Sugar Research Australia™

Weed Management in Sugarcane Manual

Acknowledgements

- Bayer Australia Limited
- Nufarm Limited
- Sumitomo Chemical Australia Pty Ltd
- Barry Callow – MSF Agriculture
- Allan Blair – Department of Agriculture and Fisheries
- Jack Robertson – Department of Agriculture and Fisheries
- Emilie Fillols – SRA Limited
- Phil Ross – SRA Limited
- Alexa Adamson – SRA Limited

More information

We are committed to providing the Australian sugarcane industry with resources that will help to improve its productivity, profitability and sustainability.

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- Information sheets and related articles
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Edition

Sugar Research Australia Limited 2017 edition of the *Weed Management Manual* published in 2010 by BSES Limited.

ISBN: 978-0-949678-38-6

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Introduction

Introduction

This manual does not reproduce product labels in full. It does not replace the need to read, understand and follow label directions. Label instructions and legislative requirements take precedence over information in this manual, should discrepancies occur.

Costings are indicative as at July 2016, and are included as a guide only. Prices may vary by retailer, pack size, brand and location of purchase. To the best of our knowledge, products mentioned are available as at July 2016; however product availability may change over time.

Products mentioned are usually representative of a range of products available for specific active ingredients. Inclusion or non-inclusion of specific product names does not infer endorsement or non-endorsement of particular products.

Yield loss from weed competition, combined with the cost of weed control in sugarcane in Australia, was estimated to exceed $70 million annually in 2000 (McMahon et al. 2000). SRA analysis in 2008 estimated the average value of lost yield due to sub-optimal weed management to be $338 / ha (Gilmore, 2008).

Effective weed management is most important in the early stages of crop development. Weeds compete with sugarcane for light, nutrients and moisture, significantly reducing yields (Figure 1) in a relatively short period of time. Implementing a timely, cost-effective weed management strategy is vital to maximise yields. Widespread use of Green Cane Trash Blanketing (GCTB) has also reduced the spectrum of weeds germinating.

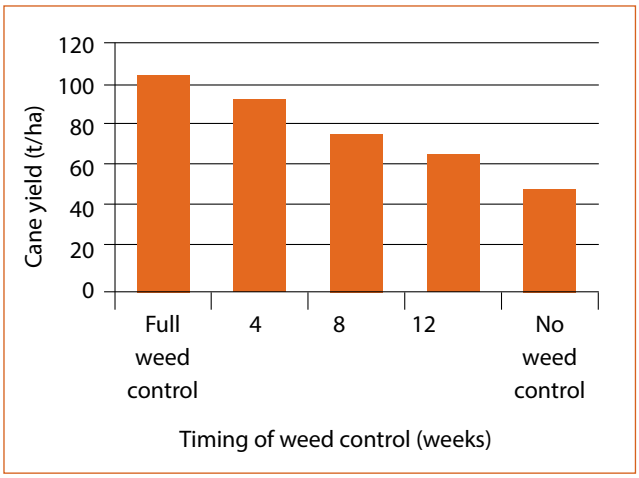


Figure 1: Effect of delayed weed control in plant cane.

Moves towards the use of minimum tillage have reduced soil disturbance and subsequent germination of weed seed, although these changed practices have resulted in wider use and greater reliance on herbicides to control weeds in ratoon cane.

The inappropriate use of herbicides may have an adverse environmental impact. These risks are minimised by using the appropriate farm management strategies. These include timing of application, using recommended rates, product choice, herbicide incorporation and use of band spraying. Choosing the right strategy will result in effective weed control and minimise off-farm impacts.

Integrated Weed Management (IWM) incorporates a grower's knowledge of the physical attributes of the farm, identifies weed species and densities and the products and equipment available for use. It is also important that growers have a good understanding of the impact of adverse weather conditions, i.e. heavy rain, on the timing of application of herbicides.

IWM enables growers to make informed decisions about weed management strategies most appropriate for their farms. Understanding soil types, weed species and product efficacy are the keys to successful weed management.

Effective weed control until stalk height is at least 10 cm can make an extra $1400 per hectare total industry income, compared to poor control (based on A$440 per tonne sugar).

Integrated Weed Management

IWM allows a range of cost-effective management techniques to be used in sequence to effectively control weeds in an environmentally responsible manner. This minimises the potential for weeds to set seed in all crop phases and therefore reduces the weed seedbank. These techniques are listed below.

Reducing the weed seedbank

Controlling weeds before seeds set in cane blocks and areas adjacent to cane lands is an important strategy to minimise the impact of weeds on the farm. Weed seedbank reduction is the most cost-effective method in controlling weeds.

By preventing weed seed entering the paddock (slashing adjacent headlands, spraying along fence lines and around hydrants, pumps, sheds, machinery, etc) the weed pressure in adjacent blocks of cane is greatly reduced.

Rotate herbicide groups

Rotation of herbicide groups helps in minimising the risk of herbicide resistance developing in weeds. This applies to non-crop situations as well. Experiences in other crops have shown that some cases of herbicide resistance in weeds originated from along fence lines and roadsides.

Practicing good hygiene procedures

Cleaning down machinery (e.g. slashers and harvesters) between blocks will minimise the introduction of weed seed to your clean block.

Using appropriate cultural practices

Trash blanketing in ratoons will suppress weeds, especially annual grasses and new grass seedlings.

A well-managed legume crop during the fallow period will reduce the grass weed pressure for the following plant cane crop.

Applying suitable herbicides

A program consisting of both pre-emergent residual and post-emergent control is most valuable in controlling weeds over a period of time. Care must be taken to choose the correct herbicide according to the soil type and weed species and to apply at the right time.

Residual herbicides provide good insurance for a weed-free crop. Weed pressures and risk should be evaluated in deciding on your herbicide strategy. Residual herbicides prevent new germinating seeds from growing. Residual herbicides are an important tool in preventing herbicide resistance developing.

Using mechanical control

Mechanical control used in plant cane and non-trash blanket systems (operations such as tillage, side dressing and filling-in) reduces weed populations.

Prevent weed seed spread by machinery

Prevent weed seed spread by machinery

Unclean machinery is a major path for weed seed dispersal, both from block to block on farms and between farms. Growers should clean down machinery especially when moving from known weedy blocks onto other parts of the farm. They should also have clean down agreements with contractors.

Harvesters are a major contributor to weed seed spread. In a survey of harvesters in Mackay during 2012, thousands of convolvulus vine seeds were collected from the spirals, shoe and floating rear shoe. In the case of pink convolvulus, the majority of seeds were viable throughout the season. Simple hygiene measures like blowing down with an air compressor remove most of these seeds.

Basic machine hygiene helps prevent weed seed spread!

Image 1 (right): Pink convolvulus seeds hidden on top of harvester spirals, after the machine was cleaned down.

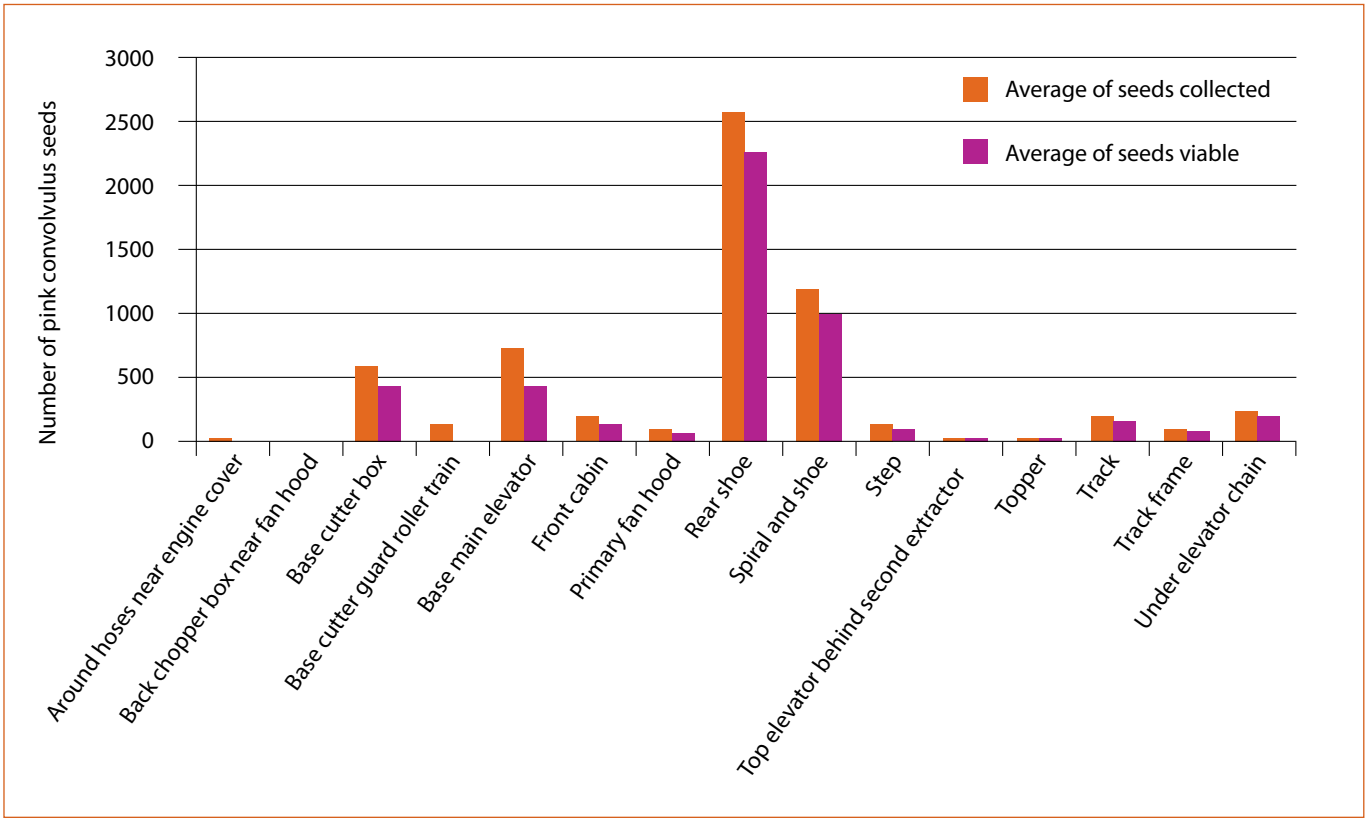


Figure 2: Location of vine seeds on a harvester before cleaning.

Herbicide resistance

Herbicide resistance

What is herbicide resistance?

Herbicide resistance is the inherited ability of a plant to survive and reproduce following exposure to a dose of a herbicide normally lethal to the wild type (Heap 2006). Resistance is present in weed populations before herbicides are used.

- Keep weed numbers low
- Control must be monitored: Find patches of surviving weeds early
- Stop seed-set on uncontrolled plants!
- Use a range of weed control methods (IWM)
- Use herbicides at rates that give a robust level of control
- Rotate chemical groups
- When you are on a good thing, don't stick to it!

Take home messages

- Use herbicides as a part of an integrated program.
- Make sure that products, rates, timing and application methods are correct.
- Rotate chemistries and use double-knocks when necessary.

Image 2: Paddock of Paterson's Curse with single white Paterson's Curse flower circled. The white flower indicates a rare change in a gene. Photo: NSW Department of Primary industries, Steve Sutherland.

How does resistance develop?

Most weed species have demonstrated the ability to develop resistance if a heavy selection pressure is applied for long enough. It is important to realise that resistance is not weed escapes from herbicides, species that were never controlled by that herbicide (tolerance) or weeds that survive, but still produce susceptible seed. It is thought that initially resistance to glyphosate for example, developed from regularly applying these products along fences, lines, etc over a period of time without rotating products from different groups. This eventually 'selected' out the naturally resistant types, allowing them to set seed and thus establish the 'patches' of the weed. From here, seed from the resistant types spreads into adjacent fields and the cycle continues. The risk of resistance developing increases as farming systems evolve to depend more on herbicides and reduced tillage. Heavy reliance on a single herbicide group also increases the risk.

An example of this is the increased use of glyphosate for fallow spraying or applied through inter-row spraying under shields. The correct strategy is to ensure that any survivors are controlled with a herbicide from another group or with cultivation (double knock). If the industry adopts herbicide resistant cane varieties (GM) it is essential that growers fully understand the principles of herbicide resistance and implement strategies to prevent/minimise resistant weeds developing. For example, regularly applying glyphosate to sugarcane varieties tolerant to this chemical greatly increases the risk of 'selecting' out the weed populations that are also 'naturally' resistant.

In 2015, three weed species (cudweed, blackberry nightshade, crowsfoot grass) were confirmed with paraquat resistance in mixed tomato/sugarcane cropping systems in the Bundaberg region. Many other major weed species in cane are likely candidates to develop resistance to herbicides (short life cycle with, many seeds produced). It is important to rotate herbicide groups to mimimise the development of resistance.

Up-to-date information regarding herbicide resistance in Australia can be found on the website glyphosateresistance.org.au

Mode of action

Mode of action

Herbicides kill weeds through various mechanisms within the plant or germinating seed. The way a particular herbicide affects a plant at cellular level is called its mode of action. Herbicides that have similar modes of action are categorised into Groups (chemical family). Using the mode of action Group is the easiest way to work out how to rotate herbicides to minimise the risk of resistance developing. Some Groups are at a higher risk of developing resistance than others. Active ingredients registered for sugarcane and their Group are listed below.

High resistance risk			
Chemical family	Active ingredient	Example trade name(s)	Uptake site and translocation
Group A (currently no herbicides in this group registered for use in-crop for cane, however registered in fallow crops)	fluazifop	Fusilade	Absorbed through leaves but is poorly translocated through plant, with most activity on the growing points. Treat like a contact herbicide and ensure good coverage.
	haloxyfop	Verdict	Absorbed by roots and foliage but is poorly translocated through plant with most activity on the growing points. Treat like a contact herbicide and ensure good coverage.
Group B	imazapic	Flame, Spark, Bobcat i-maxx	Taken up by developing roots and translocated to growing tips.
	halosulfuron - methyl	Sempra	Absorbed through leaf tissue and translocates through the vascular system.
Moderate resistance risk			
Chemical family	Active ingredient	Example trade name(s)	Uptake site and translocation
Group C	ametryn	Gesapac Combi, Amtrex, Viking	Translocates from roots and foliage.
	atrazine	Atradex, Gesaprim, Gesapax Combi	Upward translocation with the transpiration stream. Older leaves show most injury.
	terbutryn	Agtryne MA	Absorbed by leaves and roots.
	hexazinone	Bobcat Combi, Bobcat i-maxx, Barrage	Upward translocation with the transpiration stream. Older leaves show most injury.
	metribuzin	Tomahawk, Mentor	Upward translocation with the transpiration stream. Older leaves show most injury.
	diuron	Diurex, Bobcat Combi, Barrage	Upward translocation with the transpiration stream. Older leaves show most injury.

