b>Metsulfuron-methyl</b> Various trade names	60g / 60L water / ha	<b>Seedling or adult (infestations):</b> Aerial control Non-ionic surfactant required 100ml / 100L
<b>Dicamba</b> Various trade names	Kamba 500 6L / Ha	<b>Seedling or adult (infestations):</b> Aerial control – Use the wetting agent LI700®
	Kamba 500 400ml / 100L	<b>Seedling or adult (individuals or infestation):</b> Foliar application when actively growing
<b>Glyphosate</b> Various trade names	Neat or 25ml / L	<b>Seedling or adult (individuals or infestation):</b> Cut stump

**Non-chemical applications:** Hand grubbing for single plants or small outbreaks, ensure removal of the root system. Bulldozers can clear debris post-chemical control and fire can be used to kill surface seed or at least break the dormancy stage.

## Mission grass – *Pennisetum polystachion* (Class B/C)



### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Small infestations should be controlled manually, preferably before seeding. Manually remove all plant material; slash to encourage competition from desirable species.

**Mossman river grass – *Cenchrus echinatus* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Cultivation, pulling by hand or burning off before plants reach seed set.**Olive hymenachne – *Hymenachne amplexicaulis* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Heavy grazing in the dry season can decrease seed production. Mechanical or physical removal is ineffective due to highly effective vegetative reproduction from small fragments. The use of heavy earth moving machinery to remove hymenachne from drains has met with some success in north Queensland. Aim to reduce plant bulk prior to wet season flooding and drown it.**Paddy's lucerne – *Sida rhombifolia* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	15 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Metsulfuron-methyl 600 g/L</b> Various trade names	10 g / 100L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing, need wetting agent

**Non-chemical applications:** Grub plants out. Slashing before flowering will prevent seed production temporarily and produce new growth for spraying.

**Parkinsonia – *Parkinsonia aculeata* (Class B/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	350 ml / 100 L or 3 L / ha	<b>Seedling (individuals and infestation)</b> Foliar spray – avoid spraying if plants are stressed or bearing pods – add uptake spraying oil Foliar spray – plants up to 2 m or 2 years old - add uptake spraying oil
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Seedling or adult (individuals or infestation)</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter

**Non-chemical applications:** Blade-ploughing, stick-raking, bulldozing and chaining can be effective if the root layer is removed from the soil. Cultivation of pasture or native vegetation after mechanical control will help to prevent re-sprouting and seedling establishment. Fire destroys seed in the soil surface and can be used as a follow-up to remove seedlings after other control efforts. Fire may also be used to manage mature trees.

**Parthenium weed – *Parthenium hysterophorus* (Class A/C)**

\* Report this plant to the Weed Management Branch immediately if found

**OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	10 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>MCPA 340 g/L + Dicamba 80 g/L</b> Various trade names	350 ml / 100 L or 5.2 L / ha (boom)	<b>Seedling or adult (individuals or infestation):</b> Foliar spray

**Non-chemical applications:** Plough in before plants reach flowering stage and follow with vigorous pasture establishment.



**Pond apple – *Annona glabra* (Class A/C)**

\* Report this plant to the Weed Management Branch immediately if found

**OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



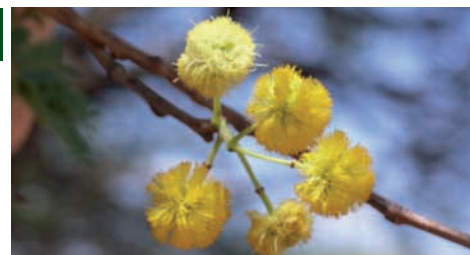
Chemical and concentration	Rate	Situation, method and comments
<b>Glyphosate 360 g/L</b> Various trade names and formulations	15 ml / 1L	<b>Seedling (individuals or infestation):</b> Foliar spray - apply when actively growing
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Seedling or adult (individuals or infestation)</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter
<b>Fluroxypyr 200 g/L</b> Various trade names	1.5 L / 100 L (diesel) 1.5 L / 100 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 10 cm stem diameter, treat up to 45 cm from ground Cut stump > 10 cm stem diameter

**Non-chemical applications:** Hand pulling is effective for smaller plants. Chain pulling and dozer pushing can be undertaken in flat country, free of sensitive vegetation however roots must not be left in contact with soil otherwise plants may re-sprout. Fire is effective where sufficient fuel is present. The entire circumference of the plant must be burnt to effectively kill the plant.

