NSW GOVERNMENT | Industry & Investment

Weed control in pastures and lucerne 2010

INDUSTRY & INVESTMENT NSW MANAGEMENT GUIDE

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Crop Care Raptor WG herbicide full page colour

Industry & Investment NSW Weed control in pastures and lucerne feedback form

1. Which of the following best describes your occupation? (Tick the box)

❑ Advisor ❑ Farmer ❑ Industry Representative ❑ Contractor

Other: (Please state).....

2. How often do you refer to the Weed Control in Pastures and Lucerne book? (Tick the box)

❑ Never ❑ Once a year ❑ 2–4 times a year ❑ > 5 times a year

3. Please rate (1–5) each book section by circling the most appropriate option

	Not Much Use	Useful	Very Useful	Extremely Useful
Introduction to IWM in pastures and lucerne	1	2	3	4
Weed control in lucerne tables	1	2	3	4
The pasture legume tolerance chart	1	2	3	4
Weed control in grass pastures only tables	1	2	3	4
Perennial grass weed control table	1	2	3	4
Reducing spray drift and Delta T diagram	1	2	3	4
Chemical compatibility chart	1	2	3	4
The indicative price list	1	2	3	4
Woody weeds, vines and creepers table	1	2	3	4
Herbicide resistance management	1	2	3	4
The book as a whole	1	2	3	4

4. How do you currently use the book? Please circle the most appropriate option (Yes or No below)

As a guide for further discussion with advisor	Yes	No
As a tool for decision making	Yes	No
As the soul source of herbicide information	Yes	No
As a substitute for the label	Yes	No

Other: (Please state).....

5. From whom do you currently receive the book? (Tick the box)

❑ Agribusiness ❑ Consultant ❑ Industry & Investment NSW Office ❑ Industry & Investment NSW Website

Other: (Please state).....

6. In what form would you prefer the book?

❑ Book form (Hard copy) ❑ Electronic form

7. The main value of the Weed Control in Pastures and Lucerne book to me is .....

.....

.....

8. Changes that could be made to the book to improve it include .....

.....

.....

Please fax the feedback form to (02) 6372 6870 or drop it in to your nearest Industry & Investment NSW Office.

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IMPORTANT: USE OF PESTICIDES

Pesticides must only be used for the purpose for which they are registered and must not be used in any other situation or in any manner contrary to the directions on the label.

Some chemical products have more than one retail name. All retail products containing the same chemical may not be registered for use on the same crops. Registration may also vary between States. Check carefully that the label on the retail product carries information on the crop to be sprayed.

This publication is only a guide to the use of pesticides. The correct choice of chemical, selection of rate, and method of application is the responsibility of the user. Pesticides may contaminate the environment. When spraying, care must be taken to avoid spray drift on to adjoining land or waterways. Residues may accumulate in animals fed any crop product, including crop residues, which have been sprayed with pesticides. In the absence of any specified grazing withholding period(s), grazing of any treated crop is at the owner's risk.

Always read the label

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 the conditions of any Permit. Users are not absolved from compliance with the directions on the label or the conditions of the Permit by reason of any statement made or omitted to be made in 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 Industry & Investment NSW over any other equivalent product from another manufacturer.

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

Note: The chemicals and rates shown in this booklet are not necessarily all those registered.
Recommendations may have changed since publication. This booklet is a guide only and not a substitute for the registered label. Always read the label directions before using agricultural chemicals.

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Cover design by Belinda Gersbach, Industry & Investment NSW, Orange
Production by Barry Jensen, Industry & Investment NSW, Orange

Contents

What's new in 2010

Those of you who have been using this publication in the past will notice a few changes in this edition.

The first is a feed back form which we would like you to take the time to fill in and fax or send back to us. It is your opportunity to let us know what you need to know about weed control in pastures and lucerne. Your feedback will help us improve the publication for future editions.

We've included new sections on Integrated Weed Management to assist landholders with long term weed management and nozzle selection to assist in more effective herbicide application and drift control.

There are three new weed control tables including;

- Table 6. Pastures – grass weeds.
- Table 7. Pastures – broadleaf weeds.
- Table 11. Woody weeds, vines and creepers – high volume application.

Integrated Weed Management in pastures and lucerne

Jenene Kidston, District Agronomist – Mudgee

Integrated Weed Management (IWM) in pastures is the integration of good pasture and livestock management with a wide range of weed control methods to achieve pastures that are productive and resilient to climatic variability and invasion by less desirable species. It is a long term strategy for an environment that does not support weeds.

The primary goal of an effective IWM program is to reduce the weed impact and enhance the production of desirable pasture species.

There are five steps to achieving this.

1. Prevent existing weeds setting seed, reducing accessions to the weed seed bank.
2. Enhance the vegetative reproduction of desirable species and reduce vegetative reproduction of weed species.
3. Remove and replace weed plants with desirable species.
4. Enhance the seed bank of desirable species and reduce the weed seed bank.
5. Prevent incursions of both new and existing weeds into an area.

Types of pasture weeds

The majority of weeds in pastures fall into the following categories; broadleaf weeds, grasses and woody weeds. They all have an annual or perennial growth habit. They also have either a warm or cool season growth cycle. Plants with a warm season growth cycle produce new vegetative growth in late spring, summer and are reproductive in summer and early autumn. Plants that have a cool season growth cycle produce new vegetative growth in autumn and winter and are reproductive in spring. Understanding the life cycles of both desirable and undesirable pasture plants is very useful in determining when to target a weed for control and when to treat a paddock to enhance the pasture; it is also helpful in deciding which strategy to use at different times of year.

Weed control methods

There are a large number of weed control tools, each of which is effective in specific situations. Some general principles are: use as many non chemical control methods as possible, use a wide range of chemical groups (types), and use a wide range of chemical techniques. Always assess the pasture quality and quantity, weed species and weed load before deciding on what action to take. Choose only those control methods that are appropriate in each situation.

Competitive pastures and crops are the most effective long term weed management tool. Full ground cover prevents weed seedlings from getting the light and moisture that they need to germinate and establish. Selecting pastures that match the needs of your enterprise and the characteristics of the soil and surrounding landscape, enhanced by the use of fertilisers and ameliorants, produces pastures that are both productive and resistant to weed invasion.

Grazing management to enhance pasture productivity is essential. A good rule of thumb when grazing pasture is to remove animals when 1500 kg/ha of dry matter (about the top of your elastic sided boots) remains on the paddock. This ensures quick pasture regrowth and full ground cover most of the time.

Crash grazing can be used to control non toxic weeds in their vegetative stages, while lighter grazing and rest periods can be used to enhance pasture during its vegetative phase. When plants have died off, crash grazing can be helpful to remove large amounts of dead dry matter and allow establishment of new seedlings.

In native pastures observe the growth cycles of your desirable species (cool or warm season, or year round green). Apply those activities that enhance the productivity of the most desirable species in your pasture. These may be grazing, fertiliser, clovers or ameliorants for some species, or long rest periods between grazing, particularly over winter, for others.

Allowing natural regeneration of the native vegetation may be the most appropriate weed management option for steep, inaccessible and unproductive country that costs more in weed control than it can generate in income.

Hand pulling, hoeing, using a mattock or shovel to remove weeds is very effective where weeds are small, or plants are young, in small areas or where the target weed is sparse.

Fire can be a useful weed management tool but needs to be managed with care.

Making silage, hay, or harvesting mature plants with a forage harvester can be an effective way of removing seed from a paddock before it falls, reducing potential additions to the weed seed bank. Remember, however, that fodder that contain a high level of mature weed plants is not generally good quality feed for livestock. It may also be a potential source of weed seed in the paddock where it is fed out. Silage which has a good fermentation is the only method that can kill a proportion of weed seeds.

Applying mulches provides ground cover that prevents the germination of most weed seedlings. It can enhance the productivity of desirable plants such as trees, vines and shrubs by improving moisture holding capacity and providing slow release nutrients, but is not very useful in the pasture situation.

Bulldozers, backhoes and large machinery can effectively remove large plants, particularly over large areas but they generally create a huge area of disturbance. It is essential to re-seed or re-plant such disturbance sites to achieve long term weed control.

Cultivation can be an effective method of weed management when establishing a new pasture or crop but it also creates disturbance. It often promotes a massive germination of new weed seedlings following rain. This has been used as a way to reduce the weed seed bank by following a major germination with spraying. A disadvantage is loss of soil structure and organic matter caused by cultivation.

Slashing can be successful in the management of some cool season annual broadleaf weeds but generally must be repeated every two or three weeks, during the period that plants are reproductive, to have a significant impact on seed set.

Mulching machines work along the same principle as slashing to reduce seed set. However mulching machines tend to chop plants more than slashing, reducing the potential frequency of re-treatment required to reduce flowering and seed set.

Biological control is where an insect or disease is introduced, because a weed has no natural enemies. Biological control is very specific to the target weed; the agent's lifecycle is linked to the lifecycle of the target plant. It provides long term management and does not have physical boundaries such as fences. The disadvantage of biological control is that it is not suitable for a wide range of weeds, agents take a long time to have a significant impact on weed populations and some agents are difficult to establish. Of those that are established in Australia, most are not readily available to the public outside those areas.

Herbicides are a major tool for weed control in crops and pastures. Generally herbicide control provides a one-off kill of existing weeds. There are a large number of herbicides that are selective for different groups of broadleaf weeds and grasses and general knock down herbicides that kill most plants

There is a large range of application methods. They can be applied by aeroplane, helicopter, boom spray, spot spraying, wick wiper, spray topping, spray grazing, cut and paint, basal bark application and a number of other application methods.

More detail on all of the application methods for treatment of weeds is provided throughout the book.

There are a large number of agricultural chemicals available on the market today. All of them have a Product Label and a Material Safety Data Sheet. All chemical users must have a current pesticide training certificate and read the labels and material safety data sheets. This book is not a substitute for the label of any chemical product but should be used in conjunction with the label. If in doubt, always follow the instructions on the label.

Prevention of new incursions

Preventing incursions of new and existing weeds is cheaper and more effective than any management or control method. Following is a list of precautions that can prevent the invasion of new weeds on your property;

Quarantine livestock coming on to the property for two weeks when they first arrive. Weed seed is carried on the coats and in the digestive tract of most animals. By using a quarantine paddock you can monitor, identify and control any new weeds quickly and effectively.

Feed products being brought on to the property can also carry weed seed. Keep good records including where feed came from, the type of feed product, where and when it was fed out and to which groups of animals.

Buy certified seed, if you can't buy certified seed, keep good records of where your seed came from and where and when it was planted.

Wash down machinery coming on to the property. Seed is carried on machinery in mud as well as loose seed in cracks and crevices of machinery. Keep good records of which contractors you use, where they've come from and where and when they were on your property.

Soils, gravel and many organic fertiliser products such as manures and mulches can also carry weed seed. Keep good records of the type of product, where it came from and where it was applied on the property.

Trees can be used to create a wind break that allows windblown seeds and seed heads to drop out of the air before they spread over large areas of a property. It is helpful to know which plants are spread by wind and which ones pose the greatest threats in your area. It is also helpful to know the most common wind patterns at the time of year when those plants are maturing. An example is serrated tussock which matures in late spring. Seed heads are blown on the wind from late spring through to mid summer.

Minimising disturbance and overgrazing can substantially reduce the susceptibility of a property to weed invasion. Weeds establish most easily on disturbed and over-grazed country where ground cover and competition is low. Aim to maintain plenty of dry matter on all paddocks all of the time.

Information sources

AVPMA
Chemical and machinery manufacturers
Industry & Investment NSW, District Agronomists
Local weed authority noxious weed officers
Agribusiness agronomists
Industry & Investment weed guides
Primefacts and Agfacts
Herbicide labels and Material Safety Data Sheets
Industry & Investment NSW website:
www.industry.nsw.gov.au
Industry & Investment NSW bookshop

Poison warnings on herbicide labels

The Poison Schedule

Herbicides are classified into four categories in the Poison Schedule based on the acute health hazard to the user of the herbicide. Each schedule has a corresponding signal heading which appears in large, contrasting lettering on the label of the herbicide product.

Unscheduled:	(No heading)
Very low toxicity	Examples are Brushoff®, Brodal®, Diuron, Logran®, Simazine, Broadstrike®.
Schedule 5:	Caution
Slightly toxic	Examples are 2,4-D amine, 2,4-DB, Agtryne® MA, Kamba® M, Shogun®, Dicamba, Glean®, Glyphosate, Goal®, Igran®, Lontrel®, MCPA, Raptor®, Roundup® CT, Select®, Sertin®, Spinnaker®, Targa®, Tigrex®, Tordon® 242, Tordon® 75-D, Trifluralin, Touchdown®.
Schedule 6:	Poison
Moderately toxic	Examples are Bladex®, Barrel®, Bromoxynil, Bromoxynil + MCPA, Fusilade®, Grazon® Extra, Hoegrass®, Jaguar®, Reglone®, Tussock®, Verdict®.
Schedule 7:	Dangerous Poison
Highly toxic	Examples are Gramoxone® 250, Nuquat®, Shirquat®, Spray.Seed® 250.

The Safety Directions specify what personal protective equipment should be worn and what safety precautions should be taken, for instance, do not inhale spray mist. The First Aid instructions specify what action should be taken in the event of a poisoning. Safety Directions and First Aid Instructions may be different for different formulations of the same pesticide.

Before opening and using any farm chemical, consult the label and Material Safety Data Sheet (MSDS) for specific Safety Directions. The Hazardous Substances Section of the *Occupational Health and Safety Regulation 2001* requires resellers to provide end users with an MSDS on first supply or upon request.

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

Important label changes

2,4-D HVE (high volatile esters)

As the APVMA has not yet finalised its review of 2,4-D ester, HVE products remain under suspension with restricted conditions of use:

- 2,4-D HVE formulations restricted.
- HVE esters: ethyl, butyl and isobutyl forms of 2,4-D.
- Ester 800 formulations are the restricted ones.
- Use nozzles that produce coarse – very coarse spray.
- Wind must be 3–15 km/hr.
- 100 m downwind buffer.
- Prohibited application except May 1–August 31.
- Application record mandatory.

All phenoxy herbicides: 2,4-D (HVE, LVE, amine), 2,4-DB, MCPA, mecoprop, dichlorprop

The labels of all phenoxy herbicide formulations, not just 2,4-D HVE, will have mandatory droplet size instructions, viz coarse or larger, buffer zones and weather instructions. If you use any of these products, carefully read the new labels. See also the sections in this publication on 'Reducing herbicide spray drift' and 'Pasture herbicide selection – nozzle selection'.

Bromoxynil

An APVMA review of bromoxynil has revealed a potential residue problem for livestock. As a result, bromoxynil labels will be changed to include the following.

- The Grazing Withholding Period will be increased from 14 days to 8 weeks.
- Aerial application of bromoxynil will be prohibited and a 350 metre no spray zone required for ground application when there are livestock, pasture or any land that is producing feed for livestock downwind from the application area.
- A coarse droplet size will be recommended for ground application.

Grazon Extra

The extra in Grazon Extra is aminopyralid, a herbicide in the same class as clopyralid. Like clopyralid, aminopyralid is extremely persistent and extremely effective at low rates of active. If the product is used to control woody weeds in pastures, aminopyralid drift onto these pastures could cause residue problems. To manage the risk of residues in compost, mulches and animal manures from aminopyralid application to pasture, the label is being changed to include a12 week restriction for:

- making hay and silage;
- using hay or other plant material for compost, mulch or mushroom substrate;
- using animal waste from animals grazing on treated pastures for compost, mulching, or spreading on pasture/crops.

Using herbicides successfully

Successful results from herbicide application depend heavily on numerous interacting factors. Many of the biological factors involved are not fully understood and are out of your control. Therefore, careful attention to the controllable factors is essential for profitable results.

Points to remember for the successful use of herbicides are:

- Plan the operation. Check paddock sizes, tank capacities, water availability and supply.
- Carefully check crop and weed growth stages before deciding upon a specific post-emergent herbicide.
- Read the label. Check to make sure the chemical will do the job. Note any mixing instructions, especially when tank mixing two chemicals. This booklet is a guide only; it cannot tell you all the information you need to know.
- Follow the recommendations on the label. The marketing company spent a large sum of money in developing these.
- Conditions inhibiting plant cell growth, like stress from drought, waterlogging, poor nutrition, high or low temperatures, low light intensity and disease or insect attack, are not conducive to effective herbicide uptake and movement.
- Use good quality water, preferably from a rainwater tank. Remember water from concrete tanks will be alkaline.
- Use water quality equipment which is frequently checked for performance and output – see 'Boomspray preparation and calibration'.
- Check boom height with spray pattern operation for full coverage of the target.
- Check accuracy of boom width marking equipment.
- Check wind strength. Wind helps herbicide penetration into crops. Do not spray when wind is strong or when it is calm.
- Do not spray if rain is threatening or when heavy dew or frost is present.
- Calculate the amount of herbicide required for each paddock and tank load. Add adjuvants where recommended.
- Select the appropriate nozzle type for the application. Beware of compromising nozzle types when tank mixing herbicides with fungicides or insecticides.
- **Be aware of spraying conditions to avoid potential spray drift onto sensitive crops and pastures.**
- **Keep a record of each spray operation, now a legal requirement.**

Using herbicides in pastures

Herbicides can be used to manage pasture and crop enterprises, and therefore livestock, efficiently.

But they shouldn't be used as a substitute for good management.

Benefits

Herbicides can help you manage your pasture/animal system in a number of ways.

- They can be used to remove unwanted weeds from among desirable species.
- They can be used at sub-lethal rates and combined with grazing to control unwanted weeds and retain useful species ('spraygraze' technique).
- They can be used to change the botanical composition of a pasture to:
  - improve its quality
  - remove species that increase vegetable fault in wool
  - remove species that carry diseases that can affect the following crop.
- They can be used to control the seed set of species that threaten the future productivity of the pasture, or of the pasture or crop to be sown ('spray top' technique).

Limitations

Using herbicides in pastures tends to have more limitations than using herbicides in a crop such as wheat.

These limitations are:

- A relatively small number of herbicides are available for weed control in particular situations.
- Sometimes the herbicides may cost too much to justify using them.
- The period in which you can apply the herbicides and get effective control can be very limited.
- A stock withholding period applies to most herbicides. (This may be only a day or two but may range up to several weeks).
- The tolerance of a number of pasture species to the herbicide may have to be taken into account.

You should be aware of these limitations and plan weed control strategies early.

Regardless of the limitations, using herbicides in pastures can be extremely economical. Indeed in some situations (especially when you are establishing pastures), it can make the difference between a highly-productive, profitable pasture and the loss of the pasture.

When you're planning pasture improvement programs, consider the whole range of weed control options available. Weed control by grazing management or mechanical means may be appropriate, or a combination of a number of methods may be the most economical and practical solution.