Moderate resistance risk (continued)			
Chemical family	Active ingredient	Example trade name(s)	Uptake site and translocation
Group D	pendimethalin	Stomp Xtra	Growing point inhibitor that mainly prevents root development and to a lesser extent growing point of shoots. Does not translocate.
	trifluralin	Treflan	
Group E	No products registered for use in sugarcane.		
Group F			
Group G	flumioxazin	Valor	Absorbed by and accumulates in the germinating shoot of seeds. Very little translocation to other parts of the seed.
	acifluorfen	Blazer	Does not translocate. Coverage is important. Registered for use in fallow crops, not cane.
Group H	isoxaflutole	Balance	Taken up by germinating seedlings roots and shoots.
Group I	dicamba	Cadence, Kamba, Dicamba	Downward and upward translocation. Although applied as foliar sprays, Group I herbicides can have some soil residual activity with upward translocation. Longer plant back periods indicate good upward movement.
	2,4-D	Amicide, Tordon 75D, Trooper	
	fluroxypyr	Starane, Comet	
	MCPA	Agritone 750 , MCPA 750	
	picloram	Tordon 75D, Trooper	
Group J	2,2-DPA	Dalapon	Absorbed through roots, shoots and leaves and translocates throughout plant.
Group K	metolachlor	Dual Gold, Bouncer 960S	Shoot inhibitor which prevents development of germinating shoot.
	S-metolachlor	Clincher Plus, Bouncer	Shoot inhibitor which prevents development of germinating shoot.
Group L	diquat	SpraySeed	Does not translocate. Coverage is important.
	paraquat	Gramoxone, SpraySeed, Nuquat, Revolver	
Group M	glyphosate	Roundup, Weedmaster	Downward and upward translocation from leaves to shoot tips and root tips. Most activity is downward as glyphosate deactivates on contact with organic matter in the soil.
Group N	glufosinate	Basta	Insignificant translocation. Coverage is important.
Group O	No products registered for use in sugarcane.		
Group P			
Group Q			
Group R	asulam	Asulox, Rattler	Absorbed by leaves, shoots and roots and translocates throughout plant.
Group Z	MSMA	Daconate, Monopoly	Absorbed through leaves but does not translocate further. Coverage is important.

Soil applied residual herbicides are taken up by various parts of germinating seedlings. Most, but not all, then translocate to other parts of the germinating seedling. Soil moisture is important to allow maximum uptake by germinating roots and/or shoots.

Foliar applied systemic herbicides translocate to other parts of the weed and although coverage is important, it is not as critical as with contact herbicides. Active weed growth is needed for maximum translocation within the weed. Suitable adjuvants may also increase the absorption of the herbicide, especially by weeds with hairy or waxy leaf surfaces.

Coverage of foliage is important for herbicides that do not translocate (contact herbicides). Poor coverage may cause localised burn-off of foliage. Contact herbicides do not effectively control established perennial weeds. Contact herbicides work best on smaller weeds.

For some active ingredients, there are hundreds of registered products. The website of the Australian Pesticides and Veterinary Medicines Authority (APVMA) lists all active ingredients and products registered or approved for use.

Go to www.apvma.gov.au and access the Registered chemical products (PubCRIS) section. Product labels state which Group that particular herbicide belongs to.

Up-to-date groupings for mode of actions are maintained by the CropLife Australia Herbicide Resistance Management Review Group www.croplife.org.au

Environmental considerations

Environmental considerations

It is very important that all on-farm activities have as little environmental impact as possible on downstream aquatic ecosystems, off-target plants and off-farm.

This includes applying nutrients, agricultural chemicals or carrying out mechanical operations that may promote soil erosion, especially on sloping ground near waterways.

Important information about solubility, mobility and the persistence of herbicides after application and risk periods can be found on individual product labels.

The product labels contain important information on usage and safety requirements, and growers should read these carefully.

Reef 2050 Long-term Sustainability Plan

The Reef Plan 2050 Long-term Sustainability Plan is a collaboration between the Australian and Queensland Governments.

It aims to maintain and enhance the Great Barrier Reef's health and resilience. The Plan includes ambitious reductions in pesticide, nutrient and sediment loads within the GBR, compared to baselines established in 2009.

Of the range of herbicides used in sugarcane, the PS II (Photosystem II) herbicides have been targeted because they work by interfering with photosynthesis. Like weeds, seagrass, algae and coral depend on photosynthesis for survival. PSII herbicides are those in the Group C herbicide group; for example diuron, atrazine, hexazinone, ametryn and metribuzin.

Details of Reef 2050 Plan and associated activities can be found at www.environment.gov.au/marine/gbr/long-term-sustainability-plan and www.gbr.qld.gov.au

Details of increased constraints on the use of diuron, hexazinone, atrazine and ametryn in Queensland can be found in Appendix 2.

Application of herbicides

The key considerations are listed below.

Minimising run-off

Herbicides should be applied at a time when they are not subject to run-off from irrigation or rainfall. Generally, residual herbicides require a minimum of two days without rainfall or irrigation after application to bind to the soil particles. Knockdown herbicides should not be applied when rain is imminent.

Timing

Ensure products are not applied close to or during high risk periods, i.e. high rainfall events. Products of major concern are atrazine, ametryn, hexazinone and diuron.

Research has shown that timing applications so that run-off from the sprayed area does not occur within 20 to 25 days of application significantly reduces the risk of herbicides losses in run-off water (Figure 3).

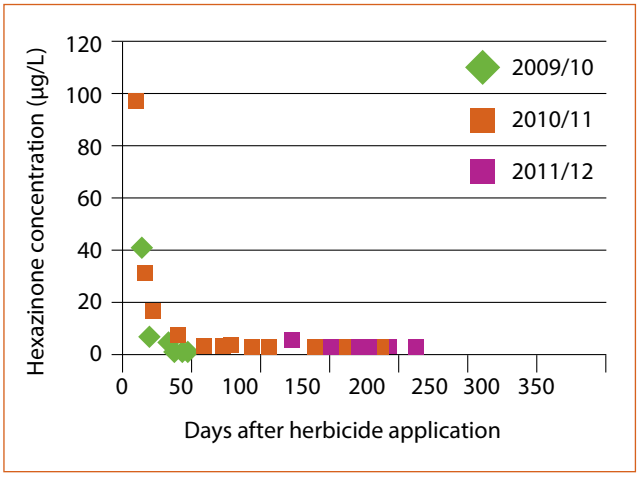


Figure 3: Effect of seasonal run-off on herbicide losses.

Figure 3 shows the concentration of a herbicide in rainfall run-off, in a series of trials in Mackay. Run-off events within the first 20 to 25 days after spraying resulted in the highest losses.

Herbicide losses in run-off also approximately halved with every 50 mm of non-runoff causing rainfall or irrigation, before the first run-off event.

Source: Rohde. K, McDuffie. S, Agnew. J, (2013) Paddock to Sub-catchment Scale Water Quality Monitoring of Sugarcane Management Practices. Final Report 2009/10 to 2011/12 Wet Seasons, Mackay Whitsunday Region. Department of Natural Resources and Mines, Queensland Government for Reef Catchments (Mackay Whitsunday Isaac) Limited Australia.

Incorporating herbicides with irrigation or rainfall without causing runoff and timing applications so that runoff does not occur for the first 20 days after application is the most effective way of minimising herbicide losses in runoff.

Use of equipment such as Irvin Legs (Image 3) and high clearance tractors (Image 4) increases the flexibility of application timing.

Image 3: Irvin Legs and other droppers allow the nozzles to operate below the level of the cane leaves.

Image 4: A high clearance tractor can be useful when applying herbicide to crops past the out-of-hand stage.

Band spraying versus blanket application

Applying residual products as a band on the row substantially reduces the amount of residual herbicides used, by applying the full or correct rate to the cane row; thereby reducing the overall amount of product applied to the field (Image 5).

Image 5: Band spraying reduces the amount of residual herbicides used.

Band spaying of residuals over the drill is particularly effective in minimising losses in tailwater in furrow irrigated systems.

Weeds in the inter-row must also be controlled, usually with a knockdown herbicide. When using a non-selective systemic herbicide (such as glyphosate) in the inter-row, a spray shield or hood or a specialised non-shielded dual sprayer must be used. (Images 6 and 7). APVMA permit PER14648 allows glyphosate products registered for application to inter-rows to be applied through non-shielded dual sprayers such as the Queensland Department of Agriculture and Fisheries (QDAF) dual herbicide sprayer.

Image 6: Shielded spraying for inter-row applications.

Image 7: DAF dual spray bar (dual circuit).

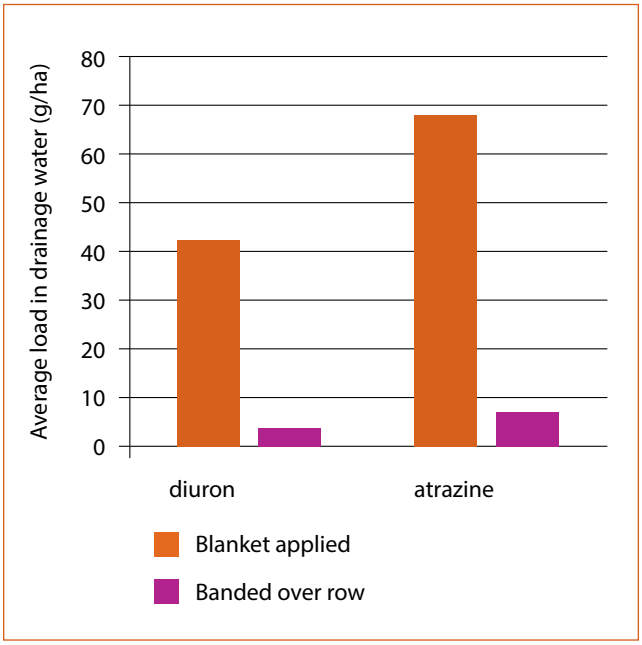


Figure 4: Total load of diuron and atrazine lost in furrow-irrigation run-off can be reduced by more than 90% by banding compared to blanket application.

Application of residual herbicides to beds only, effectively reduces losses in drainage water from furrow-irrigated sugarcane. A 60% reduction in area sprayed resulted in more than 90% reduction in herbicide losses in irrigation run-off.

Source: Oliver. P et al. (2013) Banded applications are highly effective in minimising herbicide migration from furrow-irrigated sugar cane.

Dual tank sprayers exist in a number of configurations including with and with-out spray shields or hoods (Image 6). Usually a banded residual spray at the base of the row is combined with an application of glyphosate or Basta® in the inter-row.

Care must be taken when using non-selective knockdowns in the inter-row to prevent crop injury. Spray shields and hoods must be correctly set up to avoid spray drift and also to avoid a drip line of herbicide from the lower edges of the shield or hood. The QDAF non-shielded dual sprayer must also be set-up and operated correctly to avoid crop injury. A User Manual for the Dual herbicide sprayer is available from QDAF. This manual includes drawings for those wanting to build their own sprayer.

Replacing residual herbicides in the inter-row with knockdowns requires a risk assessment based on weed pressure, machinery access to paddocks and economics of multiple applications if required.

Residual versus knock-down herbicides on trash blanketed ratoons

On green cane trash blanket (GCTB) systems often the trash layer, if heavy, will suppress grass and broadleaf weeds for some time after harvest. A heavy trash layer will be produced from about a 100 T/ha crop.

Trash blankets in Central and Southern Queensland are often sufficiently long-lasting to suppress most grasses and many broadleaf weeds. Trash blankets do suppress some vine germination (mainly convolvulus and centro), but the main outcome is delayed germination, resulting in flushes of vine germination closer to the wet season.

In these cases there is scope to use a late spray using knockdown herbicides only. Trash does not seem to delay the germination of siratro.

Trials in Mackay and in the Wet Tropics have shown that residual herbicides such as imazapic (e.g. Flame®), isoxaflutole (e.g. Balance®), diuron and hexazinone (e.g. BobCat® Combi), imazapic and hexazinone (e.g. Bobcat imaxx®) work equally well on trash blankets as on bare soil.

If residual herbicides are used in ratoons, they should be applied early after harvest rather than closer to the wet season. Trash blankets in the Wet Tropics break down much more rapidly and residual herbicides, if needed, should be applied soon after harvest. In case of a late harvest close to the rain season, band application of the residual herbicide over the row should also be considered.

Growing a good crop is one of the most effective ways to manage weeds in ratoons. In the Central and Southern Queensland regions, trash blankets from 100 T crops can suppress most weeds apart from vines.

Weed size

Small weeds (i.e. 2-3 leaf stage) are much easier to kill than large ones (Image 8) and, therefore, less herbicide is applied. The grass weeds below (left) are far more easily controlled than the 'tillered' ones below (right). Herbicides will be effective at lower rates on the small grass. Large 'woody' or flowered weeds are often more difficult to effectively control with herbicides, especially at lower rates.

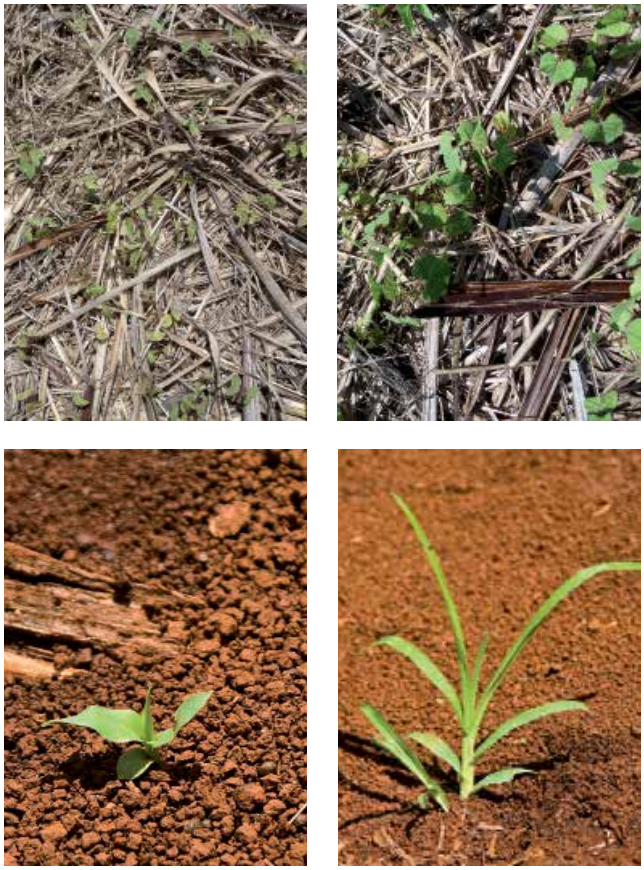


Image 8: Smaller weeds (left) are much easier to control than larger ones (right).

Application equipment

Herbicide application equipment usually consists of a tank, pump, pressure regulator, boom, delivery hoses and spray nozzles. Spray rigs may be attached to a tractor by three-point linkage or purpose built self-propelled units that are suited to spraying large areas. Equipment must be maintained on a regular basis.

Changing nozzles and calibrating regularly is essential. Nozzle replacement may seem expensive, but this cost is insignificant compared to the potential cost of ineffective weed control.

The selection of appropriate nozzles is most important in delivering chemicals to the target weed (Image 9). Inappropriate application rates and nozzle types can lead to excess product application and / or spray drift, leading to the target weed receiving excess or insufficient quantities of herbicide. Ineffective use of herbicides can be expensive.

Use of air inducted nozzles and the addition of the correct adjuvant can also reduce the production of 'driftable fines' at the nozzle orifice, thus reducing drift onto non-target areas.

It is now a label requirement for phenoxy based herbicides, such as 2,4-D, Starane® or MCPA, that applicators must use nozzles which create a coarse to very coarse droplet, in order to minimise drift onto susceptible plants.