**Prickly acacia – *Acacia nilotica* (Class A/C)****OPTIMUM TREATMENT TIMES**

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Fluroxypyr 200 g/L</b> Various trade names	750 ml / 100 L 3 L / ha (boom)	<b>Seedling (individuals or infestation) + adult (infestation):</b> Foliar spray - add uptake spraying oil
<b>Metsulfuron-methyl 600 g/L</b> Various trade names	10 g / 100 L	<b>Seedling (individuals or infestation) + adult (infestation):</b> Foliar spray – apply when actively growing, need wetting agent
<b>Hexazinone 250 g/L</b> Various trade names	15 L / ha (boom)	<b>Seedling (individuals or infestation) + adult (infestation):</b> Foliar spray
<b>Tebuthiuron 200 g/kg</b> Various trade names	1.5 g / m <sup>2</sup> 10 - 15 kg / ha	<b>Seedling (individuals or infestation) + adult (infestation):</b> Granulated herbicide: ground applied – do not use within 30 m of desirable trees or apply to single continuous area > 0.5 ha Use higher rate on dense growth or heavy clay soils
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter
<b>Fluroxypyr 200 g/L</b> Various trade names	1.5 L / 100 L (diesel) 1.5 L / 100 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 10 cm stem diameter, treat up to 45 cm from ground Cut stump > 10 cm stem diameter
<b>Triclopyr 600 g/L</b> Various trade names	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Adult (individuals or infestation)</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter

**Non-chemical applications:** Before seed pods have dropped: hand grubbing (small plants), cutting the root < 30 cm below the soil surface (blade ploughing), stick-raking and chaining (larger plants or infestations) can be effective. Fire is useful for mass seedling control if there is a sufficient fuel load.

### Rubber bush – *Calotropis procera* (Class B/C South of 16°30'S latitude)



#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	350 ml / 100 L or 3 L / ha	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – surfactant may be required
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Seedling (individuals) + adult (individuals or infestation):</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter

**Non-chemical applications:** This plant is difficult to eradicate as the deep roots survive almost any treatment. It is susceptible to regular cultivation and maintenance of a dense pasture sward will assist in preventing invasion.

### Rubber vine – *Cryptostegia* spp. (Class A/C)



\* Report this plant to the Weed Management Branch immediately if found

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC

Chemical and concentration	Rate	Situation, method and comments
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	350 - 500 ml / 100L or 3 - 5 L / ha (boom)	<b>Seedling (individuals and infestation) + adult (infestation):</b> Foliar spray – use higher rates on stands > 1.5 m when flowering, spray leaves and stems to the point of run-off and apply to base Foliar spray – apply when flowering, use higher rates on dense stands
<b>Triclopyr 240 g/L and Picloram 120 g/L</b> Access®	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter
<b>Triclopyr 600 g/L</b> Various trade names	1 L / 60 L (diesel) 1 L / 60 L (diesel)	<b>Adult (individuals or infestation):</b> Basal bark < 5 cm stem diameter Cut stump > 5 cm stem diameter

**Non-chemical applications:** Fire can destroy seeds, seedlings and adult plants providing there is sufficient fuel load. Blade or disk ploughing can be effective and will open up dense infestations for access. Slashing reduces vigour but may not kill plant.