Weed glossary

African lovegrass – *Eragrostis curvula*
Amaranthus – *Amaranthus* spp.
Amsinckia /Yellow burrweed – *Amsinckia* spp.
Annual ground cherry – *Physalis angulata*
Annual phalaris – *Phalaris minor*
Annual phalaris – *Phalaris paradoxa*
Annual ryegrass – *Lolium rigidum*
Apple of Peru – *Nicandra physalodes*
Apple-of-sodom – *Solanum hermannii*
Barley grass – *Hordeum leporinum*
Barnyard grass – *Echinochloa crus-galli*
Bathurst burr – *Xanthium spinosum*
Bellvine – *Ipomoea plebeia*
Bedstraw – *Galium tricornatum*
Bent grass – *Agrostis capillaris*
Blackberry nightshade – *Solanum nigrum*
Black bindweed /Climbing buckwheat – *Fallopia convolvulus*
Bladder ketmia – *Hibiscus trionum*
Boggabri weed – *Amaranthus mitchellii*
Brome grass – *Bromus* spp.
Buchan weed – *Hirschfeldra incana*
Buttercup – *Ranunculus* spp.
Californian burr – *Xanthium orientale*
California thistle – *Cirsium arvense*
Calomba daisy – *Oncosiphon suffraticosum*
Caltrop (yellow vine) – *Tribulus terrestris*
Camel melon (melons) – *Citrullus lanatus*
Cape tulip – *Homeria* spp.
Catsear/Flat weed – *Hypochaeris radicata*
Capeweed – *Arctotheca calendula*
Chamomile – *Matricaria matricaroidies*
Charlock – *Sinapis arvensis*
Chickweed – *Stellaria media*
Chicory – *Cichorium intybus*
Chilean needle grass – *Nassella neesiana*
Cleavers – *Galium aparine*
Cobbler's peg – *Bidens pilosa*
Columbus grass – *Sorghum* x *almum*
Convolvulus – *Convolvulus arvensis*
Corn gromwell – *Buglossoides arvensis*
Couch – *Cynodon dactylon*
Crassula – *Crassula sieberana*
Crofton weed – *Argeratina adenophora*
Crowsfoot (crab grass) – *Eleusine indica*
Cudweed – *Gnaphalium* spp.
Dandelion – *Taraxacum officinale*
Datura – *Datura* spp.
Deadnettle – *Lamium amplexicaule*
Devil's claw – *Proboscidea* spp.
Dock – *Rumex* spp.
Dodder – *Cuscuta* spp.
Dwarf marigold – *Schkahria pinnata*
English couch (Rope twitch) – *Elytrigia repens*
Erodium /Crowsfoot – *Erodium* spp.
Fat hen – *Chenopodium album*
Fennel – *Foeniculum vulgare*
Field bindweed – *Convolvulus arvensis*
Field madder – *Sherardia arvensis*
Fireweed – *Senecio madagascariensis*
Fleabane – *Conyza canadensis*
Fluke bogrush – *Schoenus apogon*
Fumitory – *Fumaria officinalis*
Galenia – *Galenia pubescens*
Galvanised burr – *Sclerolaena birchii*
Giant rat's tail grass – *Sporobolus pyrimidalis*
Golden thistle – *Scolymus hispanicus*
Ground cherry (annual) – *Physalis angulata*
Guinea grass – *Panicum maximum*
Heliotrope – common – *Heliotropium europaeum*
Heliotrope – blue – *Heliotropium amplexicaule*
Hexham scent – *Melilotus indicus*
Hoary cress – *Lepidium draba*
Horned poppy – *Glaucium flavum*
Horehound – *Marrubium vulgare*
Iceplant – *Mesembryanthemum crystallinum*
Illyrian thistle – *Onopordum illyricum*
Inkweed – *Phytolacca octandra*
Johnson grass – *Sorghum halepense*
Khaki weed – *Alternanthera pungens*
Kikuyu – *Pennisetum clandestinum*
Lesser loosestrife – *Lythrum hyssopifolia*
Liverseed grass – *Urochloa panicoides*
Lippia – *Phyla* spp.
Lovegrass (stink grass) – *Eragrostis cilianensis*
Lucerne – *Medicago sativa*
Mallow – *Malva parviflora*
Maltese cockspur – *Centaura melitensis*
Mexican poppy – *Argemone ochroleuca*
Mintweed – *Salvia reflexa*
Mountain sorrel – *Calandrinia menziesii*
Mustard – *Sisymbrium* spp.
New Zealand spinach – *Tetragonia tetragonioides*
Nodding thistle – *Carduus nutans*
Noogoora burr – *Xanthium occidentale*
Nut grass – *Cyperus rotundus*
Onion grass – *Romulea rosea*
Oxalis – *Oxalis* spp.
Ox-tongue – *Helminthotheca echioides*
Panics – *Panicum* spp.
Parramatta grass (giant) – *Sporobolus fertilis*
Parthenium weed – *Parthenium hysterophorus*
Paspalum – *Paspalum dilatatum*
Paterson's curse – *Echium plantagineum*
Penny cress – *Thlaspi arvense*
Peppercress – *Lepidium* spp.
Phalaris perennial – *Phalaris aquatica*
Pigweed – *Portulaca oleracea*
Plantains – *Plantago* spp.
Poa tussock – *Poa labillardieri*
Potato weed – *Galinsoga parviflora*
Prairie grass – *Bromus catharticus*
Prickly lettuce – *Lactuca serriola*
Prickly paddy melon (melons) – *Cucumis myriocarpus*
Purple top – *Verbena bonariensis*
Quena – *Solanum esuriale*
Ragwort – *Senecio jacobaea*
Redshank – *Amaranthus cruentus*
Rhodes grass – *Chloris gayana*
Rough poppy – *Papaver hydridum*
Saffron thistle – *Carthamus lanatus*
St Barnaby's thistle – *Centaurea solstitialis*
St John's wort – *Hypericum perforatum*
Scotch thistle – *Onopordum acanthium*
Serrated tussock – *Nassella trichotoma*
Sesbania pea – *Sesbania cannabina*
Shepherd's purse – *Capsella bursa-pastoris*
Shivery grass – *Briza minor*
Silvergrass/Vulpia – *Vulpia* spp.
Silverleaf nightshade – *Solanum elaeagnifolium*
Silvery hairgrass – *Aira caryophyllea*
Skeleton weed – *Chondrilla juncea*
Slender thistle – *Carduus pycnocephalus*
Small crumbweed – *Chemopodium punillo*
Smartweed – *Persicaria lapathifolia*
Sorrel – *Acetosella vulgaris*
Soursob – *Oxalis pes-caprae*
Sowthistle – *Sonchus* spp.
Spear (black) thistle – *Cirsium vulgare*
Speedwell – *Veronica* spp.
Spiny burr grass – *Cenchrus* spp.
Spiny emex – *Emex australis*
Spurry – *Spergula arvensis*
Stagger weed – *Stachys arvensis*
Star thistle – *Centaurea calcitrapa*
Stemless thistle – *Onopordum acaulon*
Sterile brome – *Bromus sterilis*
Stinging nettle (annual) – *Urtica urens*
Stinging nettle – *Urtica* spp.
Stinking goosefoot – *Chenopodium vulvaria*
Stinking mayweed – *Anthemis cotula*
Stinking roger – *Osteospernum clandestinum*
Stinkwort – *Dittrichia graveolens*
Stink grass (love grass) – *Eragrostis cilianensis*
Storksbill (erodium) – *Erodium* spp.
Summer grass – *Digitaria cilliaris*
Sunflower volunteer – *Helianthus annuus*
Tarvine – *Boerhavia* spp.
Thornapple (datura) – *Datura* spp.
Toad rush – *Juncus bufonius*
Tree hogweed – *Polygonum patulum*
Turnip weed – *Rapistrum rugosum*
Variegated thistle – *Silybum marianum*
Veined verbena – *Verbena rigida*
Vulpia/Silvergrass (rat's tail fescue) – *Vulpia* spp.
Wallaby grass – *Austrodanthonia* spp.
Ward's weed – *Carrichtera annua*
Water couch – *Paspalum paspalodes*
Wild garlic – *Allium vineale*
Wild lettuce – *Lactuca saligna*
Wild oat – *Avena* spp.
Wild radish – *Raphanus raphanistrum*
Wild sage – *Salvia vergenaca*
Wild turnip – *Brassica tournefortii*
Wimmera ryegrass – *Lolium rigidum*
Winter grass – *Poa annua*
Wireweed – *Polygonum aviculare*
Yorkshire fog – *Holcus lanatus*

(spp. = species)

VOLATILITY OF COMMON HERBICIDE FORMULATIONS

Form of active	Full name	Product example
Low volatility		
Amine salts		
MCPA **dma**	dimethyl amine salt	MCPA 500
2,4-D **dma**	dimethyl amine salt	2,4-D Amine 500
2,4-D **dea**	diethanolamine salt	2,4-D Low Odour 500
2,4-D **ipa**	isopropylamine salt	Surpass® 300
2,4-D **tipa**	triisopropanolamine	Tordon® 75-D
2,4-DB **dma**	dimethyl amine salt	Buttress®
dicamba **dma**	dimethyl amine salt	Banvel® 200
triclopyr **tea**	triethylamine salt	Tordon® Double Strength
picloram **tipa**	triisopropanolamine	Tordon® 75-D
picloram **tea**	triethylamine salt	Tordon® Granules
Other salts		
MCPA **Na salt**	sodium salt	MCPA 250
MCPA **Na/K salt**	sodium and potassium salt	MCPA 250
2,4-D **Na salt**	sodium salt	Tornado® DF
2,4-DB **Na/K salt**	sodium and potassium salt	Buticide®
dicamba **Na salt**	sodium salt	Cadence®
Some volatility		
Ester		
MCPA ehe	ethylhexyl ester	LVE MCPA
MCPA ioe	isooctyl ester	LVE MCPA 500
triclopyr butotyl	butoxyethyl ester	Garlon® 600
picloram ioe	isooctyl ester	Access®
High volatility		
Ester		
2,4-D **ee**	ethyl ester	Estercide® 800
2,4-D **ibe**	isobutyl ester	2,4-D Ester 800
2,4-D **ioe**	isooctyl ester	Low Volatile Ester 400

Compiled by Mark Scott, Andrew Storrie and Keith Pengilley.

Volatility refers to a pesticide's ability to pass from the liquid to gaseous phase in the atmosphere. Volatilisation is the process by which this occurs. Once the pesticide has been transformed into a gaseous form it is moved about by the wind. Many herbicide ester formulations are more volatile than amine, sodium salt and acid formulations.

2,4-D ester is highly volatile and will volatilise readily at temperatures over 25°C. 2,4-D ester should not be applied if the temperature is likely to exceed 25°C at or within 24 hours of application.

Volatilisation most often occurs during application, but can also occur after the pesticide has been deposited on plants or the soil surface. Volatility post-application generally increases with increasing temperature and soil moisture, and with decreasing clay and organic matter content. The use of a surfactant can change the volatility of a herbicide.

If there are sensitive areas near the weeds being treated, the risk of off-target damage can be reduced by using an alternative to an ester formulation. However, in winter, volatilisation of ester formulations is greatly reduced because of lower air temperatures, and ester formulations can often be used with little risk of off-target damage.

High volatile 2,4-D esters now have new labels with new restrictions on use. See APVMA website: www.apvma.gov.au and page 6 of this publication.

Managing herbicide spray drift

When applying pesticides, the aim is to maximise the amount reaching the target and to minimise the amount reaching off target areas; resulting in:

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

In areas where a range of agricultural enterprises co-exist, conflicts can arise, particularly from the use of pesticides. All pesticides are capable of drift. When spraying a pesticide, you have a moral and legal responsibility to prevent it from drifting and contaminating or damaging neighbours' crops and sensitive areas.

How to minimise spray drift

Before spraying

- Always check for susceptible crops in the area, for example broadleaf crops such as grape vines, cotton, vegetables and pulses if you are using a broadleaf herbicide.
- Check sensitive areas such as houses, schools, waterways and riverbanks.
- Notify neighbours of your spraying intentions.
- Under the Pesticides Regulation 2009 of the *Pesticides Act 1999* when spraying you must record the weather and relevant spray details. The form is reproduced on page 15 of this publication. Forms are also available from www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/188687/pesticide-application-form.pdf

During spraying

- Always monitor weather conditions carefully and understand their effect on 'drift hazard'.
- Don't spray if conditions are not suitable, and stop spraying if conditions change and become unsuitable.
- Record weather conditions (especially temperature and relative humidity), wind speed and direction, herbicide and water rates, and operating details for each paddock.
- Supervise all spraying even when a contractor is employed. Provide a map marking the areas to be sprayed, buffers to be observed and sensitive crops and areas.
- Spray when temperatures are less than 28°C.
- Maintain a downwind buffer. This may be in crop, for example keeping a boom's width from the downwind edge of the field.
- Minimise spray release height.
- Use the largest droplets that will give adequate spray coverage.
- Always use the least volatile formulation of herbicide available.
- If there are sensitive crops in the areas, use the herbicide that is the least damaging.
- Limit travel speed to 15 km/h or lower.

Types of drift

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

Droplet drift is the easiest to control because under good spraying conditions, droplets are carried down by air turbulence and gravity, to collect on plant surfaces. Droplet drift is the most common case of off target damage caused by herbicide application. For example, spraying fallows with glyphosate under the wrong conditions often leads to severe damage to establishing crops.

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

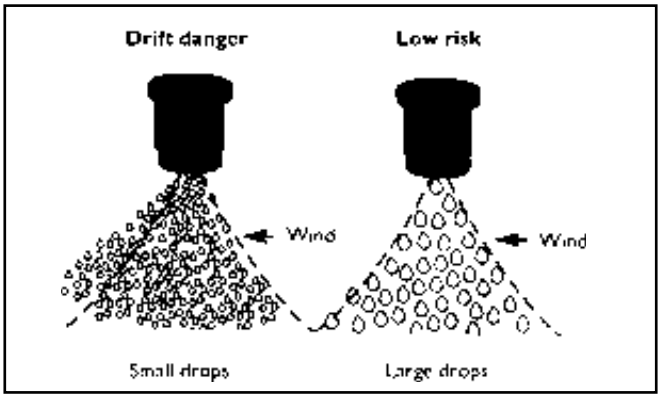
Vapour drift is confined to volatile herbicides such as 2,4-D ester. Vapours may arise directly from the spray or evaporation of herbicide from sprayed surfaces. Use of 2,4-D ester in summer can lead to vapour drift damage of highly susceptible crops such as tomatoes, cotton, sunflowers, soybeans and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

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

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

What factors affect the risk of herbicide spray drift?

- Volatility of the formulation applied – ester > amine
- Proximity of crops susceptible to the particular herbicide being applied, and their growth stage. For example cotton is most sensitive to Group I herbicides in the seedling stage



- Method of application and equipment used – air, ground or mister
- Size of the area treated, and the amount of active herbicide applied
- Efficiency of droplet capture – bare soil versus crop
- Weather conditions during and shortly after application including Delta T
- Ground speed of spraying equipment
- Boom height
- Day versus night spraying

Reduce spray release height

- Operate the boom at the minimum practical height. Drift hazard increases from 5–10 times as nozzle height doubles. Angle nozzles forward 30° to allow lower boom height with double overlap. Lower heights however, can lead to more striping as the boom sways and dips below the optimum height.
- 110° nozzles produce a higher percentage of fine droplets than 80° nozzles; however they allow a lower boom while maintaining the required double overlap.
- Operate within the pressure range recommended by the nozzle manufacturer. Production of driftable fine droplets increases as the operating pressure is increased.
- Halve the nozzle spacing on the boom.

Size of area treated

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

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

What is your 'capture surface'?

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

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

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

Weather conditions to watch out for

Midday turbulence

- Updrafts during the heat of the day cause rapidly shifting wind directions. Avoid spraying during this part of the day.

High Temperatures

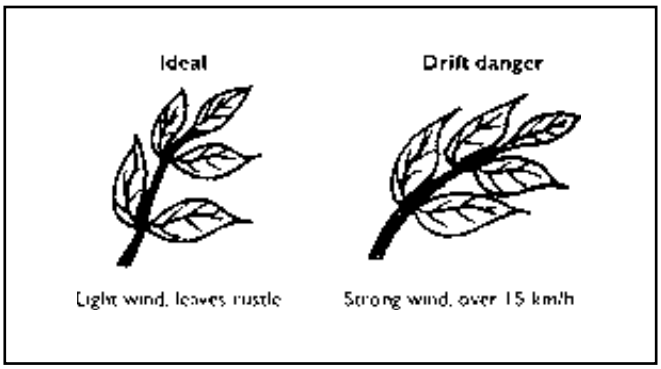
- Avoid spraying when temperatures exceed 28°C.

Humidity

- Avoid spraying under low relative humidity conditions (less than 35%) i.e. when the difference between wet and dry bulbs (Delta T) exceeds 10°C, see Delta T table on page 12.
- High humidity extends droplet life and can greatly increase the drift hazard under inversion conditions. This results from the increased life of droplets smaller than 100 microns.

Wind

- Avoid spraying under still conditions.
- Ideal safe wind speed is 7–10 km an hour. Leaves and twigs are in constant motion.
- 11–14 km/h (moderate breeze) is suitable for spraying if using low drift nozzles and/or higher volume application (80–120 L/ha). Small branches move, dust is raised and loose paper is moving.



Inversions

- The most hazardous condition for herbicide spray drift is an atmospheric inversion, especially when combined with high humidity.
- Do not spray under inversion conditions.
- An inversion exists when temperature increases with altitude instead of decreasing and a cold blanket of air forms at height above the ground which is usually less than 50m thick. Air will not rise above this blanket; and smoke or fine spray droplets and particles deposited within an inversion will float until the inversion breaks down.
- Inversions usually occur on clear, calm mornings and nights. Windy or turbulent conditions prevent inversion formation. Blankets of fog, dust or smoke and the tendency for sounds and smells to carry long distances indicate inversion conditions.
- Smoke generators or smoky fires can be used to detect inversion conditions. Smoke will not continue to rise but will drift along at a constant height under the inversion 'blanket'.

Source: A Storrie, Technical Specialist – Weeds, Department of Industry & Investment NSW, Tamworth

Night Spraying

Night spraying is often undertaken in the mistaken belief that drift is less likely because Delta T is more favourable and there is little wind to move pesticides off-target.

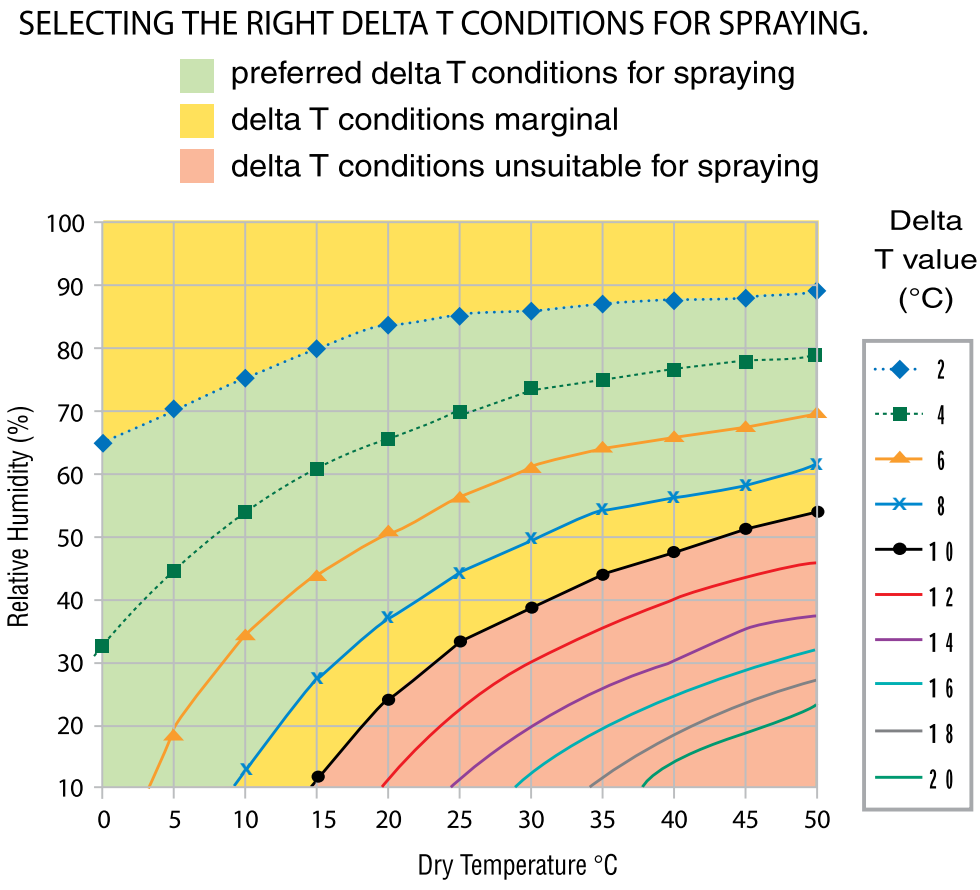
During spring and summer, there is little variation between day and night for Delta T. Rather than assume Delta T will be favourable at night, measure temperature and relative humidity before and during spraying, and consult the Delta T chart in this publication to see whether or not conditions are favourable. Stickers with the Delta T chart on them can be obtained from Nufarm and stuck on the inside windscreen of a tractor or self-propelled sprayer.

If the Delta T is adverse, spraying will be high risk. Slow down and drop the boom. Increase the water rate. Use a low drift nozzle.

While the risk of droplet drift is reduced at night, inversion conditions are common and have resulted in massive off-target damage in recent seasons, particularly to cotton and grapes. Use a smoke generator to check for inversion conditions before spraying at night, and continue to monitor during spraying. If an inversion is present before starting spraying, DO NOT spray. If an inversion develops during spraying, stop spraying immediately.

Night spraying is inherently high risk and should be avoided.

Source: M Scott Agricultural Chemicals Officer, Department of Industry & Investment NSW, Orange



Delta T diagram supplied by Nufarm Ltd

Managing your legal responsibilities in applying pesticides

Pesticides Act

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

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

A regulation was gazetted in 2009 renewing the requirement for all commercial pesticide users, i.e. all farmers and spray contractors, to keep records of their pesticide application (Records Regulation).

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

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

A form that captures all the information required by the Records Regulation, together with notes on how to fill it in, is included in this guide. The form and notes can also be downloaded from the Department's website. A self-carboning record book is available from Murrumbidgee Rural Studies Centre, Yanco, phone 1800 138 351.

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

The same regulation requires all commercial pesticide users to be trained in pesticide application.

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

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

The minimum prescribed training qualification will be the AQF2 unit of competency, 'Apply chemicals under supervision', although owner-applicators are encouraged to train and be assessed in the two higher AQF3 competencies, 'Prepare and apply chemicals' and 'Transport, handle and store chemicals'. The DECCW intends to make these two competencies the minimum some time in the future.

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

How to fill out your pesticide application record

(This form includes more than the Records Regulation requires, so compulsory information is in *italics*.)

Property/holding:

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

Fill in the residential address.

Applicator details:

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

Sensitive area identification:

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

Paddock identification:

Identify the paddocks/blocks and order of treatment (if there is more than one) in the 'paddock' row of the form. This should be filled in prior to the start of application, along with the residential address. If using a contractor or employee, this information should also be given to them BEFORE they start the job. Applicators using global positioning systems (GPS) could include a GPS reading in addition to the paddock number/name.

Crop/animal identification:

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

Product details:

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

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

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

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

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

Equipment details:

As a minimum, you have to fill in what equipment you used. Positive identification can be assisted by specifying the settings used for the application, for instance, nozzle type and angle, pressure. The nozzle type will usually include the angle. With pressure, the reading should be as close to the nozzle as possible. Other details are useful as a reminder for future use, or as a check on your set-up should you have a treatment failure, for instance, date of calibration and water quality. Water quality is important for herbicide efficacy. At the most basic level, water quality can be described in terms of its source, for instance, rainwater, dam water, bore water.

Weather:

As a minimum, you have to record wind speed and direction. This is better measured with instruments than estimated. Record any changes during application.