Wind speeds must also be between 3 and 15 km/h or between 2 and 20 km/h, depending on product label.

Image 9 (below): Correct nozzle, pressure selection and adjuvant is critical to minimise drift as shown with the three left nozzles on the boom. Photo: Supplied by Nufarm Australia.

Adjuvants

The correct 'adjuvant' is as important as product choice and nozzle selection in delivering a lethal dose to the target weed. Adjuvants (surfactants, oils, acidifiers) have a variety of functions such as spreading, wetting and modifying droplet formation and behaviour and, therefore, drift management. See adjuvant chart in Appendix 5.

Record keeping

Record keeping

As a minimum, spray application records should include:

- Crop and block identification
- Product applied
- Rate of application of product
- Water volume applied
- What weeds are targeted
- What application equipment was used
- Who did the spraying
- Weather conditions at the time
- Date and time of application

In Queensland, under the Chemical Usage (Agricultural and Veterinary) Control Act 1988, the above records plus additional details must be recorded for products containing diuron, hexazinone, atrazine and ametryn; in the Great Barrier Reef catchments of Wet Tropics, Burdekin Dry Tropics and Mackay / Whitsunday. These additional records are:

- Name of the person supervising the spraying (if relevant)
- The prescribed qualifications held by the applicator or supervisor (see Appendix 2 regarding qualifications)
- Total quantity of product used
- Method of application (e.g. directed spray, band spray, over-the-top)
- These records must be kept for 6 years

Some product labels require more extensive records to be kept, regardless of which catchment or State they are used in. For example diuron (e.g. Diurex WG) and diuron plus hexazinone (e.g. Bobcat® Combi WG) product labels state:

> Users of this product MUST make an accurate written record of the details of each spray application within 24 hours following application and KEEP this record for a minimum of 2 years. The spray application details that must be recorded are: 1. Date with start and finish times of application; 2. Location address and paddock/s sprayed; 3. Full name of this product; 4. Amount of products used per hectare and number of hectares applied to; 5. Crop/situation and weed/pest; 6. Wind speed and direction during application; 7. Air temperature and relative humidity during application; 8. Nozzle brand, type, spray angle, nozzle capacity and spray system pressure measured during application; 9. Name and address of person applying this product. (Additional record details may be required by the State or Territory where this product is used.)

Note that the below label requirement to keep records for 2 years is superseded by the Queensland Chemical Usage Act's requirement of 6 years, if used in Wet Tropics, Burdekin Dry Tropics or Mackay/Whitsunday.

Detailed recording requirements will appear on more product labels as registrations are renewed.

Record keeping may be manual, like the CANEGROWERS Chemical Usage Form, electronically like the Smartcane BMP phone app, or spatially on GIS systems like Agdat and FarmWorks™.

Selection guide

Selection guide

This is a guide to herbicide selection at different crop stages. Note: the following recommendations are not exhaustive. Refer to local Productivity Service's or consultants recommendations for site specific recommendations.

Plant cane and ratoon on bare soil

Other crop situations

Problem weeds

Plant cane and ratoon on bare soil

Stage 1: Early emergence

Important factors in herbicide selection

Soil type	Soil condition
Sandy soils	• Potential damage is greater from leaching into the crop root zone.
Cracking soils	• Cracking may expose untreated soil which will reduce the length of control.
Hard setting soils	• May require cultivation to ensure sugarcane emergence. Cultivation reduces the length of residual control.
Hot, dry surface	• Efficacy of atrazine, ametryn, diuron, pendimethalin, metolachlor and trifluralin will be reduced if applied to hot dry soil.
Mound planted and dual row cane	
• Residual herbicide application provides weed control between, on mounds and dual rows where cultivation is difficult. • Mounds reduce the risk of root damage from leaching.	
Incorporation	
• Early incorporation of residual herbicides by rainfall, overhead irrigation or cultivation to a depth of 5-7 cm improves the length of residual control and reduces the risk of losses in run-off. • Incorporation by irrigation or rainfall should not cause run-off.	
Leaf stage	
• Herbicide absorption into sugarcane at this stage is minimal provided leaves are still unfurled in the spike. If some leaves are unfurled, the addition of paraquat to some residual herbicides is necessary to avoid substantial crop damage (refer to the product label).	

Residual control*				
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Soil type	Incorporation time
ametryn + atrazine (Gesapax Combi 800 WG)	3.75 - 5 kg	$35 - $48	All soils	<10 days
ametryn (800 g/kg) + atrazine (900 g/kg)	2.5 kg + 3.3 kg	$68 + $33		
pendimethalin (Stomp Xtra) + atrazine (900 g/kg)	2.2 - 3.3 L + 1.5 kg	$41 - $61 + $15		
diuron (900 g/kg)	1.9 kg	$26	Avoid light sandy soils	
imazapic (Flame)	300 - 400 mL	$8 - $10		>10 days
isoxaflutole (Balance)	100 - 200 g	$17 - $35	Soil test required	>10 days
imazapic + hexazinone (Bobcat i-MAXX) (Only apply in ratoons at this crop stage)	2.9 - 3.8 L	$65 - $85	Use low rate on sandy soil	<3-4 days
metribuzin (Tomahawk)	0.64 - 2 kg	$23 - $72	Avoid light sandy soils	<7 days
S-metolachlor (Dual Gold) + atrazine (900 g/kg)	1.1 - 1.45 L + 1.5 - 2 kg	$18 - $24 + $15 - $21	Southern region Bundaberg south	<10 days
	1.45 - 1.8 L + 2 - 2.5 kg	$24 - $30 + $21 - $26	North Qld only (Mackay north)	
metolachlor (Clincher Plus) + atrazine (900 g/kg)	1.6 – 2.17 L + 1.5 – 2 kg	$21 - $29 + $15 - $21	Southern region Bundaberg south	<10 days
	2.1 – 2.7 L + 2 – 2.5 kg	$28 - $36 + 21 - $26	North Qld only (Mackay north)	
trifluralin (Triflur Z, Treflan)	2.3 - 3 L	$24 - $31	All soils	< 6 hours

*Recommendations provide approximately 6-10 weeks control of grass and broadleaf weeds.

Broad-spectrum knockdown control			
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
paraquat	1.2 - 1.6 L	$5 - $7	Use lower paraquat rate for control of grass with small root system. Add diuron for control of grass with more advanced root system.
paraquat + diuron	1.2 - 1.6 L + 0.275 - 0.5 kg	$5 - $7 + $4 - $7	
diquat + paraquat (Spray.Seed)	1.6 - 2 L	$19 - $24	Provides better broadleaf weed control than paraquat alone.
diquat + paraquat (Spray.Seed) + diuron	1.6 - 2 L + 0.5 - 1 kg	$19 - $24 + $4 - $8	Addition of diuron improves broadleaf and grass weed control.
metribuzin (Tomahawk)	0.64 - 1 kg	$23 - $36	Three-ways of translocation (taken up by roots, shoots and leaves). Rapidly rain fast.

Plant cane and ratoon on bare soil

Stage 2:

Sugarcane 3-4 leaf stage

Important factors in herbicide selection

Grass control
• This is the last stage for broadcast paraquat application. • Paraquat will scorch sugarcane but insignificant yield loss will occur provided sugarcane is actively growing. • There are limited grass control options from this stage until a directed spray is possible.
Crop damage
• Please refer to individual product label for more specific information.
Residual grass control
• Stomp Xtra, Dual Gold, Balance, Tomahawk, Flame or TriflurX will provide residual grass control to where a directed spray is possible. The rate applied should not exceed that which is required to give residual control until cultivation or fertilising is expected.

Grass control			
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
paraquat	1.2 - 1.6 L	$5 - $7	Use lower rate for grass with small root system. Do not add diuron at this crop stage.
paraquat + diquat (Spray.Seed)	1.2 - 2 L	$15 - $24	
pendimethalin (Stomp Xtra)	2.2 - 3.3 L	$41 - $61	Use higher rate when longer weed control is required.
trifluralin (TriflurX)	2.3 - 3 L	$24 - $31	Requires incorporation within 6 hours. Do not apply trifluralin until after cane has emerged. Trash or cover crop stubble can bind trifluralin, reducing its effectiveness.
imazapic (Flame) + paraquat (250 g/L)	300 - 400 mL + 1.2 L	$8 - $10 + $5	Add paraquat to prevent cane leaf uptake. Do not apply to plant cane at this crop stage; only apply to ratoons.
imazapic + hexazinone (Bobcat i-MAXX) + paraquat (250 g/L)	2.9 - 3.8 L + 1.6 L	$65 - $86 + $7	
isoxaflutole (Balance) + paraquat (250 g/L)	200 mL + 1.2 L	$35 + $5	
hexazinone + diuron (Barrage) + paraquat (250 g/L)	0.6 - 1.2 kg + 1.2 - 1.6 L	$11 - $22 + $5 - $7	Apply as a directed band spray only. Observe region specific spray windows and other labels requirements.

Broadleaf control			
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
MCPA (Agritone 750)	0.93 L	$11	Apply as a directed inter-row spray.
2,4-D amine (625 g/L)	0.56 L - 3.5 L	$3 - $20	Avoid use near hormone sensitive crops. Must be applied using a coarse spray quality or larger. Refer to product labels.
2,4-D amine (700 g/L) (Amicide Advance 700)	0.5 L - 3.1 L	$4 - $24	
terbutryn + MCPA (Agtryne MA)	2 - 4 L	$38 - $76	Can be applied over the top of cane. Non volatile and, therefore, safer near horticultural crops. Must be applied using a coarse to very coarse droplet. Refer to product labels.
fluroxypyr (Starane Advanced) or (Comet 400) + 2,4-D amine 625	Ground application 780 mL or 650 mL + 800 mL	$18 $22 + $5	Fluroxypyr is a low-volatile ester and safer near horticultural crops. Spray quality must be coarse to very coarse. Refer to product labels.
dicamba (Cadence WG) + atrazine (900 g/kg)	370 - 740 g + 560 g - 1.1 kg	$11 - $22 + $6 - $11	Add atrazine for residual control.

Plant cane and ratoon on bare soil

Stage 3: Stooling

Important factors in herbicide selection

Grass control
• There are limited grass control options until a directed spray is possible. • Prevent grass establishment in the row as large grasses cause significant yield loss.
Crop damage
• Please refer to individual product label for more specific information.
Residual grass control
• Spray contact with the soil surface may be difficult due to the canopy height.

Grass control			
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
asulam 400 (Asulox, Rattler, Asulam)	8.5 L	$178	Safe to apply over sugarcane. A band spray may be a suitable option for effective grass control in the row. Ensure use of high water volume (200 - 400 L/ha).
MSMA (Daconate) + diuron followed at 3 weeks by: MSMA (Daconate)	3 L + 1.1 kg 3 L	$54 + $15 $54	May only be applied in circumstances where grass population is very dense. Crop damage will occur where Daconate contacts the sugarcane leaf.

Broadleaf control			
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
MCPA (Agritone 750)	0.93 L	$11	Apply as a directed inter-row spray.
2,4-D amine 625	0.56 L - 3.5 L	$3 - $20	Avoid use near hormone sensitive crops. Must be applied using a coarse to extremely coarse droplet. Refer to product labels.
2,4-D amine 700 (Amicide Advance 700)	1.6 L - 3.1 L	$12 - $24	
terbutryn + MCPA (Agtryne MA)	2 - 4 L	$38 - $76	Can be applied over the top of cane. Non volatile and, therefore, safer near horticultural crops. Must be applied using a coarse to very coarse droplet. Refer to product labels.
fluroxypyr (Starane Advanced) or (Comet 400) + 2,4-D amine 625	Ground application 780 mL or 650 mL + 800 mL	$18 $22 + $5	Fluroxypyr is a low-volatile ester and safer near horticultural crops. Must be applied using a coarse to very coarse droplet. Refer to product labels.
dicamba (Cadence WG) + atrazine (900 g/kg)	370 - 740 g + 560 g - 1.1 kg	$11 - $22 + $6 - $11	Add atrazine for residual control.

Residual control to be applied as a directed spray				
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Soil type and regional recommendations	Incorporation time
trifluralin 480 (TriflurX)	3 L	$31	All soils	<6 hours
pendimethalin (Stomp Xtra) + atrazine or + metribuzin (Tomahawk)	2.2 L + 1.5 kg or + 1.5 - 2 kg	$28 + $15 or + $54 - $72		<7 days
S-metolachlor (Dual Gold) + atrazine or + metribuzin (Tomahawk)	1.1 - 1.4 + 2 kg or + 1.5 - 2 kg	1.1 - 1.4 + 2 kg or + 1.5 - 2 kg	Southern region Bundaberg south	<10 days
S-metolachlor (Dual Gold) + atrazine or + metribuzin (Tomahawk)	1.45 - 1.8 + 2 kg or + 1.5 - 2 kg	$24 - $30 + $21 or $54 - $72	Northern Qld only Mackay north	
Metolachlor (Clincher Plus) + atrazine or + metribuzin (Tomahawk)	1.65 - 2.1 + 2 kg or + 1.5 - 2 kg	$22 - $28 + $21 or $54 - $72	Southern region Bundaberg south	
Metolachlor (Clincher Plus) + atrazine or + metribuzin (Tomahawk)	1.65 - 2.7 + 2 kg or +1.5 - 2 kg	$22 - $36 + $21 or + $54 - $72	Northern Qld only Mackay north	
imazapic (Flame) + paraquat (250 g/L)	300 - 400 mL + 1.2 L	$8 - $10 + $5	Avoid light sandy soil	<10 days
isoxaflutole (Balance) + paraquat (250 g/L)	100 - 200 g + 1.2 L	$35 + $5	Soil test required	<10 days
isoxaflutole (Balance) + metribuzin (Tomahawk)	Refer to Balance label			<7 days
imazapic + hexazinone (Bobcat i-MAXX) + paraquat (250 g/L)	2.9 - 3.8 L + 1.6 L	$65 - $86 + $7	Use lower rate on lighter soils	<3-4 days

Plant cane and ratoon on bare soil

Stage 4: Established sugarcane

Important factors in herbicide selection

Soil type	Soil condition
Sandy soils	• Potential damage is greater from leaching into the crop root zone.
Hot, dry surface	• Efficacy of atrazine, ametryn, pendimethalin, metribuzin and diuron will be reduced if applied to hot, dry soil.
Sugarcane leaf contact	
• Crop damage may occur from directed spray contact with sugarcane leaves. • Correct equipment set-up and application greatly reduces the potential for crop damage.	
Residual control	
• Apply residual herbicides to provide weed control after the out-of-hand stage, and to reduce weed pressure in ratoons.	