### Saffron thistle – *Carthamus lanatus* (Class B/C)

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L or 1.1 - 2.4 L / ha	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing Foliar spray – use lower rate on seedlings
<b>Glyphosate 360 g/L</b> Various trade names and formulations	15 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing

**Non-chemical applications:** Deep ploughing, to a depth of 10-15 cm will bury many seeds and reduce emergence. Seedlings emerging can be destroyed by shallow cultivation. Improved perennial or native pastures will prevent establishment. Avoid heavy grazing as it will encourage growth. Slashing shortly before flowering can also effectively prevent seed production – but not too early as plants can re-sprout and produce new flower heads.

### Salvinia – *Salvinia cucullata* (Class C), *Salvinia molesta* (Class B/C) and *Salvinia nantans* (Class C)

\* Report this plant to the Weed Management Branch immediately if found

**Non-chemical applications:** Remove small infestations by hand, ensuring all of the plant is removed and destroyed.



### Sicklepod – *Senna obtusifolia* (Class B/C)

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>Triclopyr 200 g/L and Picloram 100 g/L</b> Tordon® DS	375 ml / 100 L	<b>Seedling or adult (individuals and infestation):</b> Foliar spray – apply when actively growing, need non-ionic wetting agent
<b>Dicamba 500 g/L</b> Various trade names	500 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray, surfactant may be required
<b>Triclopyr 300 g/L and Picloram 100 g/L</b> Various trade names	200 ml / 100 L or 3 L / ha (boom)	<b>Seedling or adult (individuals and infestation):</b> Foliar spray – need non-ionic wetting agent: do not apply to podding plants

**Non-chemical applications:** Slashing can reduce old plants to a manageable size. Slashing should always be done prior to seed set, preferably when plants are flowering. Rotary hoeing or discing infested areas and immediately sowing with improved pastures can be effective, if the grasses are well managed. Avoid grazing paddocks containing sicklepod or senna, especially when mature seed is present. A constant, dense sward of grass will exclude sunlight and help to maintain soil moisture.



### Snake weeds – *Stachytarpheta* spp. (Class B/C)

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray - apply when actively growing

**Non-chemical applications:** Slash before seed set and re-establish pasture grass for competition.

### Spinyhead sida – *Sida acuta* (Class B/C)

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray - apply when actively growing
<b>Metsulfuron-methyl 600 g/L</b> Various trade names	10g / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray - apply when actively growing, need wetting agent

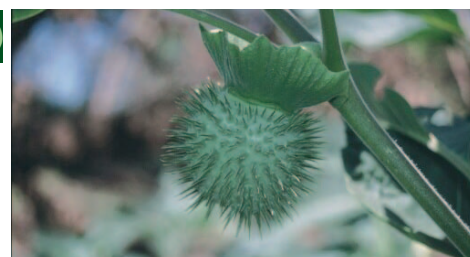
**Non-chemical applications:** Repeated slashing and cultivation; vigorous pasture competition.

### Thornapples – *Datura ferox* (Class A/C), *Datura* spp. (Class C)

#### OPTIMUM TREATMENT TIMES

darker colour indicates preferred treatment times

JAN	FEB	MAR	APR	MAY	JUN
JUL	AUG	SEP	OCT	NOV	DEC



Chemical and concentration	Rate	Situation, method and comments
<b>2, 4-D amine 625 g/L</b> Various trade names	320 ml / 100 L	<b>Seedling or adult (individuals or infestation)</b> Foliar spray - apply when actively growing
<b>Glyphosate 360 g/L</b> Various trade names and formulations	15 ml / 1L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray – apply when actively growing
<b>MCPA 340 g/L + Dicamba 80 g/L</b> Various trade names	350 ml / 100 L	<b>Seedling or adult (individuals or infestation):</b> Foliar spray