You must also record the time of day when you started and the time when you finished.

Weather records have to be made for all equipment that distributes pesticide through the air.

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

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

NSW GOVERNMENT | Industry & Investment

No.

Location, Applicator, Date of Application

Property/Holding: (residential address)					Date:
Applicator's Full Name:			Owner (if not applicator):		
Address:			Address:		
		Phone:			Phone:
Mobile:	Fax:	E-mail:	Mobile:	Fax:	E-mail:
Sensitive Areas (including distances, buffers): N / W / Treated Area / E / S			Comments (including risk control measures for sensitive areas):		

Host/Pest

Paddock Number/Name:	Paddock Area:	Order of Paddocks Sprayed:
Crop/Situation:	Type of Animals:	
Crop/Pasture Variety:	Age/Growth Stage:	
Growth Stage:	Mob/Paddock/Shed:	
Pest/Disease/Weed:	Animals – Number Treated:	
	Pest Density/Incidence: ❑ Heavy ❑ Medium ❑ Light	

Application Data

Full Label Product Name:		Rate/Dose:		Water Rate @ L/ha:
Permit No.:	Expiry Date:	Additives/Wetters:		
Total L or kg:	WHP:	ESI:	Date Suitable for Sale:	
Equipment Type:		Nozzle Type:	Nozzle Angle:	Pressure:
Date Last Calibrated:	Water Quality (pH or description):			

Weather

❑ Showers ❑ Overcast ❑ Light Cloud ❑ Clear Sky

Rainfall (24 hours before and after)

Before: mm During: mm After: mm

Time (show time in this column	Temperature °C	Relative Humidity (%)	Wind Speed	Direction	Variability (e.g. gusting)
Start					
Finish					

Comments:

Pasture herbicide application – nozzle selection

Basic Overview

Nozzle selection for application of herbicides to pasture should primarily focus on reducing the risk of spray drift without compromising efficacy. Drift (or loss) is a significant issue facing the industry and applicators of herbicides not only have a moral but a legal obligation to adopt drift management best practise.

Although there remains confusion regarding nozzle selection, the industry in general (backed largely by several years of trials on application rates, nozzle designs, travel speeds etc) generally agree and recommend that most *herbicides can be applied with coarser spray quality without any detrimental effect on efficacy.*

How coarse you can go will still depend on the herbicide, the target and the conditions at the time of spraying, and growers need to be prepared to adjust either application rate or nozzle design appropriately. For example if using very coarse droplets, higher water volumes may be required to maintain high levels of efficacy particularly when targeting fine leaf grasses with a grass selective (Group A and B) products.

At TeeJet we recommend that (at least) two nozzles will be required for pasture herbicide applications, though the final choice will depend mainly on travel speeds (or application volume) and the applicators pre-spray drift risk assessment (weather conditions, location of susceptible crops and so on).

For the South Eastern States we are generally recommending the Turbo TeeJet (or Turbo TwinJet – TTJ60) **plus** the AIXR.

Knockdown

By far the majority of products and targets can be sprayed with a **coarse–very coarse** droplet. The AIXR is our recommended nozzle. It is widely used for pasture applications of knockdown herbicides at pressures between 2 and 6 bar. Coarse droplets widen the application window and most trial data show no decline in efficacy, even at common (say 50–60 L/ha) application rates.

That said, if the AIXR is to be used when targeting fine grasses with grass selective products, we recommend a higher application rate (80 L/ha plus). This means either slowing down or changing to a larger nozzle capacity. If users are not prepared to do either, then they must spray with a **medium** droplet size: see TT or TTJ below.

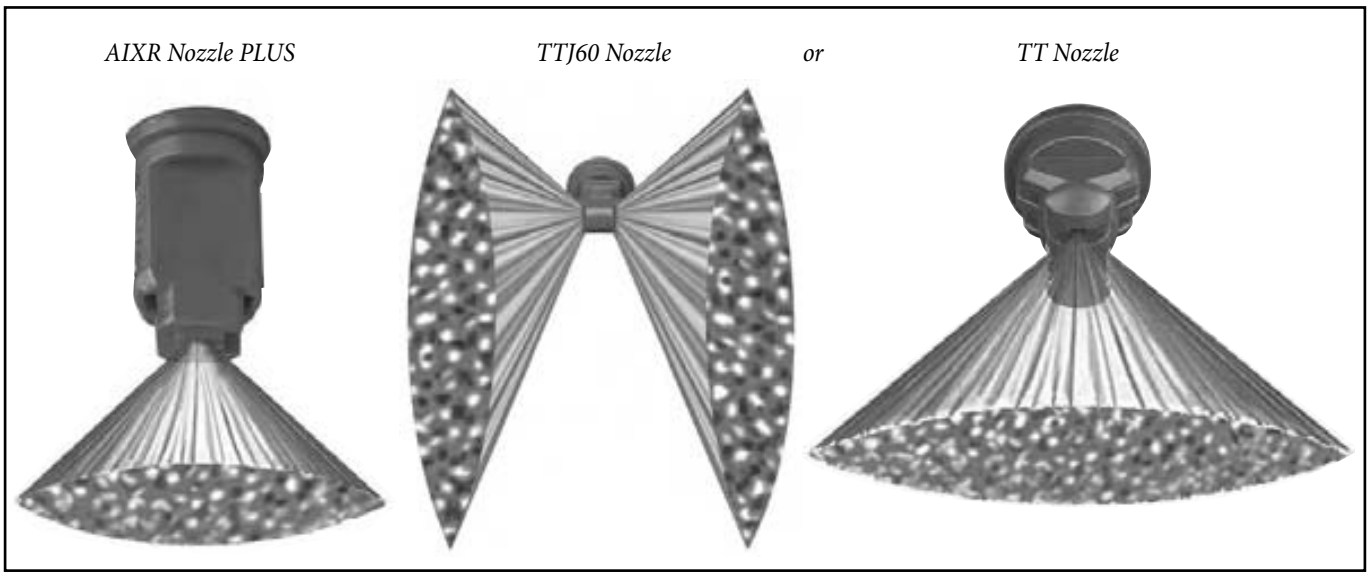
Grass selective

The TT or TTJ60 would be used for grass selective products at pressures of 1–6 bar when spraying conditions are ideal. These nozzles are also excellent for penetration into lush/dense pasture and also for contact fungicides/insecticides if required.

However one limitation of all TwinJet's (and Twin caps/bodies etc.) is that at speeds greater than 16 km/h, the forward fan 'bends' into the rear fan, negating any benefit of the forward trajectory. So if spraying is to occur at speeds greater than 16 km/h, the TTJ should be avoided and the standard TT would then be our recommendation.

As always, any application requirements on the product label must be adhered to, and some labels are quite specific in the drop size that must be used, such as the 2-4,D label which states a coarse (or greater) spray quality.

Source: Peter Alexander, TeeJet Australasia Pty Ltd, 65 West Fyans Street, Newtown Vic 3220



Using adjuvants with herbicides

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

Some herbicides have sufficient adjuvant and require no additional surfactants to perform well. However, some do and this is usually detailed on the herbicide label. Always read the herbicide label before opening the container and heed the information printed there.

An adjuvant is any additive to a herbicide which is intended to improve the effectiveness of the herbicide. There are many products which have been developed to assist herbicides to contact the weed target, then remain and penetrate the weed leaf.

The APVMA classes adjuvants into two categories:

- adjuvants which enhance product efficacy; and
- adjuvants which improve the ease of application.

Adjuvants which enhance product efficacy

Wetters/Spreaders (enhance adhesion to and spreading of spray droplets on target surfaces by reducing the surface tension of the pesticide formulation and improving coverage) such as;

- Non-ionic surfactants - non-reactive, i.e. they do not have a negative charge or a positive charge; they remain on the leaf once dry and allow rewetting after rain, permitting additional pesticide uptake.
- Anionic surfactants – negative charge
- Cationic surfactants – positive charge
- Amphoteric surfactants
- Organo-silicate surfactants
- Acidified surfactants

Stickers (increase adhesion of pesticides to target surfaces) such as;

- Latex-based
- Terpene/pinolene
- Pyrrolidone-based

Penetrants (improve the transfer of active ingredients from the target surface to interior tissues) which may include:

- Mineral oil
- Vegetable oil
- Esterified vegetable oil
- Organo-silicate surfactants
- Acidified surfactants

Extenders (enhance the amount of time the active ingredient remains toxic by increasing resistance to environmental degradation) which may include;

- Ammonium sulphate
- Menthene-based

Humectants (increases the density/drying time of an aqueous spray deposit)

- Glycerol
- Propylene glycol
- Diethyl glycol

Adjuvants which improve ease of application

Acidifying/Buffering agents (adjusts the pH of alkaline or acidic water and minimizes decomposition of the pesticide through alkaline hydrolysis).

Anti-foaming/De-foaming agents (reduces or suppresses the formation of foam in the spray tank preventing foam overflow):

- Dimethopolysiloxane

Compatibility agents (permit the mixing of different agrochemicals by preventing antagonism between different ingredients in the spray solution) such as:

- Ammonium sulphate

Drift control agents (alter the viscoelastic properties of the spray solution yielding a coarser spray with greater mean droplet sizes):

- Polyacrylamides
- Polysaccharides

Dyes (commonly used for spot or boom spraying herbicides to detect missed spots or avoid spraying a plant or area twice).

Water conditioners (prevents reaction between hard water ions in spray solutions and suppresses formation of precipitates or salts)

- Ammonium sulphate

Factors affecting adjuvant use include:

1. **Crop safety** – addition of an adjuvant can reduce herbicide selectivity and thereby increase crop damage. This is not an issue for fallow and pre-emergent herbicides.
2. **Effectiveness or activity** – adjuvants are usually added to increase the effectiveness of herbicides. However, use of the wrong type or rate can reduce effectiveness, such as decreasing herbicide retention on leaves.
3. **Water hardness** – hard water can lead to poor mixing of the chemical with water. This particularly occurs with emulsifiable concentrates. High levels of calcium and magnesium ions bind with amine formulations causing them to be less soluble and therefore less effective.
4. **Water temperature** – low water temperature can lead to gelling in the tank. High concentration herbicides might not mix and surfactants may perform poorly.

Decontaminating a sprayer after sulfonylurea herbicides (SUs)

What are sulfonylurea (SU) herbicides?

Sulfonylurea (SU) herbicides inhibit cell division in the roots and shoots of plants. SUs are rapidly taken up and translocated but are not persistent in the plant.

They include: Chlorsulfuron (Glean), Sulfosulfuron (Monza), Metsulfuron-methyl (Ally and Brushoff), Triasulfuron (Logran), Thifensulfuron-methyl (Harmony).

SUs are characterised by their efficacy at low application rates and their persistence in soil. SUs are particularly effective against broad leaf weeds. They can also be just as damaging to desirable broadleaf plants such as canola, pulses, lucerne and clovers. At one five-hundredth of the concentration used to control broadleaf weeds SUs will seriously affect susceptible crops and pastures. Therefore residues left in a boom spray can be extremely harmful if sprayed out on sensitive species.

Good practice when applying SUs

Always use good quality water. SUs dissolve better in water that is neutral to alkaline. Test the pH of the water to be used. Avoid using acidic water or adjust the pH if there is no alternative. Poor quality water will result in a loss of efficacy and increased residues in the system.

Housekeeping rules

SUs should not be left in the tank after spraying. Mix exactly the amount of chemical required. If any SU solution remains, spray this out on the headlands in the paddock where the herbicide was applied. It is illegal to spray the solution on anything other than a crop for which it is registered.

Clean and decontaminate the boom as soon as spraying is finished, don't leave it over night. All chemical residues are more easily removed when they are still moist; before they dry out and crust.

There are two stages in cleaning spraying equipment that has been used to apply SUs. The first is to neutralise the herbicide by flushing with chlorine; then physically dislodge any SU residues by thoroughly cleaning filters and the like.

Allow about 2 hours for the job.

Washing down the exterior

Start by putting on appropriate PPE (personal protective equipment). This should include cotton overalls, gumboots and unlined nitrile or PVC gloves.

Before the chlorine is added, remove any residues from the exterior with a high pressure spray, which will prevent remaining residues from re-contaminating the plumbing when filters and tank lids are removed for rinsing.

Be sure to wash down: nozzles and spray lines, trapeze and boom structure, all tanks, trailer body and suspension, mudguards, access platform and steps, pump exteriors and PPE/spares lockers.

Thorough flushing with clean water and a chlorine solution

Whether you are putting clean water or a chlorine solution through the system, it is important to:

- Include any chemical transfer systems, such as induction hoppers, probes/flushers, enviro drum connections and special purpose concentrate tanks
- Spray out through the nozzles, including nozzles at the ends of spray lines and used along fence lines
- Briefly open taps in the ends of spray line sections and taps isolating pressure gauges (check the operator's manual to see whether or not taps at the end of spray lines can be opened when the pump is running).

Chemical transfer systems should be flushed before spraying starts, immediately after the concentrate has been transferred to the main tank. The first reason being that concentrate is most easily dissolved while still moist, and the second is that all chemical put through the transfer system will end up where intended, dissolved residues will be returned to the main tank in the form of rinsate.

Although induction hoppers are most likely to be used for transferring SUs, do not neglect other chemical transfer systems (even if they are not used to transfer SUs), as residues can form in the lines and associated valves (e.g. probes/flushers).

Booms have a dump or pressure equalisation/regulator/compensator valve that diverts fluid from spray lines back to the main tank. Its purpose is to maintain pressure in the spray lines without activating the principal pressure relief valve. This is why it is known as a 'dump valve' or a 'pressure equalisation/regulator/compensator valve'. This valve and line need to be activated to clean them of residues. This may involve shutting the valves to the spray lines, or the dump line may be the default flow before the system is pressurised and the valves to the spray lines opened. Check the operator's manual for details. If there are no specific instructions on how to flush this line, remove and clean the line and its valve manually. It may be useful to have two separate fittings: one for SUs and one for other pesticides.

Once the exterior has been cleaned down, put clean water from the flush/rinse tank throughout the system for at least 10 minutes. (the capacity of the flush/rinse tank should be 10% of the capacity of the main tank.) Cycle and spray out as above.

Fill the main tank with clean water and add 300mL chlorine bleach (4% chlorine) per 100 L water. Leave in the tank for 15 minutes, continuously agitating. Cycle and spray out as above. Do this twice. Refill with clean water for 10 minutes' spraying again, and repeat the initial clean water rinse.

Cleaning filters and residue traps

Remove all filters:

- Basket filter in top of main tank
- Filter on suction to pump(s) and on delivery line between pump(s) and main tank
- Filter on delivery side of main tank to spray lines
- In-line filters on spray lines
- Individual nozzle filters

Not all spray equipment will have all of the filter stages mentioned above. Most booms have a least three. Consult the operator's manual for details.

All filters should be cleaned in water with a soft brush (a toothbrush is good). Basket filters, with a coarse mesh, should be tapped on a hard object to remove residues. Large suction and delivery filters should also be tapped. So called 'self cleaning' filters should also be cleaned. Don't forget to rinse the filters in clean water before replacing them, and don't forget to clean the insides of filter housings. Remove and clean 'O' rings separately, replace any that are damaged. Rinse the cap and nozzle as well as filters before re-assembling.

Remove and clean tank lids, caps at the ends of spray lines. The pressure relief valve should be disassembled, cleaned and rinsed in the same way as for nozzle assemblies. Consult the operator's manual for details.

External sight gauges that indicate volume in the main tank by displacing a float in a transparent tube should be flushed with clean water.

Design faults

There are some potential traps for residues that can be easily fixed.

- If the flush/rinse tank is not plumbed independently to the main tank or does not have an operating one way valve to prevent contamination, it can be solved by fitting a one way valve.
- There should be no 'dead ends' in the plumbing, if the lines to pressure gauges lack taps between the gauge and the line, fit one. The dump valve and line from the valves controlling the spray lines back to the main tank is an ideal place for residues to precipitate and adhere to the spray line. Dry formulations such as SUs need constant agitation. If it is not subject to constant agitation the active ingredient will precipitate out of solution. If the dump line is not activated during spraying, or not cleaned after spraying, the residues will remain until they are dissolved in a future spray job when the dump valve is automatically activated to maintain pressure in the spray lines.
- Tanks may develop cracks over time. A UV (ultraviolet) stabiliser is added to the polythene, but this slowly breaks down due to movement of the tank within its retaining brackets, caused by the weight of the water plus the forces transmitted from the boom to the trailer during spraying. If you are inspecting the inside of the tank, be sure to follow confined spaces procedures; which includes carrying out and documenting a risk assessment, testing the atmosphere, and having someone outside while you're inside, etc. Consult Work Cover for advice.

The next spray

A safety precaution is to apply an emulsifiable concentrate (EC) solution to a crop or pasture which is not susceptible to SUs following an SU application. The carriers of ECs are organic solvents. SUs are soluble in EC formulations. Using an EC on a non SU susceptible crop or pasture before spraying a susceptible crop also provides an additional clean.

To tell if a formulation is an EC, look on the label for:

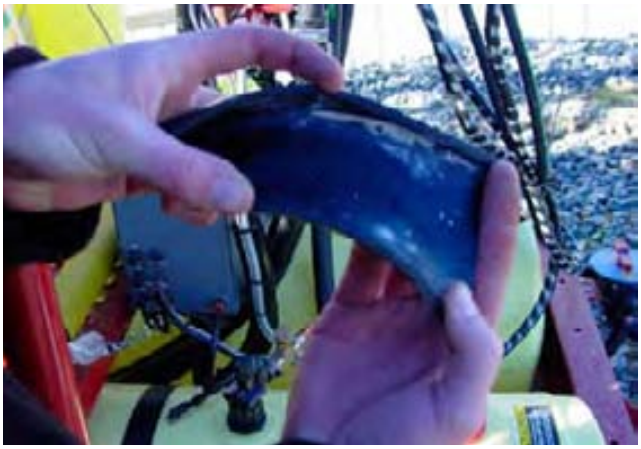
- 'EC' or 'emulsifiable concentrate'
- 'Liquid hydrocarbons' (under the active constituent on the front panel), eg xylene.
- ECs are liquid formulations and will have characteristic solvent, chemical smell.

As explained earlier, minute amounts of SUs can cause damage to susceptible crops. This damage usually occurs after the boom has been spraying for some time, as it may take a while for SU residues to become dislodged and dissolved and then contaminate the new spray solution. Applying an EC to a non SU susceptible crop after an SU application and before using the boom on an SU susceptible crop or pasture reduces the risk of damage to the SU susceptible crop.

Potential residue accumulation points

Pressure equalisation/regulator/compensator valve

Potential residue accumulation points



Dead lines, e.g. hoses to pressure compensator valve

Photos courtesy John Francis, Industry & Investment NSW

Filters and screens

Solenoid valves

Manifolds

Hollow boom line end caps

Photos courtesy Syngenta

Boomspray calibration

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

In the template, enter the information asked for such as spray tank capacity, chemical rate and ground speed in the space provided in the right hand column. You will need this information to perform the calculations. The numbers in the black 'golfballs' tell you which figures you need to perform the calculations. For example, to work out your water application rate, you need to know your total spray output, your effective spray width and your actual ground speed. The 'golfball' numbers in the formula show you where to get these figures.

General Information

Item of equipment to be calibrated.	
Spray tank capacity (litres).	L ❺
Area to be sprayed (hectares).	ha ❼
Chemical used.	

Recording

What is the minimum water application rate – if any (from the chemical label)?	L/ha
Select the correct chemical application rate from the label.	L/ha ❹
Select an appropriate ground speed.	gear rpm
Record spray operation pressure.	bar or kPa
Record nozzle type and size in the spray unit. Check the rated 'water output' using the manufacturer's nozzle charts. Rated output	type size ..... mL/min
Record minimum boom height above target for these nozzles.	cm

Measuring

Record the output from every nozzle for 1 minute. 1..... 2..... 3..... 4..... 5..... 6..... 7..... 8..... 9..... 10..... 11..... 12..... 13..... 14..... 15..... 16..... 17..... 18..... 19..... 20..... 21..... 22..... 23..... 24..... Replace any nozzles that vary 10% or more from the manufacturer's correct nozzle output. (Nozzles with both higher and lower outputs must be replaced.)	Total spray output (add all nozzles) L/min ❶
Record actual effective spray width in metres by measuring the distance across the outside nozzles and adding the distance between two adjacent nozzles.	m ❷

Calculating

Actual Ground Speed*	$\frac{\text{Distance covered (m)} \times 3.6}{\text{Time taken (seconds)}}$	$\frac{(\quad) \times 3.6}{(\quad)}$	= ..... km/hr ❸

'3.6' in the calculation is a conversion factor to convert metres to kilometres (metres ÷ 1000) and seconds to hours (seconds ÷ 3600): D/1000 ÷ S/3600 = D/1000 × 3600/S = D/S × 3600/100 = D/S × 3.6.

* To calculate your actual ground speed:

- Measure a set distance, for example 100 metres.
- Make sure that the spraying conditions are like those in the area that you will be spraying.
- Time how long it takes using the appropriate gears and revs.

Now you can calculate the water application rate, how much chemical you will need to mix in each tank and how many tank loads you will need to do the whole job. Follow the steps below:

1. Copy the answers you worked out on the previous page into the boxes below. You will need these numbers to do the calculations on this page. (The numbers in black circles (e.g. ❶) tell you the step where the answer is on the previous page.