Broad-spectrum knockdown and residual control				
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Soil type	Incorporation time
hexazinone + diuron (Barrage)	3 - 3.8 kg	$56 - $70	Do not use on light sandy soil Observe district specific spray constraints	<10 days
diuron + paraquat	2 kg + 1.2 L	$28 + $5		
ametryn + atrazine (Gesapax Combi)	3.75 - 5 kg L	$36 - $48	All soils	
MSMA (Daconate) + diuron	3 L + 2 kg	$54 + $28	Do not use on light sandy soil Observe district specific spray constraints for diuron	
imazapic + hexazinone (Bobcat i-MAXX) + paraquat	2.9 - 3.8 L + 1.6 L	$65 - $86 + $7	Use low rate on sandy soils	<3-4 days
paraquat + diquat (Spray.Seed)	1.2 - 1.6 L	$14 - $19	Directed application	
glufosinate-ammonium (Basta)	1 - 3 L	$17 - $51	Directed application	
	1 - 5 L	$17 - $86	Shielded/hooded application	

Broadleaf control					
Treatment	Rate/ha		Indicative cost/ha (GST inclusive)		Comments
MCPA (Agritone 750)	930 mL		$11		Apply as a directed inter-row spray.
2,4-D amine 625	1.8 L - 3.5 L		$10 - $20		Avoid use near hormone sensitive crops. Must be applied using a coarse to extremely coarse droplet. Refer to product labels.
2,4-D amine 700 (Amicide Advance 700)	1.6 - 3.1 L		$14 - $24		
terbutryn + MCPA (Agtryne MA)	2 - 4 L		$38 - $76		Can be applied over the top of cane. Non-volatile and therefore safer near horticultural crops.
fluroxypyr (Starane Advanced) or (Comet 400) + 2,4-D amine 625	Ground application 780 mL or 650 mL + 800 mL	Aerial application 900 mL or 750 mL + 800 mL	Ground application $22 $18 + $5	Aerial application $26 $21 + $5	Fluroxypyr is a low-volatile ester and safer near horticultural crops. Must be applied using a coarse to very coarse droplet. Refer to product labels.

Stage 5:

Ratoon cane on GCTB

Broadleaf weeds, vines and perennial grasses may dominate the trash blanket.

Important factors in herbicide selection

GCTB
• Heavy trash layers may reduce herbicide contact with the soil. • Residual herbicides such as imazapic (e.g. Flame), isoxaflutole (e.g. Balance), diuron plus hexazinone (e.g. BobCat Combi), imazapic plus hexazinone (e.g. Bobcat i-MAXX) work equally well on trash blankets as on bare soil. • Rainfall or irrigation following herbicide application may improve herbicide movement to the soil and increase the effectiveness of residual herbicides.
Broadleaf weed control
• Establishing weed free plant cane may reduce the need for grass control on a trash blanket. However, vines may become more dominant on trash. • Residual broadleaf control with atrazine may be less effective due to chemical tie-up.

Broad-spectrum knockdown and residual control				
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Soil type	Comments
hexazinone + diuron (Barrage)	3 - 3.8 kg	$56 - $70	Do not use on light sandy soil (Observe district specific spray constraints – Appendix 1)	Particularly efficient over light trash blankets. Heavy trash layers may prevent the herbicide reaching the soil. Apply as a pre or early post emergent. Broadcast or band spray from harvest to sugarcane emergence. Use a directed spray where sugarcane has emerged. Apply to actively growing weeds.
diuron + paraquat	2 kg + 1.2 L	$28 + $5		
imazapic (Flame) + paraquat	300 - 400 mL + 1.2 L	$8 - $10 + $5	Do not use on light sandy soil	
isoxaflutole (Balance) + paraquat	100 - 200 g + 1.2 L	$18 - $35 + $5	See label for specific soil texture constraints	
imazapic + hexazinone (Bobcat i-MAXX) + paraquat	2.9 - 3.8 L + 1.6 L	$65 - $86 + $7	Use low rate on sandy soils	
ametryn + atrazine (Gesapax Combi)	6 - 8 L	$57 - $76	May be applied on sandy soil	

Broad-spectrum knockdown control			
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
glufosinate-ammonium (Basta)	1 - 3 L (directed application) 1 - 5 L (shielded/hooded application)	$17 - $51 $17 - $86	Do not apply until cane is 100 cm overall height or 20 cm to growing point. Avoid contact with cane growing points. Minimise contact with green foliage.
glyphosate (Roundup Ultra Max or Weedmaster argo)	1.1 - 4.7 L 1.2 - 5 L	$9 - $40 $10 - $41	Apply using spray shield/hood. Do not apply more than 3 applications. Avoid contact with all parts of the cane plant.
paraquat (Gramoxone 250)	1.2 - 1.6 L (directed application)	$5 - $7	Add 275 - 500 g Diurex for improved control of weeds to 5 cm high Add non-ionic wetting agent.

Broadleaf knockdown control					
Treatment	Rate/ha		Indicative cost/ha (GST inclusive)		Comments
MCPA (Agritone 750)	930 mL		$11		Apply as a directed inter-row spray.
2,4-D amine 625	1.8 L - 3.5 L		$10 - $20		Avoid use near hormone sensitive crops. Must be applied using a coarse to extremely coarse droplet. Refer to product labels.
2,4-D amine 700 (Amicide Advance 700)	0.5 - 3.1 L		$4 - $24		
terbutryn + MCPA (Agtryne MA)	2 - 4 L		$38 - $76		Do not apply by air. Can be applied over the top of cane.
fluroxypyr (Starane Advanced) or (Comet 400) + 2,4-D amine 625	Ground application 780 mL or 650 mL + 800 mL	Aerial application 900 mL or 750 mL + 800 mL	Ground application $22 $18 + $5	Aerial application $26 $21 + $5	Fluroxypyr is a low-volatile ester and safer near horticultural crops.
dicamba (Cadence WG) + atrazine (900 g/kg)	370 - 740 g + 0.56 - 1.1 kg		$11 - $22 + $6 - $11		Add atrazine for residual control.

Stage 6: Fallow management

Break the weed cycle! Prevent weeds from setting seed.

Ratoon spray-out			
Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
glyphosate 360 – single salt (Roundup)	4 - 9 L	$34 - $77	Apply to actively growing ratoons 60 to 120 cm tall. Use lower rate for suppression or where cultivation is to follow.
glyphosate 360 – dual salt (Weedmaster Duo)	6 - 9 L	$64 - $96	
glyphosate 450 (Roundup CT)	4.8 - 7.2 L	$31 - $47	
glyphosate 470 – dual salt (Weedmaster DST)	4.6 - 6.9 L	$36 - $55	
glyphosate 540 – dual/single salts (Weedmaster Argo/Glyphosate 540 K)	4 - 6 L	$33 - $50	
glyphosate 570 (Roundup Ultra Max)	3.8 - 5.7 L	$32 - $48	

Legume herbicide options: Pre-plant residual herbicides					
Crop	Weed	Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
Soybean Cowpea Lablab Mung bean	Grasses	pendimethalin (Stomp Xtra)	1.8 - 2.2 L	$33 - $41	Mechanically incorporate to a depth of 2 to 5 cm within 24 hours of application. Use higher rate on heavier soils.
		trifluralin (Trifluralin 480)	1.2 - 2.3 L	$12 - $24	Incorporate mechanically within 6 hours of application.
Soybean	Grasses	S-metolachlor (Dual Gold)	1 - 2 L	$17 - $33	Apply before or immediately after planting and before weeds germinate. Incorporate within 10 days with rain or irrigation, or alternatively mechanically incorporate to 3-4 cm.
	Broadleaf weeds and grasses	imazethapyr (Spinnaker*)	100 - 140 g	$22 - $31	Rainfall or irrigation is required to incorporate to a depth of 5 cm prior to weed emergence. Apply post emergence in crusting soils.
		imazapic (Flame*)	300 - 400 mL	$8 - $10	Apply pre or post emergence to the crop.
Peanut	Grasses	S-metolachlor (Dual Gold)	1 - 2 L	$17 - $33	Apply before or immediately after planting and before weeds germinate. Incorporate within 10 days with rain or irrigation, or alternatively mechanically incorporate to 3-4 cm.
	Broadleaf weeds and grasses	imazethapyr (Spinnaker*)	100 - 140 g	$22 - $31	Rainfall or irrigation is required to incorporate to a depth of 5 cm prior to weed emergence. Apply post emergence in crusting soils.
		imazapic (Flame*)	300 - 400 mL	$8 - $10	Apply pre or post emergence to the crop.

Legume herbicide options: Post-plant knockdown herbicides					
Crop	Weed	Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
Soybean Mung bean Peanut	Broadleaf weeds	imazethapyr (Spinnaker*)	100 - 140 g	$22 - $31	Apply to actively growing weeds in the 2-4 leaf stage. Withholding period harvest 14 days, grazing 28 days. Add non-ionic wetting agent 200 mL/100 L.
		acifluorfen (Blazer)	1 - 2 L	$77 - $154	Apply to actively growing weeds up to the 4 leaf stage.
		bentazone (Basagran)	1.5 - 2 L	$101 - $135	Do not harvest within 21 days for peanuts. Do not harvest for 8 weeks for soybean.
	Grasses	Butroxydim (Factor)	120 - 189 g	$19 - $29	Use lower rate for seedlings at the pre-tiller stage. Use higher rate for grasses at early tillering (2-3 tillers). Use the lower rate only and only for pre-tillering stages for Eragrostis species (Elastic grass, Mexican love grass, Stink grass). Always apply with Supercharge at 1 L/100 L spray solution for ground application. Do not graze or cut for stockfood for 14 days after application.
		fluazifop-P (Fusilade forte)	1.24 - 1.65 L (Peanut) 0.82 - 1.65 L (Soybean)	$79 - $106 $52 - $106	Apply the lower rate to actively growing pre-tillering grasses at the 3-5 leaf stage. Apply the higher rate to perennial grasses above the 6 leaf stage. Apply in a minimum of 100 L/ha. Withholding period before harvest, grazing 17 weeks.
		haloxyfop (Verdict 520)	0.10 - 0.15 L	$6 - $9	Nil withholding period before harvest, 28 days for grazing. Always add an adjuvant – Add Uptake Spraying Oil at 0.5 L/100L of spray solution. Alternatively add non-ionic wetting agent at 200 mL/100 L and use the higher rate of Verdict 520. Do not add Uptake Spraying Oil if tank mixing with Blazer or Basagran.
		quizalofop (Quizalofop 200EC)	0.25 - 0.5 L	$4 - $8	Withholding periods before harvest: mung beans 12 weeks, peanuts 11 weeks, soybean 12 weeks. Do not graze or cut for stockfood for 4 weeks (mung beans), 11 weeks (peanuts), 4 weeks (soybean) after application. Always add a surfactant/wetting agent when applying to weeds that have started to tiller.
		clethodim (Select)	0.25 - 0.5 L	$8 - $16	Always apply with D-C-Trate at 2 L/100L or Hasten or Kwicken at 1 L/100L or Uptake at 500 mL/100 L spray volume. For peanuts, do not apply after the pod full stage. For mung beans, do not apply after first flower buds are visible. For soybeans, do not apply after first flower buds are visible.

Group A herbicides (e.g. Fusilade forte®, Verdict™ 520,Select®, Quizalofop) are classified as high risk of resistance. Monitoring is essential to identify survivors after spraying with Group A herbicides. Survivors must be killed before seed set. Survivors may be more likely at the lower usage rates. Spray water quality is important and bicarbonate levels should be below 170-180 ppm. Ammonium sulphate may help improve performance if water quality is suspect.

* Refer to label for detail on plant back periods - all crops.

Legume herbicide options: Pre-harvest desiccates for legumes				
Crop	Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
Soybean Mung bean	diquat (Reglone) (Diquat)	2.0 - 3.0 L	$38 - $57	Soybean Spray when 80% of pods are yellow/brown and seeds are ripe – yellow and pliable. Harvest 4 to 7 days after spraying. Mungbean Spray when 80-90% of pods are black or brown. Harvest 2 to 5 days after spraying. Desiccation may increase harvest losses.
	glyphosate (Roundup Ultra Max) (Weedmaster argo) (Weedmaster DST)	0.645 - 1.7 L 0.68 - 1.8 L 0.78 - 2.1 L	$5 - $17	Soybean Spray after pods have lost all green colour and 80-90 % of leaves have dropped. Do not harvest within 7 days of application. Mungbean Spray mature crops when pods are brown/black. Do not harvest within 7 days of application. Seed production Do not use glyphosate on crops intended for seed production.

Problem broadleaf weeds

Sicklepod and Milkweed control					
Weed	Weed stage	Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
Sicklepod	Early seedling stage	dicamba (Cadence WG) + atrazine (900 g/kg)	0.56 kg + 0.83 kg to 0.74 kg + 1.1 kg	$17 + $9 to $25 + $11	Add atrazine for residual control.
	<50 cm	2,4-D + picloram (Tordon 75-D*) + 2,4-D amine 625	0.7 L + 0.8 L	$10 + $5	Must be applied using coarse to very coarse droplets. Do not add 2,4-D to known sensitive varieties. Avoid use near sensitive crops.
	50-100 cm		1 L + 0.8 L	$15 + $5	
	>100 cm		1.5 L + 0.8 L	$22 + $5	
Milkweed	< 8 true leaves	dicamba (Cadence WG) + atrazine (900 g/kg)	0.56 kg + 0.83 kg	$17 + $9	Boom or directed spray.
	Up to flowering	fluroxypyr (Starane Advanced) (Comet 400)	Refer to labels		Safe over sugarcane.
	<50 cm	paraquat + diquat (Spray.Seed)	1.2 - 1.6 L	$14 - $19	Directed spray.

* Refer to label for detail on plant back periods - legume crops.

Hard-to-kill vine control				
Weed	Weed stage	Treatment	Rate/ha	Indicative cost/ha (GST inclusive)
Centro	All stages	fluroxypyr (Starane Advanced) (Comet 400)	Refer to label	
Calopo	< 8 leaves	dicamba (Cadence WG) (Kamba 500)	0.40 kg 0.56 L	$12 $17
	<100 cm	terbutryn + MCPA (Agtryne MA)	2 - 4 L	$38 - $76
Horned Cucumber	All stages	fluroxypyr (Starane Advanced) (Comet 400)	Refer to label	

Problem grass weeds and sedges

Nutgrass

Nutgrass (Cyperus rotundus) is common in all sugarcane production regions. It is an aggressive competitor, because of its characteristics:

- Perennial
- Develops an extensive network of underground tubers (nuts)
- Each tuber can develop into a new plant
- Some tubers (especially those below about 15 cm) remain dormant for extended periods
- Severe infestations can consume 25 to 45 kg nitrogen/ha and at least 45 kg potassium/ha
- Nutgrass can remove the equivalent of about 12 mm rain from the cultivated layer in 4 to 8 days.

Poor nutgrass management may result in significant yield losses. Delayed control of nutgrass has resulted in cane yield losses of 18 and 25 percent, in irrigated and dryland crops, respectively in trials at Mackay (see Figures 5 and 6). Trials in Queensland and NSW show completely unmanaged nutgrass may result in as much as 30 percent reduction in cane yield.

Image 10: Nutgrass at late seedling stage.

Image 11: Connected chain of nutgrass tubers.