**Non-chemical applications:** Easily removed by hand, collect and burn mature seeds.



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## Websites

- Australian Pesticides and Veterinary Medicines Authority <http://www.apvma.gov.au/index.asp>
- Australian Weeds Strategy, A national strategy for weed management in Australia, [http://www.weeds.org.au/docs/Australian\\_Weeds\\_Strategy.pdf](http://www.weeds.org.au/docs/Australian_Weeds_Strategy.pdf)
- Commonwealth Scientific and Industrial Research Organisation (CSIRO): <http://www.csiro.au> – search 'weeds'
- Co-operative Research Centre for Tropical Savannas: <http://savanna.ntu.edu.au>- search 'weeds'
- Co-operative Research Centre for Weed Management: [http://www.weeds.crc.org.au/index\\_flash.html](http://www.weeds.crc.org.au/index_flash.html)
- Katherine Regional Weed Management Strategy and Action Plan 2005-2010: <http://www.nt.gov.au/weeds>
- Northern Territory Weeds Management Act <http://www.nt.gov.au/dcm/legislation/current.html>
- Weed Identification Tool: <http://www.weeds.org.au/ntmap.htm>
- Weed Management Branch, Natural Resources, Environment, The Arts and Sport: <http://www.nt.gov.au/weeds>
- Weeds of National Significance (WoNS): <http://www.weeds.org.au/natsig.htm>

## Acknowledgements

Some sections of this manual have been directly reproduced, with permission, from the NSW Noxious and Environmental Weed Handbook (3rd edition) 2007 by Rod Ensbey and Annie Johnson.

## **Appendix A – Preventing Weed Seed Spread**

### **Vehicle Hygiene**

Vehicles, including quad bikes and farm machinery can easily spread weed seed if a high level of vigilance is not maintained. Ideally a strict inspection regime should be implemented before and after all travel, especially when travelling to areas known to be infested with weeds.

It should also be noted that many seeds have anatomically developed in such a way to facilitate their spread. Many have hooks or burrs which catch readily in clothing, footwear or in animal hair, so people and animals should be checked prior to moving into clean areas.

The checklist below can be used as guide to establish a checking program for your property.

#### **Before Travel**

- Before travelling check clothing and shoes are free of mud and seeds.

#### **Inside the Vehicle**

- Check the foot wells and mats to make sure that no weed seed has fallen off your shoes.

#### **Engine**

- Check radiator and grill.

#### **Around the Vehicle**

- Check along wheel trims, mud flaps, tyres and tray of the vehicle for mud and weed seed.

#### **Quad Bikes/Machinery**

- Check around the wheels and where mud or weed seed may be caught.

#### **Underneath the Vehicle**

- Check the undercarriage and guards to ensure that there is no mud or weed seed.

#### **Washing Down Procedures**

- Establish a designated location to wash down your vehicle.
- Monitor plants growing in this area.
- Control all weed growth immediately.

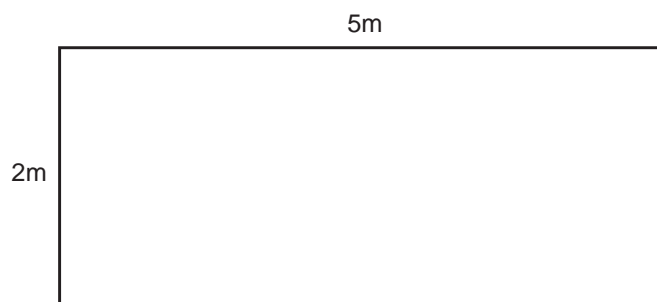
## Appendix B – Research and Development of Biological Control Agents in the NT