Total Spray Output	**Effective Spray Width**	**Actual Ground Speed**
…… litres/minute ❶	…….. metres ❷	…… km/hr ❸

2. Work out the water application rate by using the numbers you have recorded above. Put these numbers in the correct place in the calculation below.

Water Application Rate	$\frac{❶ \times 600}{❷ \times ❸}$	$\frac{(\quad) \times 600}{(\quad) \times (\quad)}$	$= \frac{(\quad)}{(\quad)}$	❻ ..... litres/ha

'600' in the calculation is a conversion factor to convert litres per minute to litres per hour (minutes × 60), and kilometres to metres (km × 1000), then square metres (m × km × 1000 = m^2) to hectares (m^2 ÷ 10000): 60 ÷ 1000/10000 = 60 ÷ 1/10 = 60 × 10 = 600.

Does this water application rate meet the chemical label requirements? (See Part B above) Yes No
If not, how could you change this rate to meet this requirement? ....

3. Now that you know the water application rate you can calculate how much chemical you need to mix in each tank.

Chemical Application Rate		**Spray Tank Capacity**
..... litres/ha ❹		..... litres ❺

How much chemical to mix in each tank?	$\frac{❹ \text{ (L/ha)} \times ❺ \text{ (L)}}{❻ \text{ (L/ha)}}$	$\frac{(\quad) \times (\quad)}{(\quad)}$ = ... litres

4. Finally, you can now work out how many tank loads you will need to do the job.

Spray mix needed for the job	❼ (ha) × ❻ (L/ha) ( ) × ( )	= ..... litres ❽
Number of tanks needed	$\frac{❽ \text{ (L)}}{❺ \text{ (L)}}$ $\frac{(\quad)}{(\quad)}$	= ..... tanks

(To crosscheck your calculations: *Number of tanks × Volume of chemical per tank = Area to be sprayed × Chemical rate)*

Source: SMARTtrain Chemical Reference Manuals, 2005.

Water quality for herbicide application

Good quality water is important when mixing and spraying herbicides. It should be clean and of good irrigation quality. Poor quality water can reduce the effectiveness of some herbicides and damage spray equipment. Some poor results with herbicides could possibly be due to water quality problems.

Effects of water quality

Water quality depends on the source of the water (rain-fed tank, dam, river, bore or aquifer) and the season (e.g. heavy rain, drought). There are several characteristics of water quality which affect chemical performance.

Dirt: Dirty water has very small soil particles (clay and silt) suspended in it. These soil particles can absorb and bind the chemical's active ingredient and reduce its effectiveness. This applies especially to **glyphosate, paraquat** and **diquat.**

Dirt can also block nozzles, lines and filters and reduce the sprayer's overall performance and life. As a guide, water is considered dirty when it is difficult to see a 10¢ coin in the bottom of a household bucket of water.

Water hardness: Water is termed hard when it has a high percentage of calcium and magnesium. Hard water won't lather with soap and can cause some chemicals to precipitate. Susceptible chemicals often have agents added to overcome this problem.

Formulations of 2,4-DB are particularly sensitive to hard water (> 400 ppm $CaCO_3$ equivalent). Other herbicides such as glyphosate, 2,4-D amine and MCPA amine, Lontrel™ and Tigrex® can also be affected.

Hard water can also affect the balance of the surfactant system and affect properties such as wetting, emulsification and dispersion. Very hard water can also reduce the efficiency of agents used to clear dirty water.

Water pH: pH is a measure of acidity and alkalinity scaled on a range between 1 and 14. A pH of 7 is neutral, less than 7 acid and more than 7 alkaline. Most natural waters have a pH between 6.5 and 8.

In highly alkaline water (pH>8) many chemicals undergo a process called alkaline hydrolysis. This process causes the breakdown of the active ingredient into other compounds which can reduce the effectiveness of the pesticide over time. This is one reason why spray mixes should not be left in spray tanks overnight.

Very acid water can also affect the stability and physical properties of some chemical formulations.

Dissolved salts: The total amount of mineral salts dissolved in water is usually measured by the electrical conductivity (EC) of the water.

The EC of bores and dams depends largely on the salt levels in the rock and soil that surrounds them. During a drought the salinity of water increases.

Very salty water can cause blockages in equipment and is more resistant to pH changes.

Organic matter: Water containing a lot of organic matter, such as leaves or algae can block nozzles, lines and filters. Algae can also react with some chemicals, reducing their effectiveness.

Temperature: Very hot or cold water can affect the performance of some chemicals.

Improving water quality

Water needs to be tested to see whether it will affect chemical performance. There are commercial products available to reduce pH (e.g. Primabuff BB5 and LI700 and Hotup®), soften hard water and clear dirty water. To reduce the effects of very salty water, you may need to mix water from several sources.

Acknowledgement: Extracts from SPRAY SENSE Bulletin No.12 T. Burfitt, S. Hardy and T. Somers (1996).

The following table summarises the effect of water quality on some herbicides:–

Herbicide tolerances to water qualities:

Herbicide	Water Quality				
	Muddy	Saline	Hard	Alkaline (> pH 8)	Acidic (< pH 5)
2,4-DB			✗	NR	
2,4-D or MCPA amine	✓	✓	✗	NR	
2,4-D or MCPA ester	✓	Test	Test	✓	✓
Affinity®	✓	✓	✓	✗	NR
Ally®, Associate®/Lynx®	✓	✓	✓	Marginal	✗
Brodal®/Bonanza® Elite		✓	✓	✗	
Dicamba	✓	✓	NR	NR	
Diuron	✓	Test	✓	✓	
Diuron + 2,4-D amine	✓	Test	✗	NR	
Diuron + MCPA amine	✓	Test	✗	NR	
Fusilade®	✓	✓	✓	NR	✗
Chlorsulfuron,Glean®,Lusta®/ Tackle®	✓	✓	✓	Marginal	✗
Glyphosate	✗	✓	✗		✓
Hoegrass®, Nugrass®	✓	✓	✓	NR	✓
Logran®, Nugran®/Lonestar®	✓	✓	✓	Marginal	✗
Lontrel™/Victory®	✓	✓	✗	✗	
Sertin®	✓	✓	✓	✓	✓
Simazine	✓	✗	✓	NR	
Spray·Seed®, paraquat, diquat	✗	✓	✓	✓	✓
Targa®/Leopard®	✓	✓	✓	✓	✓
Tigrex®	✓	✗	✗	NR	
Trifluralin/Trilogy®		✓	✓	✓	✓
Verdict®	✓	✓	✓	NR	✓

Key:
✓ = OK.
✗ = Do not use.
NR = Not recommended but use quickly if there is no alternative.
Test = Mix herbicides and water in proportion and observe any instability.
Marginal = Not ideal, but acceptible.

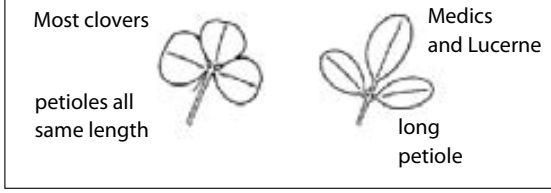
Tips for tankmixing herbicides

Tankmixing herbicides is a common practice to improve weed control and broaden the weed spectrum. There may also be some advantages in helping avoid herbicide resistance problems. Many tankmixes are included on registered herbicide labels. Generally provided herbicides are registered for a particular use, they may be tankmixed provided they are compatible and label mixing instructions are followed. Note that some herbicides although being physically compatible can be antagonistic to weed control. This information is usually outlined on herbicide labels under compatability.

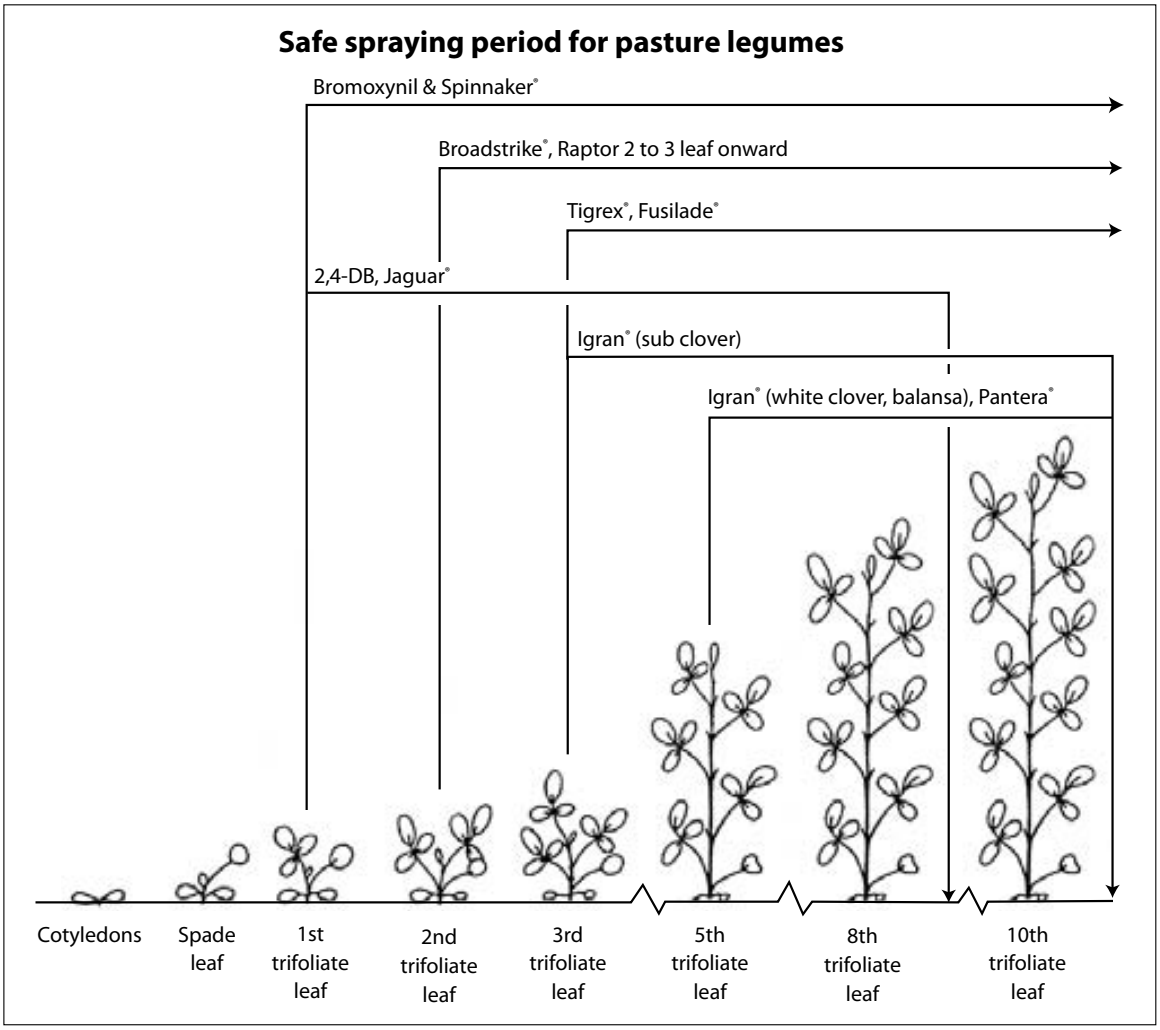
The order that herbicides are mixed is also important and the following mixing sequence is usually followed:

1. Water conditioning agents (if required – e.g. LI 700, Liase® or Primabuff®).
2. Water dispersable granules (WG)/dry flowable products (including those in water-soluble bags first).
3. Wettable powders (WP).
4. Flowables or suspension concentrates (e.g. atrazine-simazine liquids).
5. Emulsifiable concentrates (EC) (e.g. Trifluralin, Topik®, Kamba®, bromoxynil).
6. Water-soluble concentrates (e.g. glyphosate, Amicide® 500, Surpass®, Spray·Seed® 250, Gramoxone® 250).
7. Surfactants and oils (e.g. BS1000, Hasten™, DC Trate®).
8. Soluble fertilisers.

Identification of legume species



Safe spraying period for pasture legumes



Herbicide resistance management

• Rotate herbicide groups • Avoid spraying dense weed infestations

Defining herbicide resistance

Herbicide resistance is the inherent ability of a weed to survive a herbicide rate that would normally control it. This is not the same phenomena as poor herbicide performance.

Why it is a problem?

If herbicide resistance develops, herbicides from different chemical 'groups' or different control methods will have to be used to control the weed. These options may be more expensive or less effective. Once developed, herbicide resistance will persist for many years.

Understanding herbicides

Herbicides act by interfering with specific processes in plants. This is known as the herbicides 'mode of action' (MOA).

Watch your paddocks

- Keep accurate records.
- Monitor weed populations and record results of herbicides used.
- If herbicide resistance is suspected, prevent weed seed set.
- If a herbicide does not work, find out why.
- Check that weed survival is not due to spraying error.
- Conduct your own paddock tests to confirm herbicide failure and what herbicides are still effective.
- Have a herbicide resistance test carried out on seed from suspected plants testing for resistance to other herbicide (MOA) groups.
- Do not introduce or spread resistant weeds in contaminated grain or hay.

Herbicide resistant weeds

Grass weeds	Herbicide MOA group
Annual phalaris	A
Annual ryegrass	A, B, C, D, M
Barley grass	A, L
Barnyard grass	M, C
Brome grass	A
Liverseed	C
Summer grass/Crabgrass	A, B
Vulpia	L
Wild oat	A, B, K
Rice irrigation weeds	
Arrowhead	B
Dirty dora	B
Starfruit	B

Broadleaf weeds	Herbicide MOA group
African turnip (Queensland)	B
Black bindweed	B
Capeweed	L
Charlock	B
Fumitory	D
Indian hedge mustard	I, B
Lincoln weed	B
Paterson's curse	B
Prickly lettuce	B
Sowthistle	B
Stinging nettle	C
Turnip weed	B
Wild radish	B, C, F, I
Wild turnip	B

Preventing herbicide resistance

Aim to:

- Reduce weed numbers by preventing seed set.
- Avoid spraying dense weed infestations and begin a cropping phase with low weed numbers.
- Use as many different control options (chemical and non-chemical) as possible in both crop and pasture phases.

When using herbicides:

- Rotate herbicides from different groups.
- Reduce reliance on high-risk herbicides (Groups A and B).
- Make every herbicide application count – use the rate that kills.
- The 'double knock' herbicide option; before sowing – glyphosate followed by paraquat + diquat.

Weed control options for crop and pasture phases

Pasture phase		Cropping phase	
Chemical	**Non-chemical**	**Chemical**	**Non-chemical**
Spray topping Winter cleaning Chemical Fallow	Competitive pasture Make silage or hay Cultivated fallow Grazing	Crop topping Pre-sow knockdown Selective spraytop Selective herbicides Low risk herbicides	Competitive crop Timely cultivation Green manure crop Later sowing Silage or hay crops Collect or burn weed seeds

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A. Storrie, B. Haskins, A. Schipp 3/09

Mode of Action Groups (as at 28 February 2009)

The active constituents and some products that were moved to a different group in February 2009 are listed in **bold** in red.

Produced courtesy CropLife Australia Limited, Locked Bag 916, Canberra ACT 2601. Phone (02) 6230 6399 Fax (02) 6230 6355
Website www.croplifeaustralia.org.au Email info@croplifeaustralia.org.au

High Risk

CHEMICAL FAMILY	ACTIVE CONSTITUENT (FIRST TRADE NAME)
GROUP A. Inhibitors of acetyl coA carboxylase (Inhibitors of fat synthesis/ACCSection 0 ase inhibitors)	
Aryloxyphenoxypropionates: (Fops):	clodinafop (Topik®), cyhalofop (Barnstorm®), diclofop (Cheetah® Gold*, Decision®*, Hoegrass®, Tristar® Advance*), fenoxaprop (Cheetah® Gold* ,Tristar® Advance*, Wildcat®), fluazifop (Fusilade®, Fusion®*), haloxyfop (Motsa®*, Verdict®), propaquizafop (Correct®), quizalofop (Targa®)
Cyclohexanediones: (Dims):	butroxydim (Falcon®, Fusion®*), clethodim (Motsa®*, Select®), sethoxydim (Cheetah® Gold*, Decision®*, Sertin®), tepraloxydim (Aramo®), tralkoxydim (Achieve®)
Phenylpyrazoles: (Dens):	Pinoxaden (Axial®)
GROUP B. Inhibitors of acetolactate synthase (ALS inhibitors)	
Sulfonylureas: (SUs):	azimsulfuron (Gulliver®), bensulfuron (Londax®), chlorsulfuron (Glean®), halosulfuron (Sempra®), iodosulfuron (Hussar® OD), mesosulfuron (Atlantis® OD), metsulfuron (Ally®, Harmony®* M, Crossbow®*, Trounce®*), rimsulfuron (Titus®), sulfometuron (Oust®), sulfosulfuron (Monza®), thifensulfuron (Harmony®* M), triasulfuron, (Logran®, Logran® B-Power®*), tribenuron (Express®), trifloxysulfuron (Envoke®, Krismat®*)
Imidazolinones: (Imis):	imazamox (Raptor®, Intervix®*), imazapic (Flame®, Midas®*, OnDuty®*), imazapyr (Arsenal®, Midas®*, OnDuty®*, Intervix®*, Lightning®*), imazethapyr (Spinnaker®, Lightning®*)
Triazolopyrimidines: (Sulfonamides):	flumetsulam (Broadstrike®), metosulam (Eclipse®), florasulam (Torpedo®* and Conclude™*), pyroxsulam (Crusader™*)
Pyrimidinylthiobenzoates:	Pyrithiobac-Na (Staple®)

Moderate Risk

GROUP C. Inhibitors of photosynthesis at photosystem II (PS II inhibitors)	
Triazines:	ametryn (Primatol Z®, Gesapax® Combi*, Krismat®), atrazine (Gesaprim®, Gesapax® Combi*, Primextra® Gold*), cyanazine (Bladex®), prometryn (Gesagard®, Cotogard®*, Bandit®*), propazine (Agaprop®), simazine (Gesatop®), terbutryn (Igran®, Agtryne® MA*)
Triazinones:	hexazinone (Velpar® L, Velpar® K4*), metribuzin (Sencor®)
Uracils:	bromacil (Hyvar®, Krovar®*), terbacil (Sinbar®)
Pyridazinones:	chloridazon (Pyramin®)
Phenylcarbamates:	**phenmedipham (Betanal®)**
Ureas:	diuron (Karmex®, Krovar®*, Velpar® K4*), fluometuron (Cotoran®, Cotogard®*, Bandit®*), linuron (Afalon®), methabenzthiazuron (Tribunil®), siduron (Tupersan®), tebuthiuron (Graslan®)
Amides:	propanil (Stam®)
Nitriles:	bromoxynil (Buctril®, Buctril® MA*, Barrel®*, Jaguar®*, Barracuda®*), ioxynil (Totril®, Actril DS*)
Benzothiadiazinones:	Bentazone (Basagran®, Basagran® M60*)
GROUP D. Inhibitors of microtubule assembly	
Dinitroanilines: (DNAs):	oryzalin (Surflan®, Yield®*), pendimethalin (Stomp®), trifluralin (Treflan®, Yield®*)
Benzoic acids:	chlorthal-dimethyl (Dacthal®, Prothal®*)
Benzamides:	**propyzamide (Kerb®)**
GROUP E. Inhibitors of mitosis / microtubule organisation	
Carbamates:	carbetamide (Carbetamex®), chlorpropham (Chlorpropham®)

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Moderate Risk (continued)

CHEMICAL FAMILY	ACTIVE CONSTITUENT (FIRST TRADE NAME)
GROUP F. Bleachers: Inhibitors of carotenoid biosynthesis at the phytoene desaturase step (PDS inhibitors)	
Nicotinanilides:	diflufenican (Brodal®, Jaguar®*, Tigrex®*, Giant®*, Chipco Spearhead®*)
Picolinamides:	picolinafen (Paragon®*, Sniper®)
Pyridazinones:	norflurazon (Solicam®)
GROUP G. Inhibitors of protoporphyrinogen oxidase (PPOs)	
Diphenylethers:	Acifluorfen (Blazer®), oxyfluorfen (Goal®)
N-phenylphthalimides:	flumioxazin (Pledge®), flumiclorac (Resource®)
Oxadiazoles:	Oxadiazon (Ronstar®)
Triazolinones:	carfentrazone (Affinity®)
Pyrimidindiones:	butafenacil (Logran® B-Power®*)
GROUP H. Bleachers: Inhibitors of 4-hydroxyphenyl-pyruvate dioxygenase (HPPDs)	
Pyrazoles:	benzofenap (Taipan®, Viper®), Precept®*
Isoxazoles:	isoxaflutole (Balance®)
GROUP I. Disruptors of plant cell growth	
Phenoxycarboxylic acids: (Phenoxys):	2,4-D (Amicide®, Actril DS®*), 2,4-DB (Trifolamine®), MCPA (MCPA, Buctril® MA*, Banvel M®*, Midas®*, Paragon®*, Tigrex®*, Giant®*, Precept®*, Barrel®*, Tordon 242®*, Basagran® M60*, Chipco Spearhead®*, Agtryne® MA*, Conclude™*), MCPB (Legumine®), mecoprop (Mecopropamine®, Mecoban®, Methar Tri-Kombi®*)
Benzoic acids:	dicamba (Banvel®, Banvel M®*, Barrel®*, Mecoban® Methar Tri-Kombi®*)
Pyridine carboxylic acids: (Pyridines):	aminopyralid (Hotshot®*), clopyralid (Lontrel®, Torpedo®*, Chipco Spearhead®*), fluroxypyr (Starane®, Hotshot®*), picloram (Tordon®, Tordon 242®*, Crossbow®*, Grazon®*), triclopyr (Garlon®, Grazon®*)
Quinoline carboxylic acids:	quinclorac (Drive®)
GROUP J. Inhibitors of fat synthesis (Not ACCase inhibitors)	
Chlorocarbonic acids:	2,2 DPA (Dalapon®), flupropanate (Frenock®)
Thiocarbamates:	EPTC (Eptam®), molinate (Ordram®), pebulate (Tillam®), thiobencarb (Saturn®), triallate (Avadex®), vernolate (Vernam®)
Phosphorodithioates:	bensulide (Prefar®)
Benzofurans:	ethofumesate (Tramat®)
GROUP K. Inhibitors of cell division / Inhibitors of very long chain fatty acids (VLCFA inhibitors)	
Acetamides:	napropamide (Devrinol®)
Chloroacetamides:	metolachlor (Dual® Gold, Primextra® Gold*), propachlor (Ramrod®, Prothal®*)
GROUP L. Inhibitors of photosynthesis at photosystem I (PSI inhibitors)	
Bipyridyls:	diquat (Reglone®, Spray Seed®*), paraquat (Gramoxone®, Spray Seed®*)
GROUP M. Inhibitors of EPSP synthase	
Glycines:	glyphosate (Roundup®, Sickle® 540, Trounce®*, Illico®*)
GROUP N. Inhibitors of glutamine synthetase	
Phosphinic acids:	glufosinate (Basta®, Liberty®)
GROUP O. Inhibitors of cell wall (cellulose) synthesis	
Nitriles:	dichlobenil (Casoron®)
Benzamides:	isoxaben (Gallery®)
GROUP P. Inhibitors of auxin transport	
Phthalamates:	naptalam (Alanap-L®)
GROUP Q. Bleachers: Inhibitors of carotenoid biosynthesis unknown target	
Triazoles:	amitrole (Amitrole®, Illico®*)
Isoxazolidinones:	clomazone (Command®, Viper®*)
GROUP R. Inhibitors of dihydropteroate synthase (DHP inhibitors)	
Carbamates:	asulam (Asulox®)
GROUP Z. Herbicides with unknown and probably diverse sites of action	
Arylaminopropionic acids:	flamprop (Mataven L®)
Dicarboxylic acids:	endothal (Endothal®)
Organoarsenicals:	DSMA (disodium methylarsonate) (Methar®), MSMA (Daconate®)

* This product contains more than one active constituent.