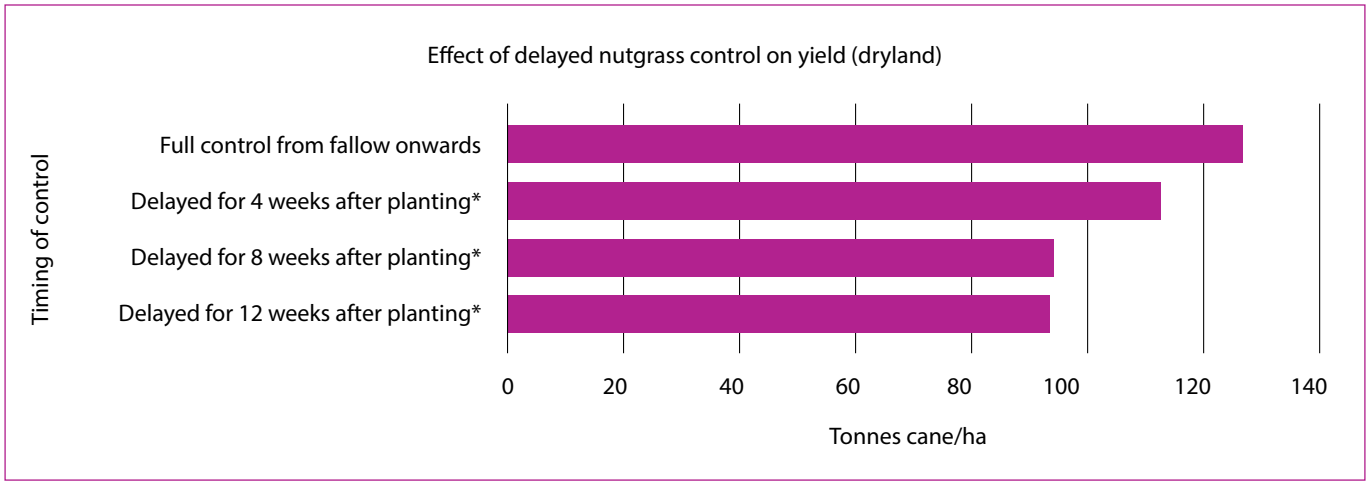


Figure 5: Productivity losses from nutgrass (dryland).

* no control in fallow.

In a dryland system, delaying nutgrass control by 4 weeks or more from planting can reduce industry income by at least $968* per hectare.

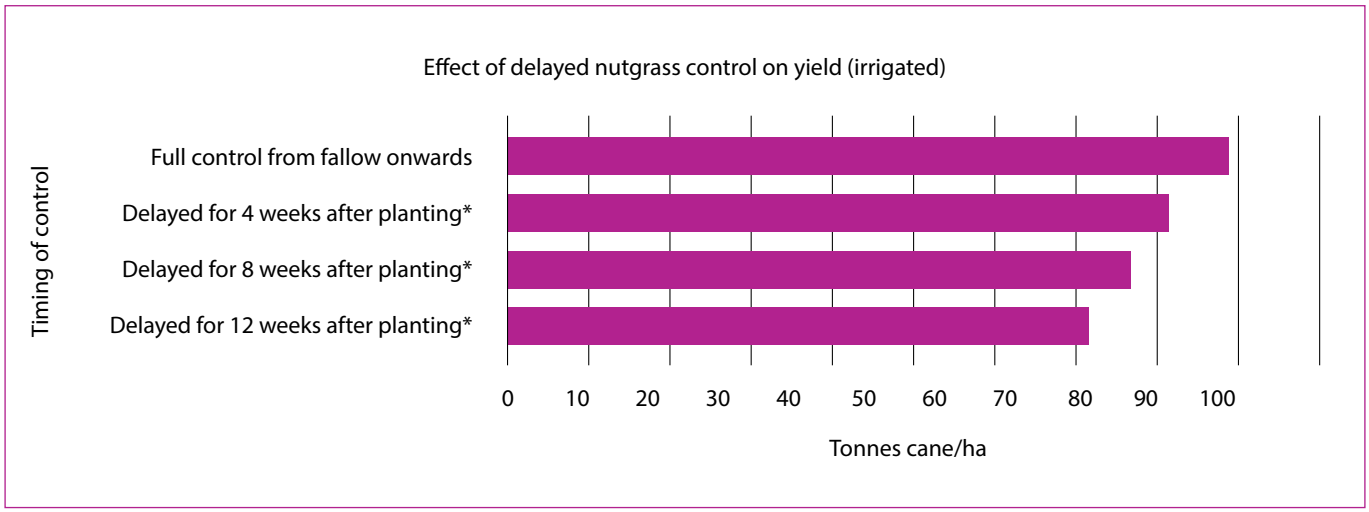


Figure 6: Productivity losses from nutgrass (irrigated). * no control in fallow.

In an irrigated system, delaying nutgrass control by 4 weeks or more from planting can reduce industry income by at least $790* per hectare.

* based on A$440 per tonne sugar

Nutgrass should be managed in each stage of the crop, especially in fallow

Bare fallow before planting

Glyphosate kills the nutgrass plant and also translocates down to the root and tuber network, killing all connected tubers and preventing the plant from producing new viable tubers. It is better not to till the ground before the glyphosate application to keep the tubers connected.

Repeat applications may be required to target later flushes from unconnected tubers. The first application should be made when the majority of plants have reached the 6-8 leaf stage but preferably when at least 20% have reached the head stage.

Downward translocation is maximised at this growth stage, giving better results.

Legume fallows

Legume fallows provide an additional opportunity to control nutgrass.

- Use glyphosate before and after the fallow crop to reduce tuber numbers.
- Use imazethapyr (e.g. Spinnaker®) in soy or imazapic (e.g. Flame®) in peanuts to suppress nutgrass.

Tillage in plant cane

Tillage in dry soil conditions will kill tubers brought to the surface. As tillage breaks up the tuber chains, repeated tillings are needed to bring tubers to the surface where they will dry out and die. Cultivation to 30 cm is needed to reach deeper tubers.

Shading

Shading provides some control after canopy closure, however large yield losses will occur if nothing is done to control nutgrass before canopy closure.

Pre-emergent herbicides for plant and ratoon cane

Imazapic (e.g. Flame®) effectively reduces tuber viability. It can be applied before or after nutgrass emergence. It has the benefit of also preventing the emergence of a range of other weeds.

Post-emergent herbicides for plant and ratoon cane

Apart from glyphosate, haloxysulfuron-methyl (e.g. Sempra®) is the most effective herbicide for reducing tuber viability.

Double knock treatments using 2,4-D followed by Sempra® also reduce tuber viability.

For effective nutgrass control, herbicides that reduce tuber viability must be used.

Products containing 2,4-D, paraquat or MSMA may kill the parent nutgrass plant but do not provide reduction in tubers and tuber viability.

Recommended herbicides include glyphosate, Sempra® and Flame®, or double knock treatments.

Nutgrass control					
Situation	Weed stage	Treatment	Rate/ha	Indicative cost/ha (GST inclusive)	Comments
Soy fallow crop	2-4 leaf stage	imazethapyr (Spinnaker)	140 g	$31	Add non-ionic surfactant at 200 mL/100 L or Hasten or Kwickin at 500 mL/100 L.
Peanut fallow crop	3-4 leaf stage	imazapic (Flame)	400 mL	$10	Add Hasten or Kwicken at 1 L/100 L. Apply before crop flowering and not more than once per year.
Bare fallow	At flowering	glyphosate 360 (Roundup)	3 L	$26	Two applications are needed to reduce tuber populations.
		glyphosate 450 g/L (Roundup CT)	2.4 L	$16	
		glyphosate 540 g/L – dual salt (Weedmaster Argo)	2 L	$17	
		glyphosate 540 g/L – potassium salt (Glyphosate 540)	2 L	$17	
		glyphosate 570 g/L (Roundup Ultra Max)	1.9 L	$16	
In-crop	4-6 leaf stage	halosulfuron- methyl (Sempra)	65 - 130 g	$49 - $99	Always add Banjo or Supercharge Elite at 1 L/100 L. May be applied over sugarcane.
		2,4-D (Amicide 625) Followed by halosulfuron-methyl (Sempra)	1.5 L 65 - 130 g	$9 $49 - $99	Double knock treatment. Allow at least 2-4 weeks between treatments.
		glyphosate 540 g/L – dual salt (Weedmaster Argo)	1.2 - 4.7 L	$10 - $41	Apply to inter-row only using spray shields/hoods or QDAF dual herbicide sprayer.
		glyphosate 540 g/L – potassium salt (Glyphosate 540)	1.2 - 5.0 L	$10 - $41	
		glyphosate 570 g/L (Roundup Ultra Max)	1.1 - 4.7 L	$9 - $40	

Perennial grass: Guinea grass, sorghum, setaria, paspalum			
Treatment	Rate	Indicative cost/ha (GST inclusive)	Comments
asulam 400 (Asulox, Rattler)	8.5 L/ha	$178	Safe to apply over sugarcane. Use high water volumes 200-400 L/ha. Apply when weeds are actively growing, before flowering and before they exceed 200-250 mm. For Guinea Grass, apply to seedlings only – up to 10 cm.
asulam 400 (Asulox, Rattler) + diuron	2 L/100 L + 0.5 kg/100 L	$42/100L + $7/100L	Spot spray.
hexazinone + diuron (Barrage)	3 - 3.8 kg/ha	$56 - $70	Directed spray.
	1 kg/100 L	$19/100L	Spot spray.
diuron* + paraquat	2 kg + 1.5 L/ha	$28 + $5	Directed spray.
	1 kg/100 L + 0.5 L/100 L	$14/100L + $3/100L	Spot spray.
MSMA (Daconate) + diuron*	3 L + 2 kg/ha	$54 + $28	Directed spray.
	1 L + 1 kg/100 L	$18/100L + $14/100L	Spot spray.

Repeated application or double knock may be necessary if the perennial weeds are well established.

* Always observe district specific spray constraints for products containing diuron.

Herbicide suitability

Herbicide suitability

Active ingredient	Product name examples	Page number
Broadleaf knockdown herbicides		
2,4-D	Amicide Advance 700, Baton Low, Amine 625, 2,4-D LV Ester	50
2,4-D + picloram	Tordon 75-D (registered for control of sicklepod only)	54
dicamba	Kamba 500, Cadence WG	64
flumioxazin	Valor (as a "spike" for non-selective knockdown mixes)	70
fluroxypyr	Comet 400, Starane Advanced	74
glufosinate-ammonium	Basta	76
glyphosate	Roundup Ultra Max, Roundup CT, Roundup, Weedmaster Argo, Weedmaster DST, Weedmaster Duo	78
MCPA	Agritone 750, MCPA 750	90
paraquat + diquat	Spray.Seed, Revolver	100
terbutryne + MCPA	Agtryne MA	108
Nutgrass knockdown herbicides		
glyphosate	Roundup Ultra Max, Roundup CT, Roundup, Weedmaster Argo, Weedmaster DST, Weedmaster Duo	78
halosulfuron-methyl	Sempra	82
Grass knockdown herbicides		
2,2-DPA	Dalapon	52
asulam	Asulam, Asulox, Rattler	60
MSMA	Daconate, Monopoly	96
Broad-spectrum knock-down herbicides		
glufosinate-ammonium	Basta	76
glyphosate	Roundup Ultra Max, Roundup CT, Roundup, Weedmaster Argo, Weedmaster DST, Weedmaster Duo	78
paraquat	Gramoxone, Nuquat, Paraquat, Spraytop	98
paraquat + diquat	Spray.Seed, Revolver	100

Active ingredient	Product name examples	Page number
Residual (pre-emergent) herbicides		
ametryn	Ametryn 800 WG, Viking 800 WG	56
atrazine	Atrazine 900WG, Atradex WG, Gesaprim 900 WG	62
ametryn + atrazine	Gesapax Combi	58
diuron	Diuron 900DF, Diurex WG	66
diuron + hexazinone	Barrage, Bobcat Combi	68
imazapic	Flame, Spark	84
imazapic + hexazinone	Bobcat imaxx	86
isoxaflutole	Balance	88
flumioxazin	Valor 500WG	70
metolachlor	Clincher Plus, Metolachlor 720, Bouncer	92
metribuzin	Tomahawk, Mentor	94
pendimethalin	Stomp Xtra	102
S-metolachlor	Dual Gold, Bouncer 960S	104
S-metolachlor + atrazine	Primextra Gold	106
trifluralin	Trifluralin, Treflan, TriflurX	110

2,4-D

Broadleaf systemic knockdown herbicide

AMICIDE® ADVANCE 700, BATON® LOW, AMINE 625, 2,4-D LV Ester 680

Amicide Advance 700 – 2,4-D 700 g/L
Present as the dimethylamine and monomethylamine salts

Baton Low – 2,4-D 800 g/kg
Present as the dimethylamine salt

Amine 625 – 2,4-D 625 g/L
Present as the dimethylamine and diethanolamine salts

2,4-D LV Ester 680 – 2,4-D 680 g/L
Present as the 2-ethylhexyl ester

Selective systemic herbicide for post-emergent control of broadleaf, including Ipomea vines, convolvulus vines, jute, fleabanes, blue top and cobblers pegs.

Herbicide suitability
Weather conditions
• Rainfast after 6 hours. • Do not use unless wind speed is more than 3 km/h and less than 15 km/h measured at boom height (this is mandatory). • For best results Delta T should be below 8.
Target weed conditions
• Apply to actively growing weeds with good soil moisture. • Seedling weeds are easily controlled when small. • Perennial weeds should be sprayed just prior to flowering. • High rates may cause rapid leaf drop.
Variety susceptibility
• Refer to QCANESelect™ for variety sensitivity information.
Withholding period
• Do not cut for stock food for 7 days.
Risk to other crops
• Avoid drift onto non-target areas/crops. • 2,4-D amines are water based products. They will not vaporise and drift. However, physical drift due to high winds, small droplets or thermal inversions is possible. • 2,4-D LV Ester is a low volatile formulation. • Do not spray near crops such as bananas, vegetable crops, fruit trees, legume pastures and crops, and susceptible trees. • Baton Low® is a low odour formulation. • Plant back days: 14 to 21 (soybean); 7 to 14 (rice) depending on rate.
Environmental risk
• Short persistence in the soil. • Low hazard to bees. • Do not contaminate streams, rivers or waterways.
Herbicide resistance
• Moderate risk (Group I).

AMICIDE® ADVANCE 700, BATON® LOW, AMINE 625, 2,4-D LV Ester 680

Signal heading and risk

poison	• Dermal risk: PROLONGED CONTACT WITH SKIN MAY BE HARMFUL. • Inhaled risk: MAY BE HARMFUL. • Oral risk: SWALLOWING IS HARMFUL. • PPE as per Safety Data Sheet. • Avoid contact with skin and eyes. • Do not inhale spray mist.

Compatibility

- Diuron, Nuquat, Revolver, Nutrazine, Tordon 50, Tordon 75D, Comet 400, Asulox, Daconate, Dicamba, Flame, Sempra.
- Amicide Advance 700 is compatible with Weedmaster ARGO and Weedmaster DST.
- Check other 2,4-D product labels for compatibilities with other glyphosate products.
- Follow label mixing instructions, highly loaded formulations require 60-70% tank mix volume of water before additional products are added.

Formulation

- Amicide Advance 700: Soluble liquid.
- Baton Low: Water dispersible granule.
- Amine 625: Soluble liquid.
- 2,4-D LV Ester: Soluble liquid

Water quality

- Hard water – add Liase (add Liase to tank first).
- If using crystalline ammonium sulphate, ensure product is fully dissolved before adding 2,4-D.
- Salinity, muddiness are generally not a problem, BUT will reduce performance of glyphosate, paraquat or paraquat + diquat if tank-mixed.
- Avoid water high in bicarbonates.
- High pH – add LI700.

Application equipment

- Boom, aerial, handgun.
- Coarse to extremely coarse spray quality is required.