Weed	Agent	Type of agent	first released	plant part attacked	Established?
Mimosa ( <i>Mimosa pigra</i> )	<i>Acanthoscelides puniceus</i>	beetle	1983	mature seed	yes
	<i>Acanthoscelides quadridentatus</i>	beetle	1983	mature seed	no
	<i>Chlamisus mimosae</i>	beetle	1985	leaves and stems	yes
	<i>Neurostrotia gunniella</i>	moth	1989	pinnae and tips	yes
	<i>Carmenta mimosa</i>	moth	1989	large stems	yes
	<i>Coelocephalapion aculeatum</i>	weevil	1992	flower buds	no
	<i>Coelocephalapion pigrae</i>	weevil	1994	flower buds and leaves	yes
	<i>Phloeospora mimosae-pigrae</i>	fungus	1995	leaves , stems and pods	no
	<i>Chalcodermus serripes</i>	weevil	1996	green seed and tips	no
	<i>Diabole cubensis</i>	fungus	1996	leaves	no
	<i>Sibinia fastigiata</i>	weevil	1997	green seed and flowers	no
	<i>Malacorhinus irregularis</i>	beetle	2000	Leaves, roots and nodules	yes
	<i>Macaria pallidata</i>	moth	2002	leaves	yes
	<i>Leuciris fimbriaria</i>	moth	2004	leaves	currently being reared / released
	<i>Nesaecrepida infuscata</i>	beetle	2007	roots and seedlings	currently being reared / released
Bellyache bush ( <i>Jatropha gossypifolia</i> )	<i>Agonosoma trilineatum</i>	bug	2003	fruit	no
Parkinsonia ( <i>Parkinsonia aculeate</i> )	<i>Rhinacloa callicrates</i>	bug	1989	leaves and flower buds	no
	<i>Mimosestes ulkei</i>	beetle	1995	seed	no
	<i>Penthobruchus germani</i>	beetle	1995	seed	yes
Salvinia ( <i>Salvinia molesta</i> )	<i>Cyrtobagous salviniae</i>	weevil	1981	leaves, roots	yes
Sida ( <i>Sida acuta</i> )	<i>Calligrapha pantherina</i>	beetle	1989	leaves	yes
	<i>Eutinobothrus</i> sp.	weevil	1997	stems	no
	<i>Eutinobothrus pilosellus</i>	weevil	1997	stems	no
Noogoora Burr ( <i>Xanthium occidentale</i> )	<i>Epiblema strenuana</i>	moth	1982	stems	yes
	<i>Puccinia xanthii</i>	fungus	~1975	leaves	yes

## Appendix C – Calibrating Spray Equipment

### Hand gun calibration

1. Mark out an area 5 m x 2 m = 10m<sup>2</sup> = **1/1000th** of 1 hectare (representative of the area to be treated)



2. Time taken in **seconds** to spray **10m<sup>2</sup>**
3. Measure output in litres/seconds taken to spray 10 m<sup>2</sup>
4. Multiply **output x 1000** = L/ha

### Boom sprayer calibration

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

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



## Appendix D - Courses Relevant to Chemical Application in the NT

### Charles Darwin University

Chemical training courses offered:

- AQF3 SMARTtrain Chemical application course - (2 days). The chemical accreditation ticket valid for 5 years.
- AQF3 Re-accreditation course - (1 day). Refresher for people with expired SMARTtrain or ChemCert tickets.
- AQF4 Chemical risk management. Advanced course for managers.
- AQF2 Apply chemicals under supervision - (3 days). For people working under supervision. This course is well suited for people with low literacy and numeracy skills.

The following courses meet requirements for some pest control or ground spray application licenses:

- RTC3401 Control weeds (may be run in conjunction with the AQF3 SMARTtrain Accreditation course).
- RTC2401 Treat weeds (may be run in conjunction with AQF2 Apply chemicals course).
- RTC3404 Treat pest and disease - self paced or on request.
- RTC2404 Control pest and disease - self paced or on request.
- RTC2704A First Aid course - on request.

Chainsaw operations course - many companies are using chainsaws and chemicals together for bush clearing or woody weed control.

- Operate chainsaws - (2 days) - basic chainsaw skills.
- Tree felling course - (2 days) - more advanced for controlled felling of trees.