HERBICIDE TOLERANCE PAGE

HERBICIDE TOLERANCE PAGE

TABLE 1. KNOCKDOWN AND SEEDBED PREPARATION

Active Ingredient	2,4-D dma amine 625 g/L	Dicamba 500 g/L	Fluroxypyr 200 g/L	Glyphosate 450g/l	Glyphosate 540 g/L	Glyphosate 500 g/L	Diquat 200 g/L	Paraquat 135 g/L + Diquat 115 g/L	Paraquat 250 g/L
Trade Name	**Amicide ®625 Amicide® LO-625A**	**Kamba® 500**	**Acclaim® Comet® 200**	**Glyphosate® CT Roundup®CT**	**Roundup Power Max®**	**Touchdown® Hitech**	**Reglone® Diquat 200**	**Spray.Seed 250**	**Gramoxone 250 Paraquat 250 Nuquat 250**
Per hectare	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	I	I	I	M	M	M	L	L	L
Amaranthus	0.56–1.1	0.32–0.56 c						Controls young annual grasses and some broadleaf weeds. Suppression only of advanced annuals and established perennials. 0.6–3.2 L/ha g	Controls annual weeds. Suppression only of advanced annuals, many broadleaf weeds and established perennials. 1.2–2.4 L/ha
Amsinkia				0.8–1.6	0.63–1.37	0.66–1.32			
Annual phalaris				0.4–1.6	0.63–1.37	0.66–1.32			
Annual ryegrass		0.16–0.24 c		0.8–1.6	0.63–1.37	0.66–1.32			
Apple of Peru		0.16–0.24 c							
Barley grass				0.4–1.2	0.32–0.99	0.33–1.0	0.75–1.5 f		
Barnyard grass		0.32–0.24 c		0.8–1.6	0.63–1.37	0.66–1.32			
Bathurst burr	0.8–1.1	0.32–0.56	0.75						
Bellvine	1.8	0.32–0.56	0.5 d						
Bent grass					1.2–1.9				
Blackberry Nightshade	0.56–1.1	0.32–0.56							
Black bindweed		0.28	0.75 d		1.2–1.7	1.3–1.8			
Brome grass				0.4–1.6	0.32–1.37	0.33–1.33	0.75–1.5 f		
Caltrop (yellow vine)	0.8–1.7	0.32–0.56 c	0.5 d	0.4–1.2	0.4–1.2	0.4–1.3			
Capeweed		0.16–0.24 c		0.4–1.6	0.32–1.37	0.33–1.33	0.75–1.5 f		
Cereals (volunteer)		0.16–0.24 c		0.4–1.2	0.32–0.99	0.33–1.0			
Charlock	0.56–1.6								
Cobblers' peg	1.8	0.32–0.56							
Convolvulus		0.32–0.56							
Couch				1.2–2.4	1.2–1.9	1.6–2.0			
Dock		0.28–0.56		0.8–2.0	0.63–1.9	0.66–2.0			
Erodium (Storksbill)		0.28–0.56		1.5–2.0	1.2–1.9	1.6–2.0	0.75–1.5		
Fat hen	0.56–1.7			2.0	1.2–1.0	1.6–2.0			
Flatweed (Catsear)				0.8–1.2	0.32–0.99	0.66–1.0			
Hexham scent		0.28 b							
Hoary cress	1.1–1.7	0.28 b			0.9–1.37	1.0–1.3			
Kikuyu				0.8–1.6	0.63–1.2	0.47–1.3			
Liverseed grass				0.8–1.6	0.63–1.37	0.66–1.32			
Medics (annual)	1.2								
Melons	0.56–1.1			0.8–1.2	0.63–1.2	0.67–1.3			
Mexican poppy				0.8–1.2	0.63–1.2	0.67–1.3			
Mintweed	1.1			0.4–1.2	0.45–1.2	0.47–1.3			
Mustards	0.56–1.1			1.2–1.6	0.9–1.37	1.0–1.3			

New Zealand spinach	1.1–1.7			0.8–1.2	0.63–1.2	0.67–1.3		Controls young annual grasses and some broadleaf weeds. Suppression only of advanced annuals and established perennials. 0.6–3.2 L/ha g	Controls annual weeds. Suppression only of advanced annuals, many broadleaf weeds and established perennials. 1.2–2.4 L/ha
Noogoora burr	0.8–1.1			0.8–1.2	0.63–1.2	0.67–1.3			
Nut grass				2.4 e	1.7 e	1.8 e			
Oxalis				1.2	0.9–1.37	1.0–1.3			
Paterson's curse	1.1–1.7			0.8–1.6	0.63–1.37	0.66–1.32			
Phalaris (perennial)				1.2–2.0	0.9–1.9	1.0–2.0			
Pigweed				0.8–1.6	0.63–1.37	0.66–1.32			
Plantains					1.9–2.7	2.0–2.8			
Prickly lettuce				0.4–1.2	0.32–0.99	0.33–1.0			
Prickly paddy melon	0.56–1.1								
Saffron thistle	0.56–1.7			0.8–1.6	0.63–1.37	0.66–1.32			
Scotch thistle				0.8–1.6	0.63–1.37	0.66–1.32			
Serrated tussock					2.7–4.0	2.8–4.2			
Shepherds purse	0.56–1.7					0.66–1.0			
Skeleton weed	1.1–1.7			1.2	0.99				
Slender thistle	0.56–1.1								
Sorrel	1.7 a			1.2–2.0	0.99–1.9	1.0–2.0			
Sowthistle	1.8			0.6–1.6	0.45–1.2	0.66–1.3			
Spear thistle	0.56–1.1			0.8–1.2	0.63–1.37	0.66–1.3			
Spiny emex				0.4–1.2	0.32–0.99	0.33–1.0			
Sub-clover	1.1 a			1.2–2.0	0.99–1.9	1.0–2.0			
Thornapple	0.8–1.1								
Turnip weed	0.56–1.1			0.8–1.6	0.63–1.37	0.66–1.32			
Variegated thistle	0.56–1.7								
Vulpia				0.8–1.6	0.63–1.37	0.66–1.32			
Wild oat				0.4–1.2	0.3–0.99	0.3–1.0			
Wild radish	1.4–1.7			1.2–1.6					
Wild turnip	0.56–1.1			0.8–1.6	0.63–1.37	0.66–1.32			
Winter grass				0.8–1.6	0.63–1.37	0.66–1.32			
Wireweed				0.8–1.6	0.63–1.37	0.66–1.32			
Yorkshire fog				1.5–2.0	1.2–1.9	1.66–2.0			
Rec. Water vol L/ha B Boom, A Aircraft	B 30 L/ha A 10 L/ha	B 50 L/ha A 25 L/ha	B 50 L/ha A 35 L/ha		B 50 L/ha A 50 L/ha		B 100 L/ha A 30 L/ha	B 50 L/ha	B 100 L/ha
Wetting Agent/Adjuvant	No	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Rainfast hours	6	4	1	6	1	2	Not effected by rain falling shortly after application		
Stock withholding period days	7	7	7	Nil	Nil	Nil	1	1 7 horses	1 7 horses

a Add 0.28–0.4 L/ha Kamba® 500. Do not sow for 30 days. Needs 15 mm of rain before plantback beings. See label for specific directions.
b Add 0.64 L/ha 2,4-D amine 625 g/L.
c Add 0.4–0.7 L/ha glyphosate.
d Add Roundup® CT.
e Two applications are required.
f Add Gramoxone.
g For increased control of clover, add 0.5 L/ha dicamba (500 g/L).

TABLE 2. WEED CONTROL IN LUCERNE – GRASS WEEDS

Active Ingredient	Trifluralin 480 g/L	Sethoxydim 186 g/L	Fluazifop-p + butroxydim 212 g/kg + 250 g/kg	Propaquizafop 100 g/L	Diclofop methyl 375 g/L	Quizalofop-P 99.5 g/L	Haloxyfop-R 520 g/L	Imazamox 700 g/kg	Fluazifop-p 212 g/L
Trade Name	**Triflur®X**	**Sertin® 186 EC**	**Fusion® super**	**Shogun®**	**Nugrass®**	**Targa®**	**Verdict® 520**	**Raptor®WG**	**Fusilade®**
Per hectare	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**	**(grams)**	**(litres)**
Herbicide group	D	A	A	A	A	A	A	B	A
Do not apply before:	Pre-emergence only	1st trifoliate leaf	1st trifoliate leaf	1st trifoliate leaf	1st trifoliate leaf	1st trifoliate leaf	2nd trifoliate leaf	2nd to 3rd trifoliate leaf	3rd trifoliate leaf
Annual ryegrass	1.2–2.3	0.5–1.0	230–320	0.3–0.45	1.0 b	0.3, 0.375	0.075–0.1		0.5–1.0
Barley grass			230–320	0.2		0.25	0.05–0.1	45–50	0.5–1.0
Barnyard grass	1.2–2.3					0.5, 0.75	0.1–0.15	50	0.5–1.0
Bent grass									2.0–4.0
Brome grass			285–320	0.3		0.3, 0.375	0.05–0.1	45–50	**0.5–1.0**
Cereals (volunteer)		1.0	230–320	0.2–0.25		0.25	0.05–0.1	45–50	
Couch						0.5	0.4–0.8 b		0.75 (s) 2.0–4.0
Crabgrass (crowsfoot)	1.2–2.3					0.5	0.15		0.5–1.0
Guinea grass	1.2–2.3								
Johnson grass	1.2–2.3					0.5, 0.75	0.1–0.15		0.5–1.0 (s) 2.0–4.0
Kikuyu									2.0–4.0
Liverseed grass	1.2–2.3	1.0				0.5, 0.75	0.1–0.15	50	0.5–1.0
Panic							0.15		
Paspalum									2.0–4.0
Phalaris	1.2–2.3	0.5–1.0	230–320				0.05–0.1		
Prarie grass							0.1		
Rhodes grass						0.25, 0.5	0.4–0.8 b		0.5–1.0
Sorghum (volunteer)		1.0							
Stinking lovegrass		1.0				0.25, 0.5			0.5–1.0
Summer grass	1.2–2.3	1.0				0.5, 1.0	0.15		0.5–1.0
Water couch									0.75 (s) 2.0–4.0
Wild oat	1.2–2.3	0.75–1.0	230–320	0.25	1.5–2.0 b	0.125, 0.25	0.0375–0.1	45–50	0.5–1.0
Winter grass	1.2–2.3								
Rec. Water vol L/ha B Boom, A Aircraft		40–400 B 30–40 A	50–100 B 20–30 min A	30–150 B 20–30 A	50–150 B 20–30 A	50–150 B	50–150 B 30 A	50 min B	100–200 B 30 A
Wetting Agent/Adjuvant	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rainfast hours	Not stated	2	1	1	2	3	1	2	1
Stock withholding period days	Nil	14	21	3	49	28	21	7	21

(s) Suppression only.

a Add 1–2 L/ha paraquat 250 g/L.

b For seed crops only, not for stock feed.

c Apply only in winter when lucerne is dormant.

d For improved control of annual weed seedlings in winter add diuron.

P Pre-emergent control.

* Post-emergent control.

Table 2. WEED CONTROL IN LUCERNE – GRASS WEEDS (continued)

Active Ingredient	Quizalofop-p-tefuryl 120 g/L	Simazine 600 g/L	Imazethapyr 700 g/kg	Diuron 500 g/L	Diquat 200 g/L	Paraquat 250 g/L	Paraquat 135 g/L + Diquat 115 g/L
Trade Name	**Pantera®**	**Gesatop ® 600 SC**	**Spinnaker® WDG**	**Diuron flowable Diuron liquid**	**Reglone® Diquat®**	**Gramoxone®250 Paraquat®250 Nuquat®250**	**Spray.Seed® 250**
Per hectare	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	A	C	B	C	L	L	L
Do not apply before:	5th trifoliate leaf	12 months	12 months	12 months	12 months	12 months	12 months
Annual ryegrass	0.25, 0.375		70–140 P	3.5 c			
Barley grass	0.25		70–140 P	3.5 c	0.75–1.5 a		
Barnyard grass	0.5, 0.75		70–140 P *				
Brome grass	0.25, 0.375				0.75–1.5 a		
Cereals (volunteer)	0.25						
Couch	0.5						
Crabgrass (crowsfoot)	0.5			3.5 c			
Guinea grass				3.5 c		1.2	1.6–2.4 d
Johnson grass	0.5, 0.75						
Liverseed grass	0.5, 0.75						
Rhodes grass	0.25–0.5						
Stinking lovegrass	0.25, 0.5						
Summer grass	0.5–1.0			3.5 c			
Vulpia		0.83–1.3			0.75–1.5 a		
Wild oat	0.125, 0.25		70–140 P	3.5 c			
Rec. Water vol L/ha B Boom, A Aircraft	50–150 B	100 B	50–100 B 20 min A		100 min B 30–60 A	50–200 B	50–200 B
Wetting Agent/Adjuvant	Yes	No	Yes	No	Yes	Yes	Yes
Rainfast hours	3	Not stated	2	Not stated	Not effected by rain falling shortly after application		
Stock withholding period days	28	14	14	Nil	1	1 7 (horses)	1 7 (horses)

(s) Suppression only.
a Add 1–2 L/ha paraquat 250 g/L.
b For seed crops only, not for stock feed.
c Apply only in winter when lucerne is dormant.
d For improved control of annual weed seedlings in winter add diuron.
P Pre-emergent control.
* Post-emergent control.

TABLE 3. WEED CONTROL IN LUCERNE – BROADLEAF WEEDS

Active Ingredient	Trifluralin 480 g/L	Bromoxynil 200 g/L	Imazamox 700 g/kg	Flumetsulam 800 g/L	2,4-DB 500 g/L	Diflufenican g/L + Bromoxynil 250 g/L	Imazethapyr 700 g/kg	Diuron 500 g/L	Fluroxypyr 200 g/L	Diquat 200 g/L	Paraquat 250 g/L	Paraquat 135 g/L + Diquat 115 g/L
Trade Name	**Triflur®X**	**Various trade names**	**Raptor®WG**	**Broadstrike®**	**Trifolamine® Buttress®**	**Jaguar® Barracuda®**	**Spinnaker® WDG**	**Diuron flowable Diuron liquid**	**Starane® Acclaim® Comet® 200**	**Reglone® Diquat®**	**Gramoxone®250 Paraquat®250 Nuquat®250**	**Spray.Seed® 250**
Per hectare	**(litres)**	**(litres)**	**(grams)**	**(grams)**	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	D	C	B	B	I	C & F	B	C	I	L	L	L
Do not apply before	**Pre-emergence only**	**1st trifoliate leaf**	**3rd trifoliate leaf**	**3rd trifoliate leaf**	**1–8 trifoliate leaves & after cutting or grazing**	**1–8 trifoliate leaves & after cutting or grazing**	**12 months**	**12 months**	**18 months**	**12 months**	**12 months**	**12 months**
Amaranthus	1.2–2.3		50		1.0–3.2		70–140					
Amsinkia		1.0–2.0		25		0.5–0.75	70–140	3.5				
Annual ground cherry									0.5			
Apple of Peru							70–140 (s)					
Bathurst burr					1.0–3.2		70–140 (s)		0.5			
Bellvine							70–140 (s)					
Bedstraw		1.4–2.0	45–50 (s)	25	1.0–3.2	1.0 (s)						
Blackberry Nightshade			50 (s)									
Black bindweed		1.4–2.0										
Bladder ketmia							70–140 (s)					
Buchan weed				25–50 a			50 b					
Californian burr					1.0–3.2							
California thistle					1.0–2.0							
Caltrop (yellow vine)	1.2–2.3		50 (s)									
Capeweed		1.4–2.0	50 (s)	25 b,c	1.0–3.2		70–140	3.5		0.35–0.7		
Charlock				25	1.0–3.2	0.5–1.0						
Chickweed			50 (s)			1.0 (s)	70–140					
Cobblers' peg								3.5				
Corn gromwell		1.4–2.0				0.5–1.0					1.2	1.6–2.4 f
Crassula						0.5 (s)						
Deadnettle			40–50			0.5–0.75	70–140 (s)					
Dock					1.0–3.2							
Dwarf marigold				15								
Erodium (Storksbill)			45			0.5 (s)	70–140			0.35–0.7		
Fat hen		1.4–2.0	50	25 or 50	1.0–3.2	1.0	70–140 (s)	3.5				
Field madder		1.4–2.0				1.0						
Fireweed		1.4–2.8				0.5						
Flatweed (Catsear)		1.4–2.0										
Fumitory	1.2–2.3	2.0		25 d	1.0–3.2							
Hexham scent						1.0 (s)						
Lupins (volunteer)			45	25		0.5–1.0 (s)						
Mallow				25–50 a	1.0–3.2							
Mexican poppy		2.0			1.0–3.2							
Mintweed						1.0 (s)	70–140					
Mountain Sorrel		1.4–2.0				1.1						
Mustards		2.0	45–50	20 or 25	1.0–3.2	0.5–1.0	70–140 (s)	3.5				
Noogoora burr			50 (s)		1.0–3.2		70–140 (s)		0.5			

Nut grass							70–140 (s)				1.2	1.6–2.4 f
Oxalis		1.4–2.0										
Ox-tongue						1.0						
Paterson's curse		2.0 a		25 b,c,d	1.0–3.2	0.5–0.75	70–140					
Peppercress		1.4–2.0		25 a		1.1						
Pigweed	1.2–2.3						70–140		0.5			
Plantains					1.0–3.2							
Prickly lettuce					1.0–3.2	1.0 (s)	70–140					
Rough poppy						0.5–0.75						
Saffron thistle		1.4–2.0			1.0–3.2	1.0						
Shepherds purse		1.4–2.0	45–50 (s)	25	1.0–3.2	0.5–1.0	70–140					
Skeleton weed						1.0 (s)						
Slender thistle					1.0–3.2							
Sorrel						1.0 (s)						
Soursob						1.0 (s)		3.5				
Sowthistle		1.4–2.0			1.0–3.2							
Spear thistle					1.0–3.2							
Speedwell						1.0 (s)						
Spiny emex		2.0	45–50 (s)	25 c,b,a	1.0–3.2	0.5–0.75	70–140					
Stinging nettle (annual)					1.0–3.2		70–140					
Thornapple			50				70–140 (s)					
Toad rush						1.0 (s)	70–140 (s)					
Tree hogweed		1.4–2.0				1.1						
Turnip weed		2.0	50	15 or 25	1.0–3.2	0.5–1.0	70–140 (s)					
Variegated thistle		1.4–2.0			1.0–3.2	1.0						
Ward's weed				25		1.0 (s)						
Wild gooseberry			50				70–140 (s)		0.5			
Wild radish		2.0	45–50 (s)	25 b,d	1.0–3.2	0.5–1.0	70–140 (s)	3.5				
Wild turnip		2.0	45–50	25	1.0–3.2			3.5				
Wireweed	1.2–2.3	2.0	45–50 (s)	25 a	1.0–3.2	1.0	70–140 (s)					
Rec. Water vol L/ha B Boom, A Aircraft		50–200 B 22 min A	50 min B	50–150 B 30 min A	110 min B 10 A	50–100 B NA A	50–100 B 20 min A		50 min B 35 min A	100 min B 30–60 A	50–200 B	50–200 B
Wetting Agent/Adjuvant	No	No	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes
Rainfast hours	Not stated	3	2	4	4	4	2	Not stated	Not stated	Not effected by rain falling shortly after application		
Stock withholding period days	Nil	14	7	3	7	14	14	Nil	7	1	1 7 (horses)	1 7 (horses)

(s) Suppression only.
a Add 1.5–2.0 L/ha 2,4-DB (500 g/L).
b Add 0.7 L/ha bromoxynil (200 g/L).
c Add wetter + 0.1 L/ha diuron (500 g/L).
d Add 0.3 L/ha terbutryn (500 g/L) + wetter.
e 0.25–1.5 L/ha diquat (200 g/L) + 2 L/ha paraquat (250 g/L).
f For improved control of annual grasses and some broadleaf weeds add 1–1.5 kg/ha Diuron WG (900 g/kg).