Application rates

Product	Active ingredient concentration	Product/ha and adjuvant rate	Indicative cost/ha (GST inclusive)	Water rate L/ha
AMICIDE ADVANCE 700	700 g/L	0.5 - 3.1 L + Activator surfactant (60-120 mL/100 L water)	$4 - $24	50 - 200 L
BATON LOW	800 g/kg	1.4 - 2.8 kg + Activator surfactant (175-350 mL/100 L water)	$15 - $31	
AMINE 625	625 g/L	560 mL - 3.5 L + Shirwet 600 surfactant (300 mL/100 L water)	$3 - $20	
2,4-D LV Ester 680	680 g/L	1.15 - 2.4 L + Activator surfactant (60-120 mL/100 L water)	$12 - $25	

2,2-DPA

Knockdown Systemic Grass herbicide

DALAPON® 740 SP

2,2-DPA – 740 g/Kg

Systemic herbicide for control of hard to kill annual and perennial grasses, including couch, kikuyu, paspalum, Johnson grass and phragmites.

Has residual activity.

Herbicide suitability
Soil/weather conditions
• Moist soil conditions will enhance root uptake.
Target weed conditions
• Useful for infestations of Johnstone grass, kikuyu, couch grass and paspalums. • Weeds should be actively growing and not stressed. • Application as a post-emergent for weeds will provide some residual activity for up to 30 days, for susceptible species.
Crop stage
• Spray between rows only when cane is 1.2-1.5 m high.
Variety susceptibility
• Do not allow contact with cane leaves of any variety.
Withholding period
• Do not harvest for 7 days after application. • Do not graze or cut for stock feed for 2 days after application • Do not plant susceptible crops such as grass, small grains, corn or beans for at least 30 days after application. • Do not allow drift onto pineapples.
Risk to other crops
• Do not allow spray drift onto non-target areas/crops.
Environmental risk
• Low hazard to bees. • Do not contaminate streams, rivers or waterways.
Herbicide resistance
• Moderate risk (Group J).

DALAPON® 740 SP	
Signal heading and risk	
unscheduled classification	• Do not inhale. • Do not swallow. • Avoid contact with skin. • PPE as per Safety Data Sheet.
Formulation	
• Soluble powder.	
Water quality	
• Use clean water.	
Application equipment	
• Directed spray or handgun.	

Application rates

Product	Weed target	Rate	Indicative cost (GST inclusive)	Water rate	Comments
DALAPON 740 SP	Annual and perennial grasses	10 kg/ha	$218/ha	300 L/ha minimum	• Ensure thorough coverage of weeds. • Repeat spraying may be necessary. • Add non-ionic wetting agent.
	Johnstone grass and Phragmites	1 kg/100 L (handgun)	$22/100 L	Spot spraying	

2,4-D + picloram

Broadleaf systemic knockdown herbicide

TORDON™ 75-D, TROOPER® 75-D

2,4-D – 300g/L, Picloram – 75 g/L

Selective systemic herbicide registered for post-emergent control of sicklepod in sugarcane (picloram will remain active in the soil for some time depending on rate).

Herbicide suitability
Weather conditions
• Apply when wind speed is between 3 km/h and 15 km/h. • Do not apply if rain is forecast within 4 hours.
Target weed conditions
• Apply to actively growing sicklepod.
Crop stage
• Vegetative.
Variety susceptibility
• Do not apply to varieties susceptible to 2,4-D. • Refer QCANESelect™ for varietal susceptibility.
Withholding period
• Do not harvest for 8 weeks after application. • Do not graze or cut for stockfeed for 8 weeks after harvest.
Risk to other crops
• Highly damaging to susceptible crops, including legumes, cotton, fruit, ornamentals, potatoes, sunflower, tomatoes, vegetables, vines. • Do not allow spray drift to contact non-target crops/areas. • Do not apply close to areas containing desirable vegetation, where treated soil may be washed into.
Environmental risk
• Do not contaminate streams, rivers, or waterways.
Herbicide resistance
• Moderate risk (Group I).

TORDON™ 75-D, TROOPER® 75-D

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW. • Avoid contact with skin and eyes. • Do not inhale spray mist. • PPE as per Safety Data Sheet.

Compatibility

- Atrazine, 2,4-D amine, diquat, glyphosate.

Formulation

- Soluble concentrate.

Water quality

- Use clean water.
- Avoid water high in bicarbonates.

Application equipment

- Aerial, ground boom.
- Apply using nozzles that produce coarse to very coarse spray droplets.

Application rates

Product	Weed	Weed size	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
TORDON 75-D TROOPER 75-D	Sicklepod	< 50 cm tall	700 mL + 800 mL 2.4-D amine (625 g/L)	$10 + $5	Minimum 50 L (aerial) Minimum 200 L (ground boom)	• Add suitable non-ionic wetter. • Apply only once per season.
		50-100 cm tall	1.0 L + 0.8 L 2,4-D amine (625 g/L)	$15 + $5		
		> 100 cm tall	1.5 L + 0.8 L 2,4-D amine (625 g/L)	$22 + $5		

Ametryn

Early post-emergent and residual herbicide

AMETRYN 800 WG,
AMETREX® 800 WG,
VIKING® 800 WG

Ametryn – 800 g/kg

Pre-emergent and early post-emergent herbicide for control of some broadleaf weeds and some grasses, including barnyard grass, crowsfoot grass, summer grass, bell vine, blue top, Gambia pea, rattlepod, pigweed.

Herbicide suitability
Soil conditions
• Best applied to moist soil.
Incorporation
• Within 10 days of application when mixed with atrazine.
Target weed condition
• Emerged weeds and grasses should be no more than 3-4 leaf stage.
Crop stage
• Minimise contact with sugarcane leaves if concerned about crop injury. • Apply as a directed spray when mixing with atrazine.
Cultivation and irrigation
• Flood irrigation and cultivation may expose untreated soil and reduce control.
Variety susceptibility
• Some varieties are susceptible to ametryn. • Refer to QCANESelect™ for varietal susceptibility. • Known tolerant varieties may be sprayed over-the-top, otherwise avoid contact with leaves.
Risk to other crops/plant back period
• Do not replant sugarcane for 8 months after last application. • Do not plant to pineapples for 8 months after last application.
Withholding period
• Not required when used as directed.
Environmental risk
• PSII herbicide. • Dangerous to fish. • Do not contaminate streams, rivers or waterways. • Do not allow spray to drift onto non-target areas/crops.
Herbicide resistance
• Moderate risk (Group C).

AMETRYN 800 WG, AMETREX® 800 WG, VIKING® 800 WG

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: HARMFUL IF SWALLOWED. DO NOT INDUCE VOMITING. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Compatibility

- Atrazine, metalochlor.

Formulation

- Wettable granule.

Water quality

- Use clean water.

Application equipment

- Broadcast, band, directed.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
AMETRYN 800 WG AMETREX 800 WG VIKING 800 WG	2.8 kg	$77	300 - 400 L Pre-emergent rate	• Always add non-ionic surfactant at early post-emergent stage for weeds and grasses. • Do not apply more than 2.8 kg/ha PRODUCT per year (2.3 kg ai ametryn/ha/year).
AMETRYN 800 WG AMETREX 800 WG VIKING 800 WG + ATRAZINE (900 g/kg)	2.5 kg + 3.3 kg	$68 + $34		• Apply as pre or early post-emergent. • Apply as directed spray if cane has emerged. • Atrazine – do not apply more than 3.3 kg/ha PRODUCT per season (3 kg ai atrazine/ha/year). • Ametryn – do not apply more than 2.8 kg/ha PRODUCT per year (2.3 kg ai ametryn/ha/year).

Refer to Appendix 2 for additional Queensland legislative constraints for ametryn.

Ametryn + atrazine

Broad-spectrum early post-emergent and residual herbicide

GESAPAX COMBI® 800WG

Atrazine – 400 g/L, Ametryn – 400 g/L

Pre-emergent and early post-emergent herbicide for control of grasses and broadleaf weeds.

Controls crowfoot grass, summer grass, barnyard grasses, Mossman river grass and many broadleaf weeds.

Will not control green summer grass.

Herbicide suitability
Soil conditions
• Best applied to moist soil. • Do not apply to hot, dry soil: loss can be significant, especially where no plant canopy is present. • Safe on all soil types. • Residual control may be limited on very acid soils.
Incorporation
• Incorporate with 25 mm of rainfall or overhead irrigation within 10 days of application. • Mechanically incorporate to a shallow depth (2.5 cm) if no rainfall or irrigation is received.
Target weed conditions
• Apply to actively growing weeds. Do not spray weeds stressed from drought, waterlogging or low soil fertility. • Size of weeds should not exceed 3 leaf stage.
Crop stage
• Safe over sugarcane as a pre or early post emergent spray. • Apply as a directed spray where sugarcane has emerged.
Cultivation and irrigation
• Do not disturb soil. Flood irrigation and cultivation may expose soil and reduce the length of control.
Variety susceptibility
• Crop damage may occur from foliar absorption of ametryn. Minimise spray drift onto sugarcane leaves. • Symptoms appear as short term yellowing of some varieties. • Refer to QCANESelect™ for variety sensitivity information.
Risk to other crops
• Avoid drift onto non-target areas/crops.
Environmental risk
• PSII herbicide. • Potential for movement into ground-water and streams with excessive rainfall or irrigation. Do not apply if heavy rains or storms that are likely to cause run-off are forecast within 2 days of application and do irrigate to the point of runoff for 2 days after application. • Do not mix, apply or load within 20 m of a bore, well or water course. • Do not apply in channels or drains.
Herbicide resistance
• Moderate risk (Group C).

GESAPAX COMBI®

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Compatibility

- Cadence, diuron, 2,4-D amine.

Formulation

- Suspension concentrate.

Water quality

- Use good quality water, with no clay particles.

Application equipment

- Broadcast application up to early post emergent crop stage.
- Directed spray in established sugarcane.
- Aerial application: water rate at 20 - 30 L/ha.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
GESAPAX COMBI 800 WG	3.75 - 5.0 kg	$36 - $48	200 L minimum (ground application)	• Provides residual weed control for 6 - 12 weeks. Use the higher rate where heavy grass pressure exists. • Add 1.1 kg/ha diuron (900 g/kg) where green summer grass is present. • Observe district specific spray restrictions when using diuron mixes. • Do not use more than 3 kg ai atrazine/ha/year. • Do not use more than 2.3 ai ametryn/ha/year.

Refer to Appendix 2 for additional Queensland legislative constraints for ametryn.

Asulam

Knockdown systemic grass herbicide

ASULAM, ASULOX®, RATTLER®

Asulam – 400 g/L

Selective systemic herbicide for post-emergent control of annual grasses and hard to kill perennial grasses.

Controls summer grass, barnyard grasses, green summer grass, crowsfoot, para grass, *itch grass, *Johnson grass, and *Guinea grass (*seedlings up to 100 mm).

Herbicide suitability
Weather conditions
• Rainfast after 3 hours. • Best results with humidity above 80% and temperature above 17°C.
Target weed conditions
• Good soil moisture is critical at, and following application for herbicide translocation through the weed. • Do not apply to stressed weeds. Weeds must be actively growing to allow for herbicide uptake and movement to growing points. • Apply to grass prior to flowering and less than 200-250 mm in height.
Crop stage
• Safe at any crop stage.
Variety susceptibility
• Slight yellowing of sugarcane leaves may occur if the crop is stressed. • Do not use crop oils as crop damage may result. • Refer to QCANESelect™ for variety sensitivity information.
Risk to other crops
• Avoid drift onto non-target areas/crops.
Environmental risk
• Short persistence in soil. • Do not contaminate streams, rivers or waterways.
Herbicide resistance
• Moderate risk (Group R).

ASULAM, ASULOX®, RATTLER® 400	
Signal heading and risk	
unscheduled classification	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW. • PPE as per Safety Data Sheet. • Avoid contact with skin and eyes. • Do not inhale spray mist.
Compatibility	
• Atrazine.	
Formulation	
• Soluble liquid.	
Water quality	
• Recommended water pH: greater than 6.	
Application equipment	
• Broadcast, band or directed spray. • Use flat fan nozzles. • Do not use flood-jet nozzles.	

Application rates

Product	Rate	Indicative cost (GST inclusive)	Water rate L/ha	Comments
ASULOX, RATTLER 400	8.5 L/ha	$178/ha	200 - 400 L (ground application)	• Use high water rate to ensure thorough coverage on dense weed stands.
	2.0 L/100 L	$42 / 100 L	Spot spraying	• Add non-ionic wetting agent.

Atrazine

Broadleaf residual herbicide

ATRAZINE 900 WG,
ATRADEX® WG,
GESAPRIM® 900 WG

Atrazine – 900 g/kg

Selective pre-emergent and early post-emergent herbicide for control of most broadleaf weeds and some grasses.

Controls blackberry nightshade, bell vine, convolvulus, rattlepods, pigweed, sesbania, thickhead, wild rose, giant sensitive plant and stinking passionfruit vine.

Herbicide suitability
Soil conditions
• Best applied to moist soil. • Safe on all soil types. • Do not apply to hot, dry soil.
Incorporation
• Incorporate with 25 mm of rainfall or overhead irrigation within 10 days of application. • Do not irrigate for 48 hours after application to reduce risk of off-site movement. • Incorporate mechanically to a depth of 1-3 cm if rainfall is not received within 10 days.
Crop stage
• Safe for any crop stage.
Cultivation and irrigation
• Do not disturb soil. Flood irrigation and cultivation may expose untreated soil and reduce the length of control.
Variety susceptibility
• Safe on all varieties.
Risk to other crops/plant back period
• Avoid drift onto non-target areas/crops. • Do not plant susceptible crops for 6 months for rates up to 1.3 kg/ha and 18 months for rates up to 3.3 kg/ha (refer to label).
Withholding period
• Do not graze or cut for stockfeed within 28 days of application.
Environmental risk
• PSII herbicide. • Potential for movement into ground-water and streams with excessive rainfall or irrigation. Do not spray prior to heavy rainfall or irrigation. • Do not mix, apply or load within 20 m of a bore, well or water course, or 60 m of any lake or dam. • Do not apply to any drainage line.
Herbicide resistance
• Moderate risk (Group C).

ATRAZINE 900 WG, ATRADEX® WG, GESAPRIM® 900 DF

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Compatibility

- Ametryn, Asulox, Cadence, diuron, Flame, glyphosate, paraquat, Stomp, Spray Seed, Starane, Kamba, Tordon 75-D, trifluralin, 2,4-D (Amine).

Formulation

- Wettable granule/dry flowable.

Water quality

- Recommended water pH: 8 or lower.
- Avoid hard water.

Application equipment

- Broadcast, band, directed or spot spray.
- Aerial application: Use minimum water rate of 15 L/ha for pre-emergence and 22 L/ha for post-emergence weed control.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
ATRAZINE 900 WG ATRADEX WG GESAPRIM 900 WG	2.2 - 3.3 kg	$23 - $34	300 - 400 L (ground application, pre-emergent rate)	• Use higher rates on heavy soils due to binding to clay and organic matter. • Add paraquat if emerged grasses are present. • Do not apply more than 3.3 kg/ha PRODUCT per year (3 kg ai atrazine/ha/year).
				• Tank mix with 2,4-D amine for improved post-emergent broadleaf weed control.
ATRAZINE 900 WG ATRADEX WG GESAPRIM 900 WG + AMETRYN (800 g/kg)	3.3 kg + 2.5 kg	$34 + $68		• Apply as a directed if cane has emerged. Emerged weeds and grasses should not exceed 3-4 leaf stage. • Atrazine - do not apply more than 3.3 kg/ha PRODUCT per season (3 kg ai atrazine/ha/year). • Ametryn - do not apply more than 2.8 kg/ha PRODUCT per year (2.3 kg ai ametryn/ha/year).