Please contact Charles Darwin University directly for current information on courses offered on (08) 8946 7513 or email [hort\\_aqua@cdu.edu.au](mailto:hort_aqua@cdu.edu.au)

## Appendix E – Modes of Action

Modes of Action (Barrett, M. and Reed, G., 1997)

Resistance Risk	Mode of Action Group	Typical Actives
High	A - Inhibitors of acetyl co-enzyme A Carboxylase (lipid synthesis, cell membranes)	diclofop-methyl clethodim fluzafop-P haloxyfop propaquizafop sethoxydim
	B - Inhibitors of acetolactase synthase (ALS) (amino acid synthesis)	chlorsulfuron halosulfuron-methyl imazapyr metsulfuron-methyl triasufuron iodosulfuron
Moderate	C - Inhibitors of photosynthesis at photosystem II	atrazine diuron fluometuron prometryn
	D - Inhibitors of tubulin formation	pendimethalin trifluralin
Low	E - Inhibitors of mitosis	Carbetamide Triallate bensulide
	F - Inhibitors of carotenoid biosynthesis	norflurazon
	G - Inhibitors of chlorophyll biosynthesis	oxyfluorfen
	H - Inhibitors of protein synthesis	thiobencarb
	I - Disruption of plant hormone action	2,4-D 2,4-DB dicamba triclopyr fluroxypyr MCPA picloram
	J - Inhibitors of fat synthesis	flupropanate
	K - Herbicides with diverse sites of action	metolachlor MSMA
	L - Inhibitors of photosynthesis at photosystem I	diquat paraquat
	M - Inhibitors of aromatic amino acid synthesis	glyphosate glyphosate-trimesium
	N - Inhibitors of glutamine synthetase	glufosinate-ammonium

In Australia, the letters (A, B, C etc) are used to identify the different Mode of Action groups whereas overseas, the numbers (1, 2, 3 etc) are used.

## Appendix F – Appropriate Disposal of Chemicals and Containers

### drumMUSTER

To solve the problem of what to do with used, non-returnable chemical containers, Croplife Australia, the NFF (National Farmer's Federation), the Veterinary Manufacturers and Distributors Association (VMDA) and local governments developed the national collection and recycling scheme, drumMUSTER.

**The NT drumMUSTER Coordinator is Peter Murphy (Ph: 89 422544 or 0418 892 260). As more collection sites are set up, you can check on the locations through the drumMUSTER website – [www.drummuster.com.au](http://www.drummuster.com.au)**

From 1 February 1999, land managers and farmers have paid a 4c per litre or kilogram levy on non-returnable chemical containers, with capacities greater than 1 L or 1 kg, which funds 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.

To the end of 2007, a total of 10.8 million chemical containers had been recycled through the drumMUSTER program. Of these, approximately 12 000 drums are collected annually in the NT and in Kununurra.

Once councils enter into an agreement with drumMUSTER, land managers are 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. drumMUSTER collection points operate at landfills operated by **Alice Springs** and **Katherine** Councils, with Darwin still being negotiated.

Triple-rinsed drums can be dropped off at a depot in Albatross Street, **Winnellie** after first telephoning local drumMUSTER Coordinator Peter Murphy on the details above.

### Cleaning Containers for Collection

When rinsing, the personal protective equipment 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.

To triple-rinse a container with a capacity of <20 L:

- 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; and
- 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. Using the rinsate 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 using 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 degrees 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; and
- replace lid on container.

Large containers e.g. 200 L 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.

## ChemClear - Disposal of Unwanted Chemicals

In addition to unwanted containers, many properties also have unwanted chemicals. The program to get rid of unwanted agricultural chemicals, ChemClear, is an agreement between chemical manufacturers, the NFF and local government. Registered chemicals in original containers with identifiable labels will be collected free of charge. Unregistered, unknown and unlabelled chemicals incur a fee. It is most important that land managers with unwanted chemicals book them in for collection in advance, by logging onto 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.

## Disposal of Rinsate or Dilute Chemicals

For information pertaining to the disposal of rinsate, dilute chemicals and non-rigid containers such as plastic bags please contact the Waste Management and Resource Recovery Unit of NRETAS. See <http://www.nt.gov.au/nretas/environment/waste/index.html> for contact details and information.



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[www.nt.gov.au/weeds](http://www.nt.gov.au/weeds)