TABLE 4. CLOVER AND MEDICS – GRASS WEEDS

Active Ingredient	Paraquat 250 g/L	Butroxydim 250 g/kg	Fluazifop-p 212 g/kg + Butroxydim 250 g/kg	Fluazifop-p 212 g/L	Clethodim 240 g/L	Sethoxydim 186 g/L	Haloxyfop-R 520 g/L
Trade Name	**Gramoxone® 250** β	**Factor®**	**Fusion® Super**	**Blackout® 212 Fluazifop**	**Nisodim® Status®**	**Sertin® 186 EC**	**Verdict® 520 Haloxyfop 520**
Per hectare	**(litres)**	**(grams)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	L	A	A	A	A	A	A
Annual phalaris	0.6–2.4		230–320	0.5	0.25–0.5	1.0	0.05–0.1
Annual ryegrass	0.6–2.4	80–180	230–320	0.5	0.15–0.5	1.0	0.075–0.1
Barley grass	0.6–2.4	80–180	230–320	0.5	0.175–0.5	0.25–0.5 a	0.05–0.1
Barnyard grass						1.0	
Brome grass	0.6–2.4	80–180 b	285–320	0.5	0.175–0.5	0.25–0.5 a	0.05–0.1
Canary Grass	0.6–2.4						
Couch							0.15–0.8 c
Johnson grass						1.0 (seedling)	
Liverseed grass						1.0	
Prarie grass						1.0 (seedling)	
Rhodes grass							0.15–0.8 c
Sterile brome	0.6–2.4						
Stinking lovegrass						1.0	
Summer grass						1.0	
Vulpia	0.6–2.4				0.25–0.5 (s)		
Wild oat	0.6–2.4	80–180	230–320	0.5	0.175–0.5	1.0	0.05–0.1
Yorkshire fog	1.2						
Rec. Water vol L/ha B Boom, A Aircraft	min100 B 30 A	min 50 B 20–30 A	50–100 B 20–30 A	50–100 B min 30 A	50–150 B 20–30 A	40–150 B 30–40 A	50–150 B 30 A
Wetting Agent/Adjuvant	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rainfast hours	Not stated	30 mins	1	1	1	2	1
Stock withholding period days	1, 7 horses	14	21	21	14	21	7

(s) Suppression.
β Clover only.
a Add 250 mL/ha Fusilade.
b Tankmix for control, see label.
c See label for specific rates.

TABLE 4. CLOVER AND MEDICS – GRASS WEEDS (continued)

Active Ingredient	Imazamox 700 g/kg	Quizalofop-p-ethyl 99.5 g/L	Quizalofop-p-ethyl 200 g/L	Propaquizafop 100 g/L	Propyzamide 500 g/L	Simazine 500 g/L
Trade Name	**Raptor®**	**Tzar®** **Targa®**	**Tzar® Bolt** **Targa® Bolt 200**	**Shogun®**	**Kerb® 500 SC** **Royale® 500 SC**	**Various trade names**
Per hectare	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	B	A	A	A	K	C
Annual phalaris					1–1.5	
Annual ryegrass		0.3 or 0.375	0.15 or 0.19	0.2–0.3 b	1–1.5	
Barley grass	45	0.25	0.125	0.2	1–1.5	
Bent grass					1.5–2	
Brome grass	45	0.3 or 0.375	0.15 or 0.19	0.3	1–1.5	
Prarie grass					1–1.5	
Sterile brome	45					
Vulpia	50				1–1.5	1.0–1.6
Wild oat	45	0.125 or 0.25	0.065 or 0.125	0.25	1.5–2.0	
Winter grass					1–1.5	
Yorkshire fog					1.5–2.0	
Rec. Water vol L/ha B Boom, A Aircraft	min 50 B	50–150 B	50–150 B	30–150 B 20–30 A	Min 80 B	Min 100 B
Wetting Agent/Adjuvant	Yes	Yes	Yes	Yes	No	No
Rainfast hours	2	3	3	1	Not stated	Not stated
Stock withholding period days	7	14	14	3	25	14

(s) Suppression.
β Clover only.
a Add 250 mL/ha Fusilade.
b Tankmix for control, see label.
c See label for specific rates.

TABLE 5. CLOVER AND MEDICS – BROADLEAF WEEDS

Active Ingredient	Haloxyfop 520 g/L	Imazamox 700 g/kg	2,4-DB 500 g/L	Bromoxynil 200 g/L	Flumetsulam 800 g/kg	Propyzamide 500 g/L	MCPA 500 g/L	Terbutryn 500 g/L
Trade Name	**Verdict® 520**	**Raptor®**	**Trifolamine® Butress®**	**Various trade names**	**Broadstrike®**	**Kerb® 500 SC**	**Thistle killem® MCPA500**	**Igran® Terbutryn®**
Per hectare	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	A	B	I	C	B	K	I SUB-CLOVER ONLY	C
Amaranthus			1.0–3.2					
Amsinkia				1.4–2.0	25			
Bathurst burr			1.0–3.2					
Bedstraw		45		1.4–2.0	25			
Blackberry Nightshade						1.5–2.0		
Black bindweed				1.4–2.0				
Buchan weed					25(s) a			
California thistle			1.0–3.2					
Capeweed			1.0–3.2	1.4–2.0	25 b, c		0.7–1.4	0.55–0.7 c
Charlock			1.0–3.2		25			
Chickweed						1.5–2.0		
Corn gromwell				1.4–2.0				
Crassula								0.4–0.7 c
Deadnettle		45			25 (s)			
Dock			1.0–3.2				0.7–1.4 (s)	
Dwarf marigold					15			
Erodium spp.	0.05–0.1	45						0.4–0.7 c
Fat hen			1.0–3.2	1.4–2.0	25		0.7–1.4	
Field madder				1.4–2.0				
Fireweed				1.4–2.8				
Fumitory			1.0–3.2	2.0	25 d			
Hexham scent							0.7–1.4	
Mallow			1.0–3.2		25(s) a			
Mexican poppy			1.0–3.2	2.0				
Mountain Sorrel				1.4–2.0				
Mustard		45	1.0–3.2	2.0	25			
New Zealand spinach					25(s)			
Noogoora burr			1.0–3.2					
Paterson's curse			1.0–3.2	2.0	25(s) a, d	1.5–2.0	0.7–1.4	0.55–0.7 c
Peppercress				1.4–2.0	25(s) a			
Plantains			1.0–3.2					
Prickly lettuce			1.0–3.2					
Saffron thistle			1.0–3.2	1.4–2.0			0.7–1.4	
Shepherds purse		45	1.0–3.2	1.4–2.0	25			

Slender thistle			1.0–3.2				0.7–1.4	
Soldier thistle			1.0–3.2					
Sorrel						1.5–2.0 f		
Spear thistle			1.0–3.2				0.7–1.4	
Spiny emex		45	1.0–3.2	2.0	25a, b, c			
Stagger weed					25(s)			
Stinging nettle			1.0–3.2					
Toad rush								0.4–0.7 c
Tree hogweed				1.4–2.0				
Turnip weed			1.0–3.2	2.0	15 or 25			
Variegated thistle			1.0–3.2	1.4–2.0			0.7–1.4	
Ward's weed					25			
Wild radish		45		2.0	25(s) b		0.7–1.4 (s)	
Wild turnip		45	1.0–3.2	2.0	25			
Wireweed		45	1.0–3.2	2.0	25 a	1.5–2.0		
Rec. Water vol L/ha B Boom, A Aircraft	50–150 B 30 A	50 B	110–220 B 10min A	50–200 B	50–150 B	80min B	110 min B	50–100 B 20–30 A
Wetting Agent/Adjuvant	Yes	Yes	No	No	Yes	No	No	No
Rainfast hours	1	2	4	3	4	Needs rain to activate	6–8	6
Stock withholding period days	7	7	7	56	3	25	7	7

(s) Suppression.
a Add 1.5–2.0 L/ha 2,4-DB (500 g/L).
b Add 0.7 L/ha bromoxynil (200 g/L).
c Add 0.1 L/ha diuron (500 g/L).
d Add 0.3 L/ha terbutryn (500 g/L).
e Add 0.5 L/ha MCPA (500 g/L) in clover pastures only.
f Seedlings.
g Add 0.7–1.5 L/ha diquat (200 g/L).

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TABLE 5. CLOVER AND MEDICS – BROADLEAF WEEDS (continued)

Active Ingredient	Terbutryn 275 g/L + MCPA 160 g/L	Bromoxynil 250 g/L + Diflufenican 25 g/L	MCPA 250 g/L + Diflufenican 25 g/L	Diflufenican 500 g/L	Diquat 200 g/L	Paraquat 250 g/L	Paraquat 135 g/L + Diquat 115 g/L
Trade Name	**Agrtyne® MA**	**Jaguar®**	**Tigrex® Nugrex®**	**Brodal® Options**	**Reglone®**	**Gramoxone® 250 Nuquat® 250**	**Spray.Seed 250**
Per hectare	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	C & I	C & F	I & C	F	L	L	L
Amaranthus						Controls young annual grasses and some broadleaf weeds. Suppression only of advanced annuals and established perennials. 0.6–2.4 g	Controls annual weeds. Suppression only of advanced annuals, many broadleaf weeds and established perennials. 1.6–2.4
Amsinkia		0.75		0.2			
Bedstraw		1.0 (s)					
Black bindweed		0.5–1.0					
Capeweed	1.0–1.5	0.5–1.0	0.5–1.0	0.2	0.75–1.5		
Charlock		0.5–1.0	0.5–1.0	0.2			
Chickweed		1.0 (s)	1.0 (s)	0.2			
Corn gromwell		0.5–0.75	1.0	0.2			
Crassula	1.0–1.5	0.5 (s)	0.5–0.75	0.2			
Deadnettle			1.0	0.2			
Devil's claw		0.5–0.75					
Dock		1.0 (s)	1.0 (s)				
Erodium spp.	1.0–1.5	0.5 (s)	1.0 (s)		0.75–1.5		
Fat hen		1.0	1.0 (s)				
Field madder		1.0					
Fireweed		0.5	1.0 (s)				
Fumitory		0.75–1.0 (s)	0.75				
Hexham scent		1.0 (s)	1.0 (s)				
Iceplant			1.0 (s)				
Mallow			1.0 (s)	0.2			
Mexican poppy		1.0 (s)					
Mintweed		1.0 (s)					
Mountain Sorrel		1.1					
Mustard		0.5–1.0	0.5–1.0	0.15–0.2			
Ox-tongue		1.0					
Paterson's curse	0.3–1.5	0.5–0.75	1.0 (s)	0.2			
Peppercress		1.1	1.0 (s)				
Prickly lettuce		1.0 (s)	0.5–1.0	0.2			
Rough poppy		0.5–0.75	1.0 (s)	0.2			
Saffron thistle		1.0	1.0				
Shepherds purse		1.0	0.5–1.0	0.2			
Skeleton weed		1.0 (s)	1.0 (s)	0.2			
Sorrel		1.0 (s)		0.2			
Speedwell		1.0 (s)		0.2			

Spiny emex		0.5–0.75	1.0 (s)				
Stinging nettle				0.2			
Toad rush		1.0 (s)	1.0	0.2			
Tree hogweed	1.0–1.5	1.1	1.0				
Turnip weed		0.5–0.75	0.5–1.0	0.2			
Variegated thistle		1.0	1.0 (s)				
Ward's weed		1.0 (s)					
Wild radish		0.5–1.0	0.5–1.0	0.2			
Wild sage			0.5–1.0				
Wild turnip		0.5–0.75		0.15–0.2			
Wireweed		1.0	0.75 (s)	0.2			
Rec. Water vol L/ha B Boom, A Aircraft	50–100 B 20–30 A	50 min B	70–100 B 30 min A	50 min B	100 min B	100–200 B	50–200 B
Wetting Agent/Adjuvant	No	No	No	No	Yes	Yes	Yes
Rainfast hours	6	4	4	4	Not effected by rain falling shortly after application		
Stock withholding period days	7	56	7	14	1	1, 7 Horses	1, 7 Horses

(s) Suppression.
a Add 1.5–2.0 L/ha 2,4-DB (500 g/L).
b Add 0.7 L/ha bromoxynil (200 g/L).
c Add 0.1 L/ha diuron (500 g/L).
d Add 0.3 L/ha terbutryn (500 g/L).
e Add 0.5 L/ha MCPA (500 g/L) in clover pastures only.
f Seedlings.
g Add 0.7–1.5 L/ha diquat (200 g/L).

TABLE 6. PASTURES – GRASS WEEDS

Active Ingredient	Paraquat 250 g/L	Butroxydim 250 g/kg	Quizalofop-p-ethyl 99.5 g/L	Quizalofop-p-ethyl 200 g/L	Haloxyfop-R 520 g/L	Fluazifop-p 212 g/L	Clethodim 240 g/L	Imazamox 700 g/kg	Imazethapyr 700 g/kg
Trade Name	**Gramoxone® 250**	**Factor®**	**Tzar® Targa®**	**Tzar® Bolt Targa® Bolt 200**	**Verdict® 520 Haloxyfop 520**	**Blackout® 212 Fluazifop**	**Nisodim® Status®**	**Raptor®**	**Spinnaker®**
Use in	Vetch	Vetch	Vetch	Vetch	Vetch	Plantain, Vetch	Chicory, Plantain, Serradella	Serradella	Serradella pre- and post-emergence
Per hectare	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**	**(grams)**
Herbicide group	L	A	A	A	A	A	A	B	B
Annual phalaris	0.6–2.4				0.05–0.1	0.5	0.25–0.5		
Annual ryegrass	0.6–2.4	80–180	0.3 or 0.375	0.15 or 0.19	0.075–0.1	0.5	0.15–0.5		70–100
Barley grass	0.6–2.4	80–180	0.25	0.125	0.05–0.1	0.5	0.175–0.5	45	70–100
Barnyard grass							0.25–0.5		140
Brome grass	0.6–2.4	80–180 a	0.3 or 0.375	0.15 or 0.19	0.05–0.1	0.5	0.175–0.5	45	
Canary Grass	0.6–2.4								
Couch					0.15–0.8 b				
Crabgrass (crowsfoot)							0.25–0.5		
Johnson grass							0.25–0.5 (seedling)		
Liverseed grass							0.25–0.5		
Rhodes grass					0.15–0.8 b		0.25–0.5		
Sterile brome	0.6–2.4							45	
Summer grass							0.25–0.5		
Vulpia	0.6–2.4						0.25–0.5 (s)	50	
Wild oat	0.6–2.4	80–180	0.125 or 0.25	0.065 or 0.125	0.05–0.1	0.5	0.175–0.5	45	70
Yorkshire fog	1.2								
Rec. Water vol L/ha B Boom, A Aircraft	min100 B 30 A	min 50 B 20–30 A	50–150 B	50–150 B	50–150 B 30 A	50–100 B min 30 A	50–150 B 20–30 A	min 50 B	50–100 B 20 min A
Wetting Agent/Adjuvant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rainfast hours	Not stated	30 mins	3	3	1	1	1	2	Not stated
Stock withholding period days	1, 7 horses	14	28	28	7	21	14	7	14

(s) Suppression.
a Tankmix for control see label.
b See label for specific rates.

TABLE 7. PASTURES – BROADLEAF WEEDS

Active Ingredient	Imazamox 700 g/kg	Imazethapyr 700 g/kg	2,4-DB 500 g/L	Flumetsulam 800 g/kg
Trade Name	**Raptor®**	**Spinnaker®**	**Trifolamine® ^** **Butress® ^**	**Broadstrike®**
Use in	Serradella	Serradella pre- and post-emergence	Serradella	Vetch (popany) Serradella, Chicory
Per hectare	**(grams)**	**(grams**	**(litres)**	**(grams)**
Herbicide group	B	B	I	B
Amaranthus			1.0–3.2	
Amsinkia		70–100		25
Apple of Peru		140		
Bathurst burr		100	1.0–3.2	
Bellvine		100		
Bedstraw	45			25
Bladder ketmia		140		
California thistle			1.0–3.2	
Capeweed		70–100	1.0–3.2	
Charlock			1.0–3.2	25
Chickweed		70–100		
Deadnettle	45	70–100		
Dock			1.0–3.2	
Erodium spp.	45			
Fat hen		100	1.0–3.2	
Fumitory			1.0–3.2	
Mallow			1.0–3.2	25
Mexican poppy			1.0–3.2	
Mintweed		100		
Mustard	45	70	1.0–3.2	25
Noogoora burr		140	1.0–3.2	
Nut grass		140		
Paterson's curse		70	1.0–3.2	
Pigweed		100		
Plantains			1.0–3.2	
Prickly lettuce		70–100	1.0–3.2	
Saffron thistle			1.0–3.2	
Shepherds purse	45	70	1.0–3.2	25
Slender thistle			1.0–3.2	
Soldier thistle			1.0–3.2	
Spear thistle			1.0–3.2	
Spiny emex	45	70	1.0–3.2	
Stinging nettle (annual)		70		
Stinging nettle			1.0–3.2	
Thornapple		100		
Toad rush		70		
Turnip weed		70	1.0–3.2	25
Variegated thistle			1.0–3.2	
Ward's weed				25
Wild radish	45	70–100		25 (s)
Wild turnip	45		1.0–3.2	25
Wireweed	45	70	1.0–3.2	
Rec. Water vol L/ha B Boom, A Aircraft	50 B	50–100 B 20 min A	110–220 B 10 min A	50–150 B
Wetting Agent/Adjuvant	Yes	Yes	No	Yes
Rainfast hours	2	Not stated	4	4
Stock withholding period days	7	14	7	3

(s) Suppression. ^ See label for specific rates.