Dicamba

Broadleaf systemic knockdown herbicide

KAMBA® 500, DICAMBA 700 WG, CADENCE® WG

Kamba 500 – dicamba 500 g/L

Dicamba 700 WG – dicamba 700 g/kg

Cadence WG – dicamba 700 g/kg

Selective systemic herbicide for post-emergent control of certain broadleaf weeds, including amaranthus, bell vine, blackberry nightshade, calopo, caltrop, convolvolus, khaki weed, milkweed, prickly cucumber, sicklepod.

Herbicide suitability
Weather/soil conditions
• Do not spray if rain is likely within 4 hours.
Target weed conditions
• Apply to actively growing weeds. • Do not spray when weeds are wet with dew or rain. • Spray when weeds are in the young rosette stage or when they have no more than 8 true leaves.
Crop stage
• Safe at any crop stage.
Variety susceptibility
• Refer to QCANESelect™ for variety sensitivity information.
Withholding period
• Do not harvest, graze or cut for stock food for 7 days after application.
Risk to other crops
• Avoid drift onto non-target areas/crops. • Broadleaf crops such as cotton, vegetables, flowers, vines and fruit trees are susceptible to damage from drift. • Observe plant back periods for legume crops.
Environmental risk
• Do not contaminate streams, rivers or waterways.
Herbicide resistance
• Moderate risk (Group I).

KAMBA® 500, DICAMBA 700 WG, CADENCE® WG

Signal heading and risk

poison	• Oral risk: HARMFUL IF SWALLOWED. • Inhaled risk: DO NOT INHALE. • Eye risk: CAUSES SERIOUS EYE DAMAGE. • Skin: CAUSES SKIN IRRITATION. • PPE as per Safety Data Sheet.

Compatibility

- 2,4-D amine, diuron, atrazine, glyphosate, MCPA.

Formulation

- Kamba 500 – soluble liquid.
- Dicamba 700 WG, Cadence WG – wettable granule.

Water quality

- Use clean water.

Application equipment

- Boom.
- Directed spray.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
KAMBA 500	280 - 560 mL	$8 - $17	100 - 250 L	• Add atrazine for residual control and for improved control of certain weeds – refer to labels.
DICAMBA 700 WG CADENCE WG	370 - 560 g			

Diuron

Broad-spectrum early post-emergent and residual herbicide

DIUREX® WG, DIURON 900 DF

Diuron – 900 g/kg

Pre-emergent and early post-emergent herbicide for control of grass and broadleaf weeds.

Controls summer grass, barnyard grasses, green summer grass, Guinea grass, crowsfoot grass, pigweed and some vines.

Herbicide suitability

Soil conditions

- Best applied to moist soil.
- Do not use on very light sandy soils as crop damage may occur.
- Heavy rain after application may cause severe crop damage.

Incorporation

- Incorporate with 25 mm of rainfall or overhead irrigation within 10 days of application. Best results if incorporated within 3-4 days.
- Do not incorporate by cultivation.

Target weed conditions

- Controls pre-tillering grasses and small broadleaf weeds.
- Tank mix with paraquat to improve knockdown of larger grasses or 2,4-D amine for knockdown of broadleaf weeds.

Crop stage

- Apply over sugarcane from planting up to spike stage (below left).
- Apply as a directed spray where sugarcane has emerged (below right).
- Broadcast or band spray over ratoon cane before emergence.

Cultivation and irrigation

- Do not disturb soil. Flood irrigation and cultivation may expose soil and reduce the length of control.

Variety susceptibility

- Refer to QCANESelect™ for variety sensitivity information.

Risk to other crops/plant back period

- Avoid drift onto non-target areas/crops.
- Do not replant treated area with any crop, apart from sugarcane and pineapples within 2 years unless otherwise stated.
- Treated area may be replanted with sugarcane or pineapple one year after spray.

Environmental risk

- PSII herbicide.
- Relatively immobile in soil due to binding with clay and organic matter.
- Observe District specific application conditions (refer label).

Herbicide resistance

- Moderate risk (Group C).

DIUREX®WG, DIURON 900 DF

Signal heading and risk

unscheduled classification	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Compatibility

- Atrazine, Daconate, paraquat, 2,4-D amine.

Formulation

- Wettable granule and dry flowable.

Water quality

- Use clean water.

Application equipment

- Broadcast or banded spray over sugarcane up to spike stage.
- Directed spray over emerged sugarcane.
- Do not apply by aircraft.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Sugarcane growing district	No-spray period (do not use between these dates)	Water rate/ha, comments
DIUREX WG, DIURON 900 DF	275 - 500 g + 1.2 - 1.6 L paraquat (250 g/L)	$4 - $7 + $5 - $7	All	• Can spray all year in all regions.	• 250 - 400 L • Can be blanket sprayed.
	1.9 kg or 500 g - 1.9 kg + 1.2 - 1.6 L paraquat (250 g/L)	$26 or $7 - $26 + $5 - $7	Wet Tropics	• Prohibited all year.	• 250 - 350 L • Apply as a directed spray only over a maximum of 60% of crop area.
			Burdekin	• 1 January - 29 February.	
			Mackay/ Whitsunday	• 1 December - 30 April.	
			Burnett/Mary	• 1 November - 29 February.	
			NSW	• 1 November - 30 April.	

Refer to Appendix 2 for additional Queensland legislative constraints for diuron.

Diuron + hexazinone

Broad-spectrum early post-emergent and residual herbicide

BOBCAT® COMBI WG, BARRAGE

Bobcat Combi, Barrage – diuron 468 g/kg, hexazinone 132 g/kg

Pre-emergent and knockdown herbicide for control of grasses and broadleaf weeds. Controls summer grass, barnyard grasses, green summer grass, urochloa, Guinea grass, crowsfoot, thickhead, square weed, bell vine, convolvulus vines, star of Bethlehem, stinking passionfruit vine and giant sensitive plant. Will not control green summer grass.

Herbicide suitability

Soil conditions

- Best applied to moist soil.
- Do not use on light sandy soils.
- Do not use in waterlogged areas.
- Widely used over a trash blanket.

Sand
- Leaching with excessive rainfall may cause crop damage.

Clay
- Higher rates may be required for effective control.

Incorporation

- Incorporate with 25 mm of rainfall or overhead irrigation within 10 days of application.
- Best results if incorporated within 3-4 days.
- Do not incorporate by cultivation.

Target weed conditions

- Knockdown of annual grasses and broadleaf weeds up to 15 cm.
- Best knockdown results are achieved under conditions of high humidity and temperatures higher than 21°C.

Crop stage

- Do not apply in young plant cane.
- Apply as a directed spray where sugarcane has emerged.
- Broadcast or band spray over ratoon cane before emergence.

Cultivation and irrigation

- Do not disturb soil. Flood irrigation and cultivation may expose soil and reduce the length of control.

Variety susceptibility

- Most varieties are highly susceptible to foliar damage.

Risk to other crops

- Avoid drift onto non-target areas/crops.
- Low volatility.
- Do not plant any other crop within 2 years of application.

Environmental risk

- PSII herbicide.
- Leaching may occur on soil with high sand and gravel content.
- Do not use near desirable trees, lawns, walkways or similar areas
- When used alone, do not apply within 200 m of downwind non-target vegetation.
- When used alone, do not apply within 100 m of downwind aquatic and wetland areas.
- When mixed with paraquat, do not apply within 50 m of downwind non-target vegetation.
- When mixed with paraquat, do not apply within 25 m of downwind aquatic and wetland areas.
- Do not apply if greater than 50 mm rainfall is expected within 3 days.
- Do not irrigate within 3 days.
- Do not apply to slopes > 3%.
- Do not apply more than once per calendar year.

Herbicide resistance

- Moderate risk (Group C).

BOBCAT® COMBI WG, BARRAGE

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW.	• PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Compatibility

- Daconate, paraquat, 2,4-D amine.

Formulation

- Water dispersible granule.

Water quality

- Generally not effected by water pH or hardness.

Application equipment

• Directed spray in plant cane. • Broadcast, banded or directed spray in ratoon cane.	• Use nozzles that produce COARSE droplets. • Do not apply by aircraft.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Use situation	No-spray periods (do not use between these dates)
BARRAGE BOBCAT COMBI WG	530 - 900 g + 1.2 - 1.6 L paraquat (250 g/L)	$10 - $17 + $5 - $7	400 - 600 L	• Plant and ratoon directed spray.	• Can use any time of year in all regions.
	3.0 - 4.0 kg	$56 - $74		• Ratoons (after harvest and BEFORE cane and weed emergence).	• Wet Tropics Do not apply at any time. • Burdekin 1 December - 29 February. • Mackay/Whitsunday: 1 November - 31 May. • Mary/Burnett: 1 November - 31 May. • NSW: 1 November - 30 April.
				• Ratoon and plant (directed band spraying over a maximum of 60% of crop area).	• Wet Tropics Do not apply at any time. • Burdekin 1 January - 29 February. • Mackay/Whitsunday: 1 November - 31 May. • Mary/Burnett: 1 November - 29 February. • NSW: 1 November - 31 March.
	Spot spray 1kg/100L			• To control Guinea grass.	• Can use any time of year in all regions.

- Add non-ionic wetting agent.
- Lower rates are effective on lighter soils.
- Do not apply greater than 4 kg/ha product (1.8 kg ai diuron/ha) in any one season.
- Keep records of use as per label instructions.

Flumioxazin

Knockdown enhancer and/or broad-spectrum residual herbicide

VALOR® 500 WG

Flumioxazin – 500 g/kg

For enhanced knockdown and control of various vine and broadleaved weeds when mixed with the non-selective herbicides paraquat/diquat, glufosinate, glyphosate and also atrazine; and/or

For long term residual weed control for a range of broadleaves and grasses, including calopo, fleabane, blackberry nightshade, wild rose, square weed, billygoat weed, balsam pear, pig weed, giant pigweed, milkweed, sicklepod, common sida, spider flower, amaranthus, Ipomeas pp., pink convolvulus, red convolvulus, morning glory, star of Bethlehem, summer grass, green summer grass, feather top Rhodes grass, barnyard grass and crowsfoot grass.

Herbicide suitability
Soil conditions
• Flumioxazin is relatively poorly water soluble, and therefore good soil moisture is critical for effective residual control of weeds – see Incorporation below.
Incorporation
For residual control of weeds: • Soil should be moist at time of application, either from rainfall or irrigation. • Follow-up rainfall or irrigation (at least 15 mm) is required within 3 weeks of application. • Do not disturb treated soil surface after application.
Target weed conditions
• Do not apply as a spike for enhanced knockdown if weeds are stressed.
Crop stage and conditions
• For plant cane, apply after fill-in. • Very thick trash may reduce residual performance due to low solubility.
Cultivation and irrigation
• Soil and or trash movement either by cultivation, irrigation or rainfall may reduce residual performance.
Variety susceptibility
• Avoid contact with cane leaves – some localised phytoxicity may occur but cane will grow out of it quickly. • Does not translocate.
Risk to other crops/withholding period
• Do not plant crops other than sugarcane for 12 months after application • Do not graze or cut crops planted following treatment for stockfeed for 6 weeks after application. • Do not harvest sugarcane for 22 weeks after application. • Do not graze or cut sugarcane for stockfeed for 22 weeks after application.

Herbicide suitability
Environmental risk
• Low solubility reduces the risk of losses through leaching and in-solution in run-off. • Very toxic to aquatic life. • Do not irrigate to the point of run-off for at least 3 days after application. • Do not apply if heavy rains or storms that are likely to cause run-off are forecast within 3 days. • Do not apply more than one application per year. • Do not apply when wind speed is less than 3 km/h or more than 20 km/h. • Do not apply during surface temperature inversions. • Do not apply if there are aquatic and wetland areas within 5 m downwind from the application site. • Do not apply if there are sensitive crops, gardens, landscaping or protected native vegetation or protected animal habitat within 120 m downwind of the application site.
Herbicide resistance
• Moderate risk (Group G).

VALOR® 500 WG	
Signal heading and risk	
poison	• Dermal risk: Moderate. Poisonous if absorbed by skin. • Inhaled risk: Moderate. Do not inhale. • Oral risk: Moderate. Poisonous if swallowed. • May cause birth defects: women of child bearing age should avoid contact with flumioxazin. • May irritate eyes, nose, throat and skin. • PPE as per Safety Data Sheet.
Compatibility	
• Glyphosate 450, Weedmaster DST, Weedmaster Argo Dual Salt, SpraySeed 250, Revolver, Gramoxone, Nuquat 250, 2,4-D Ester, Estericide Xtra 680, Estericide Xtra 800, Amicide Advance 700, Hasten, Kwickin and Banjo (0.5 - 1 L/100L) and Uptake (0.5 L/100 L).	
Formulation	
• Water dispersible granule (contained in a water soluble satchel).	
Water quality	
• Do not apply in high pH water (pH >7), or allow the mix to stand overnight.	
Application equipment	
• Do not apply by aircraft. • Apply using at least a COARSE spray quality.	

Application rates

1. In-cane, for enhanced knockdown in mixtures with non-selective herbicides

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
VALOR + PARAQUAT 250 or SPRAYSEED/ REVOLVER	90 - 120 g + 1.2 - 1.6 L or 1.2 - 2.4 L	$17 - $22 + $5 - $7 or $19 - $28	250 L minimum	• Apply after fill-in in plant cane or in ratoons. • Apply when broadleaf and vines are < 9 leaf stage. • Apply as a directed spray to base of cane plants. • For vines, the growing tip must be sprayed. • Add a non-ionic surfactant or a crop oil concentrate such as Hasten. • Keep records of use as per label instructions. • Follow sprayer cleanup instructions on the label.
VALOR + ATRAZINE	90 - 120 g + 2.2 - 3.3 kg	$17 - $22 + $23 - $34		• When calopo or sicklepod are present the addition of atrazine may improve knockdown. • Do not apply more than 3.3 kg/ha atrazine PRODUCT per year (3 kg ai atrazine/ha/year).

Valor 500 WG also enhances the knockdown of glyphosate on broadleaf weeds and vines – do not allow glyphosate to drift onto cane.

2. In-cane, for enhanced knockdown in mixtures with non-selective herbicides AND long term residual control

Use situation	Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
Bare soil situations in higher rainfall areas or with supplementary irrigation (including ratoons with no trash blanket).	VALOR	350 - 560 g	$65 - $104	200 L minimum	• For residual control, Valor should be applied to moist soil with follow-up rain or irrigation of at least 15 mm within 3 weeks, particularly on trash. • Apply after fill-in in plant cane. • If existing weeds are present at the 2-8 leaf stage, add non-selective knockdown herbicide (e.g. paraquat). • If grasses greater than 3 leaf are present, adding a low rate of diuron (275-500 g/ha) to paraquat will improve knockdown. • When calopo or sicklepod are present the addition of atrazine may improve knockdown. • Add a non-ionic surfactant or a crop oil concentrate such as Hasten, if existing weeds are present. • Keep records of use as per label instructions. • Follow sprayer cleanup instructions on the label.
Ratoons with trash blanket Or Plant and ratoon with bare soil in low rainfall areas and flood irrigation (Burdekin).		560 - 700 g	$104 - $130		

• Valor 500 WG also enhances the knockdown of glyphosate on broadleaf weeds and vines – do not allow glyphosate to drift onto cane.