TABLE 8. GRASS PASTURES – BROADLEAF WEEDS

Active Ingredient	2,4-D-dea/dma 625 g/L	2,4-D-dea/dma 800 g/kg	MCPA 500 g/L	MCPA 500 g/L	Dicamba 500 g/L	Dicamba 700 g/L	Triclpyr 300 g/L + Picloram 100 g/L + Aminopyralid 8 g/L	Fluroxypyr 333 g/L	Clopyralid 300 g/L
Trade Name	**Amicide® 625**	**Baton®**	**Thistle killem® MCPA500**	**LVE MCPA**	**Various trade names**	**Cadence®**	**Grazon® Extra**	**Starane® Advanced**	**Lontrel®, Victory®, Archer®**
Per hectare	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	I	I	I	I	I	I	I	I	I
Bathurst burr	0.8–1.1	600–900	1.0–2.0	1.6					
Black bindweed			1.4–2.0						
Californian burr	0.8–1.1	600–900	1.0–2.0						
California thistle	3.2–3.8	2500–2900	2.2						
Caltrop (yellow vine)					0.28–1.1	200–800			
Capeweed	1.7–2.8	1300–2300	2.1	1.7					
Charlock	0.8–1.1	600–900	0.5–1.0	0.5–1.6					
Dandelion			2.0	1.6					
Deadnettle			2.1						
Dock					0.28–1.1	200–800			
Erodium spp.	1.6–3.2	1300–2500							
Fat hen			1.0–2.0	1.0–1.6					
Fennel			2.7						
Fumitory			1.4	1.1					
Galvanised burr	0.32/100 L water a								
Hexham scent	1.1–1.7	900–1300	1.2		0.28–1.1	200–800			
Hoary cress	1.4–1.7	1100–1300			0.28 c	200 c			
Horehound			3.0		0.28–1.1	200–800			
Iceplant					0.28 a	200 c			
Illyrian thistle					0.28–1.1	200–800			
Khaki weed	1.1–2.2	900–1800							
Mintweed			2.0						
Mustard	0.56–1.1	400–900	1.0	0.56–1.0					
Nodding thistle			2.5						0.05–0.07 d
Noogoora burr	0.8–1.1	600–900	1.0–2.0	1.6					
Parthenium weed					0.28–1.1	200–800			
Paterson's curse	1.7–2.2	1300–1800	1.0–1.5	1.7					
Plantains			2.0						
Rough poppy			0.7–1.5						
Saffron thistle	1.1–1.7	900–1300	1.0–2.5	1.1–1.9	0.28 c	200 c			0.05–0.07 d
St John's Wort							2.0–4.0	1.8	
Scotch thistle				0.7–1.7	0.28–1.1	200–800			0.05–0.07 d
Shepherds purse	0.8–1.1	600–900							

Silverleaf nightshade								0.45–0.6 or e	
Skeleton weed		1100–1800	1.5–2.0	1.1–1.6					
Slender thistle	1.1	900–1300	1.0–2.0	2.1					0.05–0.07 d
Smartweed					0.28–1.1	200–800			
Sorrel					0.28 c	200 c			
Spear thistle	1.1–1.6	900–1300	1.5–2.0	1.5–2.1	0.28–1.1	200–800			0.05–0.07 d
Spiny emex					0.28–1.1	200–800			
Star thistle					0.28–1.1	200–800			
Stemless thistle					0.28–1.1	200–800			
Stinkwort			1.0–2.0	1.6					
Sunflower volunteer			1.0–1.5 a, b	1.0 a					
Thornapple	1.6–2.4	1300–1900							
Turnip weed	0.56–1.1	400–900	0.9–1.0	0.7–1.1					
Variegated thistle	1.1–1.7	900–1300	1.0–2.0	0.84–1.1	0.28–1.1	200–800			0.05–0.07 d
Wild poppy	1.1–1.7	800–1300							
Wild radish	0.8–1.1	600–900	0.7–1.1	1.1–1.6					
Wild sage				1.1					
Wild turnip	0.56–1.1	400–900	0.7–1.1	0.5–1.5					
Wireweed									
Rec. Water vol L/ha B Boom, A Aircraft	30–120 B 10–90 A	30–120 B 10–90 A	110 min B	30–120 B 10–90 A	110–180 B 25 A	110–180 B 25 A	200 B A	50 min B	50 min B 20 min A
Wetting Agent/ Adjuvant	No	No	No	No	Yes	Yes	No	Yes	No
Rainfast hours	6	6	6–8	6	4	4	1	1	3
Stock withholding period days	7	7	7	7	7	7	Nil	7	7

(s) Suppression.
a Spot spray.
b Seedling.
c Add 0.64 L/ha 2,4-D amine 625 g/L for improved control.
d Add 1.0–1.5 L/ha MCPA amine 500 g/L for improved control.
e Add 0.225 fluroxypyr 333 g/L + 1.5–2.0 L/ha 2,4-D amine 500 g/L for improved control.
f Add 0.375 L/ha 2,4-D amine 625 g/L for improved control.
g Add 0.5 L/ha MCPA amine 500 for improved control.
h 28 g/ha clopyralid 750 g/kg + 1.0–1.5 L/ha MCPA amine 500 for improved control.
i Add 0.5–1.0 L/ha 2,4-D amine 500 g/L.
j Add 0.7 L/ha bromoxynil 200 g/L for improved control.
k Add 0.3 L/ha terbutryn 500 g/L.
l Add 1.5–2.5 L/ha 2,4-DB 500 g/L for improved control.
m Add 0.7 L/ha bromoxynil 200 g/L + 0.7 L/ha MCPA amine 500 g/L.
n Add 0.28 L/ha 2,4-D amine 625 g/L for improved control.

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TABLE 8. GRASS PASTURES – BROADLEAF WEEDS (continued)

Active Ingredient	Clopyralid 750 g/kg	MCPA 340 g/L + Dicamba 80 g/L	2,4-DB 500 g/L	Bromoxynil 200 g/L + MCPA 200 g/L	Flumetsulam 800 g/kg	Picloram 75 g/L + 2,4-D 300 g/L	Terbutryn 500 g/L	Diuron 500 g/L	Metsulfuron-methyl 600 g/kg
Trade Name	**Lontrel® 750 SG**	**Banvel® M Kamba® M**	**Trifolamine® Butress®**	**Various trade names**	**Broadstrike®**	**Tordon® 75-D**	**Igran® Terbutryn®**	**Various trade names**	**Brush-Off® WG**
Per hectare	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**
Herbicide group	I	I	I	C & I	B	I	C	C	B
Amaranthus			1.0–3.2			1.0			
Amsinkia				1.4–2.0	25	2.0			
Bathurst burr		2.8–4.0	1.0–3.2			1.0			
Bellvine						1.0			
Bedstraw					25				
Black bindweed				1.4–2.0		0.3			
Bladder ketmia						0.3 f			
Buchan weed					25(s)				
Buttercup		4.0–7.0							
California thistle			1.0–3.2						
Caltrop (yellow vine)		2.8–4.0				0.3 f			
Cape tulip						0.3 f			5
Capeweed			1.0–3.2	1.4–2.0	25 j		0.55–0.7 g	5.5–6.0	
Charlock			1.0–3.2	1.4–2.0	25				
Chicory		2.8–4.0							
Cobblers' peg						1.0		5.5–6.0	
Common bracken									60
Corn gromwell				1.4–2.0					
Crassula							0.55–0.7 g		
Crofton weed		2.8–4.0							
Cudweed		2.8–4.0							
Dandelion		2.8–4.0							
Deadnettle		2.8–4.0			25(s)				
Dock			1.0–3.2						5 or 10
Dwarf marigold					25				
Erodium spp.							0.55–0.7 g		5 or 10
Fat hen			1.0–3.2	1.4–2.0	25	1.0		5.5–6.0	
Field bindweed						7.5			
Field madder				1.4–2.0					
Fleabane		2.8–4.0							
Fumitory		2.8–4.0	1.0–3.2	1.4–2.0	25 k				
Galvanised burr									15
Golden Thistle						3.5			

Ground Cherry (annual)						1.0			
Heliotrope (common)		2.8–4.0				0.3			
Hexham scent				1.4–2.0		0.3 f			
Hoary cress		4.0–7.0							
Horned poppy				1.4–2.0					
Horehound		4.0–7.0							
Inkweed		2.8–4.0							
Khaki weed		4.0–7.0							
Mallow			1.0–3.2		25 (s) j or l or m				
Maltese cockspur		2.8–4.0							
Mexican poppy			1.0–3.2	1.4–2.0		1.0			
Mintweed		2.8–4.0		1.4–2.0		0.3 f			
Mustard			1.0–3.2	1.4–2.0	25	0.3 f		5.5–6.0	
New Zealand spinach					25 (s)	1.0			
Nodding thistle	40 or h								
Noogoora burr		2.8–4.0	1.0–3.2			1.0			
Onion grass									15
Parthenium weed						3.0			
Paterson's curse			1.0–3.2	1.4–2.0	25 (s) j or k		0.55–0.7 g		10 or 15
Penny cress		2.8–4.0							
Peppercress					25 (s) j or k				
Pigweed						1.0		5.5–6.0	
Plantains			1.0–3.2						
Potato weed		2.8–4.0				1.0			
Prickly lettuce			1.0–3.2						
Purple top		4.0–7.0							
Ragwort		2.8–4.0				3.5			15
Red shank						1.0			
Rough poppy				1.4–2.0					
Saffron thistle	40 or h		1.0–3.2	1.4–2.0		0.3			
St Barnaby's thistle	40 or h or i								
Scotch thistle	40 or h								
Sesbania pea						1.0			
Shepherds purse		2.8–4.0	1.0–3.2	1.4–2.0	25				
Silverleaf nightshade						15			
Skeleton weed						15–22			
Slender thistle	40 or h	2.8–4.0	1.0–3.2						
Smartweed		2.8–4.0							10
Soldier thistle			1.0–3.2						
Sorrel									5 or 10

THIS TABLE CONTINUES ON THE NEXT PAGE

TABLE 8. GRASS PASTURES – BROADLEAF WEEDS (continued)

Active Ingredient	Clopyralid 750 g/kg	MCPA 340 g/L + Dicamba 80 g/L	2,4-DB 500 g/L	Bromoxynil 200 g/L + MCPA 200 g/L	Flumetsulam 800 g/kg	Picloram 75 g/L + 2,4-D 300 g/L	Terbutryn 500 g/L	Diuron 500 g/L	Metsulfuron-methyl 600 g/kg
Trade Name	**Lontrel® 750 SG**	**Banvel® M Kamba® M**	**Trifolamine® Butress®**	**Various trade names**	**Broadstrike®**	**Tordon® 75-D**	**Igran® Terbutryn®**	**Various trade names**	**Brush-Off® WG**
Per hectare	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**
Herbicide group	I	I	I	C & I	B	I	C	C	B
Spiny emex			1.0–3.2	1.4–2.0	25 (s) j or l	0.3			5 or 10
Stagger weed					25 (s)				
Star thistle		2.8–4.0				3.5–7.5			
Stinging nettle (annual)		2.8–4.0							
Stinging nettle			1.0–3.2						
Stinkwort		2.8–4.0							
Thornapple						1.0 or n			
Toad rush							0.55–0.7 g		
Tree hogweed				1.4–2.0					
Turnip weed			1.0–3.2	1.4–2.0	15 or 25	0.3 f			
Variegated thistle	40 or h	2.8–4.0	1.0–3.2	1.4–2.0		2.0–4.0 or f			
Veined verbena		4.0–7.0							
Ward's weed					25				
Wild garlic									15
Wild radish				1.4–2.0	25(s) j or g	0.3 f		5.5–6.0	
Wild turnip			1.0–3.2	1.4–2.0	25			5.5–6.0	
Wireweed		2.8–4.0	1.0–3.2	1.4–2.0	25 l	0.3 f			
Rec. Water vol L/ha B Boom, A Aircraft	50 min B 20 min A	50 min B 25 A	110–220 B 10 min A	50–200 B 25 A	50–150 B	50–100 B	50–100 B 20–30 A		70 min B
Wetting Agent/Adjuvant	No	No	No	No	Yes	No	No	No	Yes
Rainfast hours	3	4	4	3	4	4	6	Not stated	4
Stock withholding period days	7	7	7	56	3	7	7	Nil	Nil

(s) Suppression.
a Spot spray.
b Seedling.
c Add 0.64 L/ha 2,4-D amine 625 g/L for improved control.
d Add 1.0–1.5 L/ha MCPA amine 500 g/L for improved control.
e Add 0.225 fluroxypyr 333 g/L + 1.5–2.0 L/ha 2,4-D amine 500 g/L for improved control.
f Add 0.375 L/ha 2,4-D amine 625 g/L for improved control.
g Add 0.5 L/ha MCPA amine 500 for improved control.
h 28 g/ha clopyralid 750 g/kg + 1.0–1.5 L/ha MCPA amine 500 for improved control.
i Add 0.5–1.0 L/ha 2,4-D amine 500 g/L.
j Add 0.7 L/ha bromoxynil 200 g/L for improved control.
k Add 0.3 L/ha terbutryn 500 g/L.
l Add 1.5–2.5 L/ha 2,4-DB 500 g/L for improved control.
m Add 0.7 L/ha bromoxynil 200 g/L + 0.7 L/ha MCPA amine 500 g/L.
n Add 0.28 L/ha 2,4-D amine 625 g/L for improved control.

TABLE 9. PERENNIAL GRASS SEED CROPS – GRASS WEEDS

Active Ingredient	Paraquat 250 g/L	Diuron 500 g/L	Asulam 400 g/L	Simazine 500 g/L
Trade Name	**Gramoxone® 250 β**	**Various Trade names**	**Asulox® ε**	**Various Trade names**
Per hectare	**(litres)**	**(litres)**	**(litres)**	**(litres)**
Herbicide group	L	C	K	C
Annual phalaris	0.6–1.2			
Annual ryegrass	0.6–1.2	5.5–6.0		
Barley grass	0.6–1.2	5.5–6.0		
Barnyard grass		5.5–6.0		
Brome grass	0.6–1.2		5.5 – soft brome	
Canary Grass	0.6–1.2			
Crabgrass (crowsfoot)		5.5–6.0		
Guinea grass		5.5–6.0		
Prarie grass			5.5	
Shivery grass			5.5	
Silvery hairgrass			5.5	
Sterile brome			5.5	
Summer grass		5.5–6.0		
Vulpia	0.6–1.2		5.5	1.0–1.6
Wild oat	0.6–1.2	5.5–6.0		
Winter grass			5.5	
Yorkshire fog	1.2		5.5	
Rec. Water vol L/ha B Boom A Aircraft	min100 B 30A		160–220 B	100 B
Wetting Agent/Adjuvant	Yes	No	Yes	No
Rainfast hours	Not stated	Not stated	3	Not stated
Stock withholding period days	1, 7 horses	Nil	21	14

β Use the low rate of paraquat 250 on Cocksfoot and Perennial ryegrass and the higher rate for Phalaris and Demeter fescue.
ε Perennial Ryegrass Seed Crops.

TABLE 10. PERENNIAL GRASS WEED CONTROL

Active Ingredient	Flupropanate 745 g/L	Flupropanate 745 g/L	Glyphosate 450 g/L	Glyphosate 450 g/L	Glyphosate 360 g/L	Glyphosate 360 g/L	Metsulfuron methyl 750 g/kg	Metsulfuron methyl 750 g/kg
Trade Name	**Taskforce®**	**Taskforce®**	**Glyphosate 450**	**Glyphosate 450**	**Glyphosate 360**	**Glyphosate 360**	**Sulfometuron 750 WG**	**Sulfometuron 750 WG**
Per hectare	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**	**(grams)**
Herbicide group	J	J	M	M	M	M	B	B
Use pattern	Boom Spray	Spot Spray	Boom Spray	Spot Spray	Boom Spray	Spot Spray	Boom Spray	Spot Spray
African lovegrass	3.0	0.3			1.0–6.0	1.0	400–800	40–80
Chilean needle grass	1.5–3.0	0.1–0.3	0.8					
Coolatai grass		0.3			2.0 b			
Columbus grass	12–22	1.0				400–800	40–80	
Giant Parramatta grass	1.5–2.0	0.2	c	c	d	d		
Guinea grass			7.2	1.0	9.0	1.3	400–800	40–80
Johnson grass	12–22	1.0	4.8	0.8	6.0	1.0	400–800	40–80
Parramatta grass	2.0	0.2						
Serrated tussock	0.5–2.0 e	0.15–0.2	0.54–4.87		0.75–6.0	a		
Spiny burr grass					2.0–3.0			
Rec. Water vol L/ha B Boom, A Aircraft	80–150 B 35–80 A	100	50–200 B 30–80 A	100	50–200 B 30–80 A	100	50–100 B	100
Wetting Agent/ Adjuvant	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Rainfast hours	Not stated	Not stated	2	2	6	6	Not stated	Not stated
Stock withholding period days	4 months	14	Nil	Nil	Nil	Nil	Nil	Nil

a High volume application 0.2 + 0.15 glyphosate 360.
b 2 L/ha Glyphosate 360 g/L + 0.2 L/ha Flupropanate (745 g/L).
c PER 9630 – Pressurised wick wiper only 0.4–2.5 L/ha.
d PER 9630 – Pressurised wick wiper only 0.5–3.0 L/ha.
e Rotating wiper 1:20.

TABLE 11. WOODY WEEDS, VINES AND CREEPERS – HIGH VOLUME APPLICATION

Active Ingredient	2,4-D-dea/dma 625 g/L	Picloram 75 g/L + 2,4-D 300 g/L	Metsulfuron-methyl 600 g/kg	Triclopyr 200 g/L + picloram 100 g/L	Triclopyr 600 g/L	Triclopyr 300 g/L + picloram 100 g/L	Dicamba 500 g/L	Fluroxypyr 333 g/L	Aminopyralid 10 g/L Fluroxypyr 140 g/L	Dichlorprop 600 g/L	Metsulfuron-methyl 63.2 g/kg + glyphosate 760.5 g/kg
Trade Name	**Amicide® 625**	**Tordon® 75D**	**Brush-Off® Metsulfuron-methyl WG**	**Tordon® Double Strength**	**Garlon® 600**	**Grazon® Extra**	**Kamba® 500**	**Starane® Advanced**	**Hotshot®**	**Lantana® 600**	**Cut-Out®**
Per hectare	**(litres)**	**(litres)**	**(grams)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(litres)**	**(grams)**
Herbicide group	I	I	B	I	I	I	I	I	I	I	B & M
African Boxthorn		1.3				0.5					95
Bitou Bush		0.65	10								95
Blackberry			10	0.5	0.17	0.35 or 0.5					
Bracken Fern			10								95
Blue Heliotrope		1.0	10 b			0.5	0.6	0.6			
Cape Broom					0.17	0.25 or 0.35					
Fireweed						0.35			0.5		
Galenia						0.5					
Gorse			10 a	0.375		0.25 or 0.35 or 0.5					95
Lantana	0.32	0.65	10 a		0.17 or 0.34	0.35 or 0.5 or 0.75		0.3 or 0.6	0.5 or 0.7	1.0	95
Lippia										1.0	
Maderia Vine								0.3			
Silver-leaf Nightshade		0.65			3.0			0.3			
St Johns Wort		0.5	10 a		0.17	0.5		0.3	0.7		
Sweet Briar			10								95
Water volume (litres)	100	100	100	100	100	100	100	100	100	200	100
Wetting Agent/Adjuvant	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Rainfast hours	6	4	4	1	1	1	6	1	1	4	4
Stock withholding period days	7	7	Nil	Nil	Nil	Nil	7	7	Nil	7	Nil

a Add 0.2 L glyphosate 360 for improved control.
b PER8444, expires 3/10/10.

Pasture manipulation

Spraygraze technique for broadleaf weed control in established pastures

Sub-lethal application rates of the herbicides MCPA and 2,4-D dimethylamine effectively control the listed broadleaf weeds if you apply them at the correct growth stage of both the weed and pasture and use them in combination with grazing livestock.

Spray the weeds when they are actively growing. Better activity may be obtained by spraying weeds when they are actively growing in autumn, 6 to 8 weeks after the autumn break. Withhold stock for 7 to 10 days, then graze heavily, preferably with sheep, at 8 to 10 times the normal stocking pressure until the weeds have been satisfactorily reduced but before the survival of desirable pasture species is threatened.

Note that these rates may be sub-lethal for some of the weed species mentioned.

Control depends on a combination of herbicide and grazing.

Caution. Legumes can be adversely affected by these herbicides. At the rates shown, the growth of established subterranean clover and white clover may be retarded.

Warning. An increased quantity of poisonous plants may be eaten by the stock used in the spraygraze technique (for example, caltrop, capeweed, Paterson's curse and variegated thistle), and deaths could result from causes such as nitrate poisoning. For Paterson's curse, preferably graze stock that are destined for slaughter, and avoid extended periods of grazing. Avoid grazing with young or breeding stock. Don't graze horses or pigs on Paterson's curse.

Do not return hungry livestock to treated area. Observe grazing livestock for at least one day following return to treated area.

Withholding period:

Do not graze or cut for stock food for seven days after application.

WEEDS AND SPRAYING RATES FOR SPRAYGRAZE TECHNIQUE (RATES ARE PER HECTARE)

WEEDS	MCPA-dma 500 g/L **Nufarm MCPA Amine 500**	2,4-D-dma 625 g/L **Nufarm Amicide® 625 Amicide® LO-625 A**	2,4-D-dma 800 g/kg **Baton®**	2,4-D-ipa 300 g/L **Surpass®**	2, 4-DB dma 500 g/L **Trifolamine® Buttress®**	MCPA 75D **Agritone® Agroxone® 750**
Caltrop, capeweed, charlock, dock, mustards, Paterson's curse, shepherd's purse, saffron,slender, spear and variegated thistles, turnip weed, wild radish, wild turnip	350 mL–1.4 L	280 mL–1.1 L	250–900 grams	0.6–2.3 L	1.0–3.2 L	0.23–0.9 L

Read the label before use

STERILISATION OF ANNUAL GRASS SEED (PASTURE TOPPING) AND SPRAY TOPPING

WEEDS	**Roundup® CT Glyphosate® CT 450 g/L** **mL/ha**	**Touchdown® Hitech Glyphosate 500 g/L** **mL/ha**	**Roundup® Power Max Glyphosate 540 g/L** **mL/ha**	**Gramoxone® 250 Paraquat 250 g/L Paraquat® 250 Nuquat® 250** **mL/ha**	**Paraquat 250 g/L** **mL/ha**
Barley grass	240–360	200–300	200–300	Apply 400 mL to reduce seedset of grasses	Apply 400 mL to reduce seedset of grasses
Bent grass	300–500	1660	240–420		
Brome grass	240–360	200–300	200–300		
Vulpia (silver grass)	240–360 Add wetting agent	200–300 Wetting agent may help	200–300		
Annual ryegrass	360 Add wetting agent	300–700 Wetting agent may help	320–680		
Capeweed	240–360 Add wetting agent	200–300 Wetting agent may help	200–300		400 mL
Saffron thistle				Apply 400 mL for prevention of seedset: spray when plant begins to run to head until flowering	

Read the label before use

- Remove stock before treatment to allow for an even heading.
- For glyphosate herbicides, apply at flowering for annual ryegrass and capeweed and at head to milky dough stage for other grasses. Apply before signs of haying-off.
- For paraquat herbicides, apply when all heads have emerged and there are initial signs of haying-off.
- Seed-set of annual legumes may be reduced.
- Roundup® CT, Glyphosate® CT, Roundup®, Glyphosate 360 + Roundup® Power Max, Touchdown® Hitech and Paraquat are not selective; pasture legumes may be adversely affected. Seed set of annual legumes may be reduced.

TABLE 12. LOCATION OF INDUSTRY & INVESTMENT NSW DISTRICT AGRONOMISTS

Town	Street	Phone	Mobile	Fax
Albury	602 Olive Street	(02) 6051 7700	0427 259 004	(02) 6041 6499
Armidale	C2 Earth Sciences Building, Ring Road North, University of New England	(02) 6738 8500	0427 311 815	(02) 6772 8664
Barham	Agricultural Research & Advisory Station, 449 Charlotte Street, Deniliquin	(03) 5881 9999	0428 236 629	(03) 5881 3719
Bathurst	Research Station Drive	(02) 6330 1200	0427 102 703	(02) 6332 1458
Bega	Rixon's Arcade, 162 Carp Street	(02) 6492 1733	0427 401 532	(02) 6492 1402
Berry	Pasture Research & Advisory Unit, 13 Schofields Lane	(02) 4464 6000	0427 102 793	(02) 4464 2113
Casino	134 Barker Street	(02) 6662 2288	0427 102 314	(02) 6662 1107
Coleambally	Centre for Irrigated Agriculture, Farm 217, Murray Road, Hanwood	(02) 6960 1300	0427 207 406	(02) 6963 0255
Condobolin	Agricultural Research & Advisory Station, Trundle Road	(02) 6895 1025	–	(02) 6895 2688
Cooma	39 Bombala Street	(02) 6452 3411	0401 993 956	(02) 6452 4872
Coonabarabran	56 Cassilis Street	(02) 6842 1377	0427 226 070	(02) 6842 2190
Coonamble	62 Aberford Street	(02) 6822 1000	0488 250 489	(02) 6822 1175
Cootamundra	87 Cooper Street	(02) 6942 4957	0427 201 946	(02) 6942 3922
Cowra	Agricultural Research & Advisory Station, Binni Creek Road	(02) 6349 9777	0427 401 547	(02) 6342 4543
Dareton	Agricultural Research & Advisory Station, Silver City Highway	(03) 5019 8400	0427 201 964	(03) 5027 4319
Deniliquin	Agricultural Research & Advisory Station, 449 Charlotte Street	(03) 5881 9999	0427 079 138	(03) 5881 3719
Dubbo	Cnr Hampton and Cobra Streets	(02) 6881 1270	0427 104 344	(02) 6881 1295
Finley	241 Murray Street	(03) 5888 2800	–	(03) 5883 1570
Forbes	Camp Street	(02) 6850 2922	0427 102 683	(02) 6852 3998
Glen Innes	Agricultural Research & Advisory Station, Wellingrove Road	(02) 6730 1900	0427 102 680	(02) 6730 1999
Goulburn	159 Auburn Street	(02) 4828 6600	0411 128 469	(02) 4822 3261
Grafton	Agricultural Research & Advisory Station, Trenayr Road, Junction Hill	(02) 6640 1600	0447 644 730	(02) 6644 7251
Griffith	Centre for Irrigated Agriculture, Farm 217, Murray Road, Hanwood	(02) 6960 1300	0427 102 309	(02) 6963 0255
Gunnedah	35–37 Abbott Street	(02) 6741 8333	0429 785 894	(02) 6742 4018
Hay	177 Lachlan Street	(02) 6993 1608	0427 007 362	(02) 6993 2177
Hillston	Centre for Irrigated Agriculture, Farm 217, Murray Road, Hanwood	(02) 6960 1300	0427 007 418	(02) 6963 0255
Inverell	127 Otho Street	(02) 6722 1388	0427 201 945	(02) 6722 4733
Kempsey	35 Elbow Street	(02) 6562 6244	0427 001 903	(02) 6562 5614
Kyogle	131 Summerland Way	(02) 6632 6904	0427 102 261	(02) 6632 1960
Lockhart	Wagga Wagga Agricultural Institute, Pine Gully Road	(02) 6938 1999	–	(02) 6938 1809
Maitland	Tocal Agricultural Centre, Tocal, Paterson	(02) 4939 8888	0427 007 425	(02) 4939 8950
Manilla	Tamworth Agricultural Institute, 4 Marsden Park Road, Calala	(02) 6763 1100	0427 401 542	(02) 6785 2176
Moree East	87–89 Balo Street	(02) 6750 6300	0428 692 984	(02) 6752 4859
Moree West	87–89 Balo Street	(02) 6750 6300	0437 374 981	(02) 6752 4859
Mudgee	1/28 Market Street	(02) 6372 4700	0427 401 652	(02) 6372 6870
Narrabri	Australian Cotton Research Institute, Wee Waa Road	(02) 6799 1500	–	(02) 6799 1503
Nyngan	66a Cobar Street	(02) 6832 1305	0429 781 967	(02) 6832 1980
Orange	Orange Agricultural Institute, Forest Road	(02) 6391 3800	0413 889 318	(02) 6391 3899
Parkes	Cnr Currajong and Court Streets	(02) 6816 3300	0427 311 816	(02) 6862 5430
Richmond	Building M14, University of Western Sydney, Castle Road, Richmond	(02) 4588 2100	0408 297 548	(02) 4588 2159
Scone	Cnr Susan and Guernsey Streets	(02) 6544 4900	–	(02) 6545 2639
Tamworth	Tamworth Agricultural Institute, 4 Marsden Park Road, Calala	(02) 6763 1100	0427 311 819	(02) 6763 1222
Taree	1 Macquarie Street	(02) 6552 7299	0427 007 468	(02) 6551 2253
Temora	Agricultural Research & Advisory Station, Barmedman Road	(02) 6977 3333	0427 007 395	(02) 6977 2333
Tumut	64 Fitzroy Street	(02) 6947 4188	0419 616 154	(02) 6947 4149
Wagga Wagga	Agricultural Institute, Pine Gully Road	(02) 6938 1999	0427 102 707	(02) 6938 1995
Walgett	89 Wee Waa Street	(02) 6828 0125	0419 217 553	(02) 6828 2274
Warren	95 Dubbo Street	(02) 6883 7100	0419 277 480	(02) 6847 3664
Wellington	30 Warne Street	(02) 6845 4438	0437 140 577	(02) 6845 4452
West Wyalong	40 Church Street	(02) 6970 1200	0427 401 539	(02) 6972 3839
Yanco	Yanco Agricultural Institute, Trunk Road 80	(02) 6951 2611	0427 401 469	(02) 6955 7580
Yass	25 Warroo Road	(02) 6226 2199	0427 201 805	(02) 6226 1581
Young	27 Lynch Street	(02) 6380 1700	0427 401 582	(02) 6382 2228

TABLE 13. HERBICIDE / INSECTICIDE COMPATIBILITIES

This chart is a guide only. Read both product labels if using a mixture

Product		2,4-DB AMINE	2,4-D ESTER	ZINC HEPTAHYDRATE	VERDICT®	TRIFLURALIN	TORDON® 75-D	TARGA®	TALSTAR®	SURPASS®	SUPRACIDE®	STARANE™ ADVANCED	SPRAY SEED® 250	SPINNAKER®	SNIPER®	SERTIN®	ROUNDUP® POWER MAX	ROUNDUP® CT	REGLONE®	RAPTOR®	PROMETRYNE® 900 DF	PLATINUM®	MOLYBDENUM
		44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23
ATRAZINE	1			C	C		C						C	C	C			C		A			
BROADSTRIKE®	2	C	C		C	C						C	C	C	C	S		/		/			
BROMOXYNIL	3			C	N	S		C						/	C			N		N			
BROMOXYNIL + MCPA	4	N	N		N	S		/						/	C			N		N			
CADENCE®	5			C				R						C				C		C			
CORRECT®/SHOGUN®	6	N	N	N												C	C	/		/		C	
DIMETHOATE	7	A	C		/	C	C	C			C			C	C		C	C		C			
DIURON *	8	C	C	C			C							S	C			S		S			
EASY N®	9			N										C	N			S		S			
FACTOR® WG	10				C			C															
FASTAC DUO®	11																C						
FUSILADE®	12	N	N	N	/		/	S	/					/	N	C	C	/		/		C	
GARLON® 600	13	/	/	C		/	C	/	/	/	C	C	C	/	/	/	/	C		C			
GOAL® /STRIKER®	14						C							C			S	C		C			
GRAMOXONE® 250	15	N	N	C	/		/	S	/					C	C			N	C	N			
GRAZON® EXTRA	16																	C					
LE MAT®	17	C	C	C	C	C	C	C	C		C			C	C	C	C	C		C		C	
LONTREL®	18			C	S	R	C	C	C		C	C	C	C	/	C	C	C		C			R
LORSBAN® 500 EC	19	N	N	N	C		C	C			C			C	C			C		C			
MCPA AMINE	20	N	N	C	N	N	N					C	C	C	/	N		N		N			
MCPA LVE	21	/	/			S	C	R				S	C	C	/	N	C	C		C			
MCPA + DICAMBA	22	N	N	C	N		N							C	/			N		N			
MOLYBDENUM	23			/										/	/			N		N			
PLATINUM®	24				C			C								C							
PROMETRYNE® 900 DF	25					C																	
RAPTOR®	26									C													
REGLONE®	27																						
ROUNDUP® CT	28	N	N	S	/	/	/	/	/	N	C	C	C	N	/	/	/						
ROUNDUP® POWERMAX™	29	N	N	S	/	/	/	/	/	N	C	C	C	N	/	/	/						
SERTIN®	30	N	N	/	C			C	C					/	N								
SNIPER®	31									C													
SPINNAKER®	32	C	C	C	/	N	/	/	N					C									
SPRAY SEED® 250	33	/	/	C	/		/	/	/	C	C												
STARANE™ ADVANCED	34		S				C																
SUPRACIDE®	35			C	S				C														
SURPASS®	36						C																
TALSTAR®	37						C																
TARGA®	38							S															
TORDON® 75-D	39	N	N	C	N	N	/																
TRIFLURALIN	40	/	/																				
VERDICT®	41	N	N	N																			
ZINC HEPTAHYDRATE	42	N	N	N																			
2,4-D ESTER	43		/																				
2,4-DB AMINE	44																						

TABLE 13. HERBICIDE / INSECTICIDE COMPATIBILITIES (continued)

This chart is a guide only. Read both product labels if using a mixture

Product		MCPA + DICAMBA	MCPA LVE	MCPA AMINE	LORSBAN® 500 EC	LONTREL®	LE MAT®	GRAZON® EXTRA	GRAMOXONE® 250	GOAL® /STRIKER®	GARLON® 600	FUSILADE®	FASTAC® DUO	FACTOR® WG	EASY N®	DIURON *	DIMETHOATE	CORRECT®/SHOGUN®	CADENCE®	BROMOXYNIL + MCPA	BROMOXYNIL	BROADSTRIKE®	ATRAZINE
		22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
ATRAZINE	1			C	c	C				C		C					C	C				C	
BROADSTRIKE®	2			C	C	C	C		C	C		C		C		C	C				C	C	
BROMOXYNIL	3		C	C		C	C			/	C	C		C	C			C			C		
BROMOXYNIL + MCPA	4		C		C	C				/	C	/	C		C			C					
CADENCE®	5			C			C				C	/			C		C						
CORRECT®/SHOGUN®	6		N	N			N							C									
DIMETHOATE	7		N		C	C				C	C	C	S	C			N						
DIURON *	8		C	C	C	C				C	C	/			C								
EASY N®	9		C							C	C	S											
FACTOR® WG	10				N	C	C					C											
FASTAC DUO®	11																						
FUSILADE®	12	N	N	N	N	N	/			/	N	C											
GARLON® 600	13	/	/		C	C				/													
GOAL® /STRIKER®	14									C													
GRAMOXONE® 250	15	N	C		C	C	C																
GRAZON® EXTRA	16																						
LE MAT®	17	C	C	C			C																
LONTREL®	18			C	C	C																	
LORSBAN®	19		N	N																			
MCPA AMINE	20		C																				

C Compatible.
N Not compatible.
/ Not likely to be mixed. Compatibility unknown.
A Compatibility agent may improve performance. Seek advice from label or manufacturer.
S Seek advice from label or manufacturer.
R Compatibility restricted by product rate. Seek advice from label or manufacturer.

This chart is only a guide to indicate that the effectiveness of the chemicals listed is not affected by mixing. The chart is not a guarantee to compatibilities.
Crop damage can occur if chemicals are applied outside the recommended stages for application. Sequential applications of different post-emergence herbicides and/or crop oils to broadleaf crops may cause crop damage. For final authority, refer to manufacturer's recommendations. Always dilute before mixing and use immediately. Before using any pesticide, STOP, read and heed the label.

* Some flowable and dry formulations have poor compatibility.

TABLE 14. APPROXIMATE RETAIL PRICES OF CHEMICALS USED ON PASTURES AND LUCERNE

Chemical	Registered Product	$/L or $/kg	Commonly used rate/ha	$/ha ex GST	$/ha inc GST
Aminopyralid + Fluroxypyr	Hotshot	20.48	0.5 L	10.24	11.26
Amitrole 250 g/L + paraquat 125 g/L	Alliance®	13.50	2.8 L	37.80	41.58
Atrazine 500 g/L	Atrazine500 SC	9.40	1 L	9.40	10.34
Atrazine 900 g/Kg	Gesaprim, Atragranz 900, Nu-trazine	10.00	0.6 kg	6.00	6.60
Atrazine flowable 600g/L	Gesaprim, Atrazine 600 etc	9.50	0.9 L	8.55	9.41
Bromoxynil 200g/L	Brominil, Buctril 200, Bromicide	13.85	1.4 L	19.39	21.33
Bromoxynil 250g/L + Diflufenican 25 g/L	Jaguar	27.50	0.75L	20.60	22.68
Bromoxynil 200g/L + MCPA 200g/L	Buctril MA, Bromicide MA	15.00	2 L	30.00	33.00
Butroxydim 250g/kg	Factor	121.00	180 g	21.78	23.96
Carfentrazone-ethyl 240 g/L	Hammer	183.00	0.05 L	9.15	10.07
Clethodim 240 g/L	Status, Platinum	35.00	0.3 L	10.50	11.55
Clopyralid 300g/L	Lontrel, Archer	47.00	0.05 L	2.35	2.59
Clopyralid 750g/Kg	Lontrel	119.00	20 g	2.38	2.62
Dicamba 500g/L	Banvel, Kamba 500	34.50	0.5 L	17.25	18.98
Dicamba 700g/Kg	Cadence	58.00	400 g	23.20	25.52
Dicamba 80g/L + MCPA 340g/L	Kamba M, Banvel M	12.00	3 L	36.00	39.60
Diclofop-methyl 500g/L	Hoegrass, Nugrass	19.00	1.5 L	28.50	31.35
Diflufenican 500g/L	Brodal Options, Bonza Elite	90.00	0.2 L	18.00	19.80
Diflufenican 25g/L + bromoxynil 250 g/L	Jaguar	27.50	0.75 L	20.63	22.69
Diflufenican 25g/L + MCPA 250 g/L	Tigrex, Nugrex	22.00	0.75 L	16.50	18.15
Diquat 200g/L	Reglone, Diquat 200	23.50	1.5 L	35.25	38.78
Diuron 900g/Kg	Diuron 900 DF, Diurex	15.00	1.9 kg	28.50	31.35
Diuron flowable 500g/L	Diuron liquid, Diuron 500m SC	9.00	3.5 L	31.50	34.65
Fluazifop 212g/L	Blackout 212, Fluazifop	56.60	0.5 L	28.30	31.13
Fluazifop-P 128 g/L	Fusilade, Forte	70.00	0.82 L	57.40	63.14
Fluazifop-p + Butroxydim	Fusion Super	75.00	320 g	24.00	26.40
Flumetsulam 800g/Kg	Broadstrike	780.00	25 g	19.50	21.45
Fluproponate 745g/L	Taskforce, Smack, Tussock	27.50	2 L	55.00	60.50
Fluroxypyr 200g/L	Starane 200, Tomigan	19.75	0.75 L	14.81	16.29
Fluroxypyr 333g/L	Starane Advanced	29.00	0.45 L	13.05	14.36
Glyphosate 360 g/L	Roundup Biactive	8.00	1 L	8.00	8.80
Glyphosate 450g/L	Roundup CT, Glyphosate CT, Wipe-out 450	8.00	1 L	8.00	8.80
Glyphosate 540g/L	Roundup Power Max	13.00	0.8 L	10.40	11.44
Haloxyfop 520g/L	Verdict	105.60	0.1 L	10.56	11.62
Imazamox 700g/L	Raptor	900.00	45 g	40.50	44.55
Imazethapyr 700g/Kg	Spinnaker 700 WDG	357.50	70 g	25.03	27.53
Metsulfuron-methyl 600g/Kg	Brush-Off, Metsulfuron-Methyl WG	160.00	10 g	1.60	1.76
MCPA Sodium 250 g/L	MCPA 250	5.00	1.5 L	7.50	8.25
MCPA amine 500g/L	Thistle killem, MCPA 500	6.50	1.5 L	9.75	10.73
MCPA 750g/L	Agritone® 750, Agroxone®	10.00	0.46 L	4.60	5.06
MCPA LVE 500g/L	MCPA LVE	10.00	1.6 L	16.00	17.60
MCPA + Diflufenican	Tigrex, Nugrex	24.63	0.5 L	12.32	13.55
Oxyfluorfen 240 g/L	Goal, Striker, Spark	28.00	0.075 L	2.10	2.31
Paraquat 250g/L	Gramoxone 250, Paraquat 250	7.70	1.2 L	9.24	10.16

Paraquat 135 g/L+ Diquat 115 g/L	Sprayseed 250	13.00	1.2 L	15.60	17.16
Picloram 75 g/L + 2,4-D amine 300g/L	Tordon 75-D	25.00	1 L	25.00	27.50
Picloram + MCPA	Tordon 242, Envorcer 242	17.25	1 L	17.25	18.98
Prometryn 500 g/L	Gesaguard	15.00	0.85 L	12.75	14.03
Propaquizafop 100g/L	Shogun	48.65	0.3 L	14.60	16.05
Propyzamide 500 g/L	Kerb 500 SC	70.00	1.5 L	105.00	115.50
Quizalofop-P-tefuryl	Pantera	50.00	0.25 L	12.50	13.75
Sethoxydim 186 g/L	Sertin 186 EC	40.00	1 L	40.00	44.00
Simazine 500 g/L	Simazine 500 F	7.33	1.6 L	11.73	12.90
Simazine 600 g/L	Gesatop 600 SC	8.60	1.25 L	10.75	11.83
Simazine 900 g/L	Simagranz	10.73	0.83 kg	8.91	9.80
Terbutryn 500 g/L	Igran	19.00	0.7 L	13.30	14.63
Terbutryn 275 g/L + MCPA 160 g/L	Agtryne®MA	15.45	1 L	15.45	17.00
2,4-D amine 300 g/kg	surpass 300	5.50	1.2 L	6.60	7.26
2,4-D amine 475 g/kg	Surpass 475	6.75	0.76 L	5.13	5.64
2,4-D-dma 625 g/L	Amicide 625, 2,4-D amine	6.73	1 L	6.73	7.40
2,4-D - dma 800 g/kg	Baton®	15.00	0.9 kg	13.50	14.85
2,4-DB 500 g/L	Trifolamine, Buttress	15.25	2.1 L	32.03	35.23
2,4-D LV 680 g/L	LV Ester 680	10.00	0.8 L	8.00	8.80
2,4-D LV 600 g/L	LV Ester 600	8.70	0.7 L	6.09	6.70
Triclopyr 600 g/L	Garlon	30.37	0.16 L	4.86	5.35
Triclopyr 300 g/L + Picloram 100 g/L	Grazon DS	34.00	0.3 L	10.20	11.22
Triclopyr 300 g/L + Picloram 100 g/L + Aminopyralid 8 g/L	Grazon Extra	35.00	0.3 L	10.50	11.55
Trifluralin 480 g/L	Trifluralin 480, Trilogy	7.88	1.2 L	9.46	10.40
Trifluralin 500 g/L	TriflurXcel	8.10	1.2 L	9.72	10.69
Common Adjuvants			**L/100 L water**	**$/100 L water ex GST**	**$/100 L water inc GST**
Wetting agent	Agral 600	6.00	0.35	2.10	2.31
Wetting agent	BS 1000	6.00	0.2	1.20	1.32
Crop oil	Caltex Sprayplus	4.00	2	8.00	8.80
Crop oil	Uptake	7.50	0.4	3.00	3.30
Petroleum oil	DC Trate	5.00	2	10.00	11.00
Crop oil + surfactant	Hasten	7.00	1	7.00	7.70
Ammonium sulfate	Liase	2.50	2	5.00	5.50
Surfactant/ penetrant	Wetter TX	12.00	0.2	2.40	2.64
Surfactant/ penetrant	LI 700	10.00	0.25	2.50	2.75

Prices are average retail (excluding GST) and are only a guide. They will vary according to location, availability and quantity purchased.
They are current at the time of publishing but may become out of date very quickly.

The Grassland Society of NSW Inc.

A GROUP OF PEOPLE WITH A COMMON INTEREST IN DEVELOPING OUR MOST IMPORTANT RESOURCE, OUR GRASSLANDS

The objectives of the Grassland Society of NSW are:

- to provide an organisation in which landholders are the major participants in the dissemination of pasture production information
- to provide opportunities for those concerned with grassland husbandry to meet and exchange information
- to encourage the investigation of problems affecting grassland husbandry
- to stimulate the incorporation of advances from research and farmer experience into practice
- to provide a means of social and business contact for those engaged in grassland production
- to afford pasture production an ordered structure and an industry status

The Grassland Society of NSW was formed in March 1985 at a meeting of 28 interested personnel. The Society now has 500 members; a unique blend of farmers and technologists.

The Society holds a conference each year, publishes a quarterly newletter and has formed six branches.

Our internet address is www.grasslandnsw.com.au

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