Application rates				
3. For fallow, prior to sowing chick peas, mungbeans, soybean; for a pre-plant "spike" with glyphosate or with either paraquat or a diquat/paraquat				
Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
VALOR	30 g Plus the label rate of tank mix partner plus an adjuvant	$6 Plus cost of tank mix partner	As per recommendations for the tank mix partner.	• Best results are obtained when weeds are between the 2-leaf and 6-leaf stage. • Apply with Hasten or Kwicken Spray Adjuvant at 0.5 - 1 L/ 100L, or uptake Spraying Oil at 500 mL/ 100L. • Do not sow crops for at least one hour after application. • Addition of Valor to glyphosate, paraquat or diquat will not help to control large weeds or weeds hardened up from stress or with established tap roots. • Does not provide residual activity at this rate.

Fluroxypyr

Broadleaf systemic knockdown herbicide

COMET® 400, STARANE™ ADVANCED

Comet 400 – fluroxypyr 400 g/L

Starane Advanced – fluroxypyr 333 g/L

Selective systemic herbicide for post-emergent control of broadleaf weeds including milkweed, giant sensitive plant, balsam pear, stinking passionfruit vine, centro and blackberry nightshade.

Herbicide suitability
Weather conditions
• Rainfast after 1 hour. • For best results Delta T should be between 2 and 8.
Target weed conditions
• Apply to actively growing weeds with good soil moisture. • Generally, apply from 2-3 leaf until flowering. • The addition of LI700 or Activator surfactant can also improve results on larger harder to kill weeds.
Crop stage
• Safe from early tillering to maturity.
Variety susceptibility
• No known susceptible varieties.
Withholding/plant back period
• Do not cut for stock food for 7 days. • Plantback for soybean is 7-14 days, depending on rate.
Risk to other crops
• Avoid drift onto non-target areas/crops.
Environmental risk
• Short persistence in the soil. • Do not contaminate streams, rivers or waterways.
Herbicide resistance
• Moderate risk (Group I).

COMET® 400, STARANE™ ADVANCED

Signal heading and risk

caution	• Dermal risk: LOW. • Inhald risk: AVOID INHALING VAPOURS. • Oral risk: LOW. • PPE as per Safety Data Sheet. • Avoid contact with skin and eyes. • Do not inhale spray mist.

Compatibility

- Nutrazine, Tordon 75-D, glyphosate, 2,4-D amines, 2,4-D esters, Agritone 750.
- Avoid using hard water when tank mixing with atrazine.
- Do not use spray oils when tank mixing with atrazine – use Activator.

Formulation

- Emulsifiable concentrate.

Water quality

- Always use good quality water.

Application equipment

- Boom, aerial, handgun.
- Coarse to very coarse spray quality is recommended.

Application rates

Product	Active concentration	Product and rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
COMET 400 STARANE ADVANCED	400 g/L 333 g/L	Comet 400 650 mL - 1.5 L + LI700 Starane Advanced 780 mL - 1.8 L + LI700 or Activator Refer to appropriate labels	$18 - $51	100 - 400 L (ground application)	• Add Amine 625 at 800 mL/ha for bell vine, morning glory, red or pink convolvulus and star of Bethlehem. • Milkweed: best control is with the atrazine mixture.

Glufosinate - ammonium

Broad spectrum contact knockdown herbicide

BASTA®

Glufosinate – ammonium 200 g/L

Non-selective herbicide for post-emergent control of broadleaf and grass weeds.

Herbicide suitability
Weather conditions
• High relative humidity (> 50%) improves foliar uptake. • Do not spray if temperature exceeds 33°C or during periods of frost. • Do not apply within 6 hours of expected rain.
Target weed conditions
• Apply to actively growing weeds. • Do not apply to wet foliage if leaf runoff is likely to occur.
Variety susceptibility
• All varieties are susceptible. • Do not allow spray drift to contact any part of the crop, especially the growing points.
Withholding/plant back period
• Do not harvest for 16 weeks after application. • Do not graze or cut for stock food for 16 weeks after harvest.
Risk to other crops
• Avoid spray drift onto non-target areas/crops.
Environmental risk
• Very toxic to aquatic life. • Do not contaminate wetlands or watercourses.
Herbicide resistance
• Moderate risk (Group N).

BASTA®

Signal heading and risk

caution	• Dermal risk: HARMFULL IF ABSORBED THROUGH SKIN, IRRITATING TO SKIN. • Inhaled risk: HARMFULL IF INHALED. • Oral risk: HARMFULL IF SWALLOWED. • Eye: CAUSES EYE IRRITATION. • PPE as per Safety Data Sheet.

Compatibility

- Compatible with most residual herbicides and glyphosate.

Formulation

- Aqueous solution.

Water quality

- Always use clean water.

Application equipment

- Directed application.
- Shield or hood application.
- Use nozzles that produce coarse to very coarse droplets.

Application rates

Product	Active concentration	Product and rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
BASTA	200 g/L	1.0 - 3.0 L (directed application) 1.0 - 5.0 L (shielded/hooded application)	$17 - $51 $17 - $86	300 - 500 L	Directed application Plant cane • Do not apply earlier than just prior to out-of-hand stage. Ratoon cane • Do not apply until cane reaches 100 cm height to top of plants or 20 cm to growing point. Shielded or hooded application • Ensure shield or hood is set up to avoid spray contact with the cane plant. Avoid all contact with the cane plants growing points.

Glyphosate

Broad spectrum systemic knockdown herbicide

ROUNDUP ULTRA® Max, ROUNDUP® CT, ROUNDUP® WEEDMASTER® ARGO®, WEEDMASTER® DST®, WEEDMASTER® DUO

Roundup Ultra Max – glyphosate 570 g/L
Present as the potassium salt

Weedmaster ARGO – glyphosate 540 g/L
Present as the potassium and isopropylamine salts

Weedmaster DST – glyphosate 470 g/L
Present as the potassium and mono-ammonium salts

Roundup CT – glyphosate 450 g/L
Present as the isopropylamine salt

Roundup – 360 g/L
Present as the isopropylamine salt

Weedmaster Duo – glyphosate 360 g/L
Present as the isopropylamine and mono-ammonium salts

Non-selective systemic broad spectrum herbicide.

Herbicide suitability
Weather conditions
• Rainfast after 6 hours. • Roundup Ultra Max is rainfast after 60 minutes. • Weedmaster ARGO is rainfast after 20 minutes • Reduced weed control can result under conditions of slow weed growth, those being cold or overcast conditions. • For best results Delta T should be below 8.
Target weed conditions
• Apply to actively growing weeds with good soil moisture. • Avoid spraying if weeds are stressed from waterlogging, low moisture, frost, insect damage or disease. • Do not spray weeds covered with dust. • Seedling weeds are easily controlled when small. • Perennial weeds should be sprayed just prior to flowering. • For ratoon spray out, apply to actively growing plants 60 - 120 cm high. • Nutgrass should be at least 6-8 leaf stage but preferably when at least 20% have reached the head stage.
Variety susceptibility
• All varieties are susceptible. • Do not allow spray drift to contact any part of the crop.
Withholding period
• Do not disturb weeds by cultivation for 6 hours of daylight following treatment of annual weeds and seven days for perennial weeds.
Risk to other crops
• Avoid drift onto non-target areas/crops. • Do not apply by air in situations where drift onto sensitive crops is likely to occur. • Plantback period – nil.
Environmental risk
• Glyphosate adsorbs strongly to soil. • Roundup Biactive and Weedmaster Duo are registered formulations for spraying weeds in, on and over water.
Herbicide resistance
• Moderate risk (Group M).

ROUNDUP ULTRA® MAX, ROUNDUP® CT, ROUNDUP® WEEDMASTER® ARGO®, WEEDMASTER® DST®, WEEDMASTER® DUO	
Signal heading and risk	
caution	• Dermal risk: LOW. • Inhaled risk: SLIGHT. • Oral risk: LOW. • PPE as per Safety Data Sheet. • Avoid contact with skin and eyes. • Do not inhale spray mist.
Compatibility	
• Dicamba, Comet 400, Stomp Xtra, Starane Advanced, Sempra, Flame. • Weedmaster ARGO and Weedmaster DST are formulated to be compatible with Amicide Advance 700. • Tank mixes of atrazine and glyphosate may cause unacceptable control of barnyard grass and liverseed grass. The addition of Liase may enhance knockdown weed control when adding atrazine.	
Formulation	
• Soluble liquid.	
Water quality	
• Avoid hard water or add Liase (add to tank before adding glyphosate). • Read the label for the specific product used, as surfactant packages differ widely. • Avoid saline water. • Avoid muddy water. • Avoid highly alkaline water.	
Application equipment	
• Roundup Ultra Max, Weedmaster Argo are approved for inter-row spraying, using either spray shields/hoods or non-shielded dual sprayer. • Boom, handgun are preferred for other situations. • Coarse to very coarse spray quality is recommended.	

Application rates					
Product	Active concentration	Product and rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
ROUNDUP ULTRA MAX	570 g/L	1.1 - 4.7 L	$9 - $40	80 L or less	• In crop inter-row application - use a shielded/hooded sprayer or correctly set-up non-shielded sprayer (see note on p81). • Do not apply more than 3 applications or more than 11.4 L/ha per crop.
		0.425 - 1.9 L	$4 - $16		• In fallow.
		3.8 - 5.7 L	$32 - $48		• Ratoon spray-out.
WEEDMASTER ARGO	540 g/L	1.2 - 5L	$10 - $41		• In crop inter-row application - use a shielded sprayer or correctly set-up non-shielded sprayer (see note on p81). • Do not apply more than 3 applications or more than 12 L/ha per crop.
		0.34 - 2 L	$3 - $17		• In fallow.
		4 - 6 L	$33 - $50		• Ratoon spray-out.
WEEDMASTER DST	470 g/L	380 mL - 2.3 L	$3 - $18		• In fallow. • Always add suitable non-ionic wetter or LI700.
		4.6 - 6.9 L	$36 - $55		• Ratoon spray-out. • Always add suitable non-ionic wetter or LI700.
ROUNDUP CT	450 g/L	400 mL - 2.4 L	$3 - $16	25 - 100 L	• In fallow. • Add Comet 400 for improved knockdown of broadleaf weeds. • Always add suitable non-ionic wetter or LI700.
		4.8 - 7.2 L	$31 - $47		• Ratoon spray-out. • Always add suitable non-ionic wetter or LI700.

Application rates					
Product	Active concentration	Product and rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
ROUNDUP	360 g/L	2 - 9 L	$17 - $77	25 - 200 L	• For fallow. • Addition of crystalline ammonium sulphate may improve control of annual weeds under adverse environmental conditions (do not use mixture for barnyard grass control).
		4 - 9 L	$34 - $77		• Ratoon spray-out.
WEEDMASTER DUO	360 g/L	500 mL - 9 L	$10 - $41	75 - 200 L	• For fallow. • Addition of Liase may improve control of annual weeds under adverse environmental conditions (do not use mixture for barnyard grass control).
		6 - 9 L	$64 - $96		• Ratoon spray-out.

Nutgrass application rates						
Product	Active concentration	Rate/ha	Crop situation	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
ROUNDUP ULTRA MAX	570 g/L	1.9 L followed by 1.9 L	Fallow	$16 x 2	80 L	• Allow for maximum re-emergence before retreating. • Follow label recommendations for surfactants.
WEEDMASTER ARGO	540 g/L	2.0 L followed by 2.0 L		$17 x 2		
ROUNDUP CT	450 g/L	2.4 L followed by 2.4 L		$16 x 2	25 - 100 L	
WEEDMASTER DUO, ROUNDUP	360 g/L	3.0 L followed by 3.0 L		$32 x 2	75 - 200 L	
ROUNDUP ULTRA MAX	570 g/L	1.1 - 4.7 L	In-crop inter-row	$9 - $41	80 L or less	• Use a spray shield/ hood for inter-row spraying or correctly set-up non-shielded sprayer (see note below).
WEEDMASTER ARGO	540 g/L	1.2 - 5.0 L				

Note: APVMA Permit number PER14648 allows for the use of a correctly set-up non-shielded sprayer (e.g. dual sprayer designed by QDAF) for inter-row spraying of glyphosate herbicides registered for inter-row spraying in sugarcane. This permit applies to all herbicides containing 360 to 570 g/L glyphosate as their only active constituent.

Halosulfuron-methyl

Nutgrass knockdown herbicide

SEMPRA®

Halosulfuron – methyl 750 g/L

Selective systemic herbicide for post-emergent control of nutgrass.

Herbicide suitability
Weather conditions
• Rainfast after 2 hours. • Do not apply if waterlogging or drought stress is likely. • Do not apply during frost or cool weather conditions.
Target weed conditions
• Apply to actively growing nutgrass. • Best results obtained where nutgrass is rapidly growing and at the 4-6 leaf stage and new leaf growth is a minimum of 5 cm high. • Yellowing of nutgrass will occur in 7-10 days, but complete kill may take 4-6 weeks to occur.
Crop stage
• Safe at any crop stage.
Variety susceptibility
• Safe on all varieties.
Withholding period/plant back intervals
• Do not use sugarcane tops for grazing, hay or silage. • Do not plant corn/maize, sorghum or sugarcane within 2 months of application. • Do not plant pasture within 3 months of application. • Do not plant cotton within 4 months of application. • Do not plant other crops within 24 months after application.
Risk to other crops
• Avoid drift onto non-target areas/crops.
Environmental risk
• Do not apply if heavy rain is expected within 48 hours. • Do not irrigate to the point of run-off for 6 days after application.
Herbicide resistance
• High risk (Group B).

SEMPRA®

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: SLIGHTLY TOXIC. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Formulation

- Dry flowable granule.

Compatibility

- Weedmaster DUO, Weedmaster DST, Weedmaster ARGO, Kamba M and Amicide Advance 700.

Water quality

- Do not use water with high iron content.

Application equipment

- Broadcast, banded or directed spray.
- Do not apply by aircraft.

Application rates

Product	Rate	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
SEMPRA	65 - 130 g/ha + Banjo or Supercharge Elite at 1L/100L	$49 - $99	Minimum 80 L	• Use higher rate for dense nutgrass infestations or for maximum control where a single dose is intended. • Follow-up application may be necessary to control nutgrass emerging from dormant tubers. • Do not apply more than 200 g/ha per season.
	1.3 g/100 m^2		10 L/100 m^2	• Spot spray. • Add 100 mL Banjo or Supercharge Elite/10 L.

Imazapic

Broad-spectrum residual herbicide

FLAME®, SPARK®

Imazapic – 240 g/L

Pre-emergent herbicide for control of certain annual grasses and broadleaf weeds.

Controls summer grass, barnyard grasses, green summer grass, urochloa, setaria, Guinea grass, milkweed, star of Bethlehem, bell vine, pink convolvulus, black/red pigweed and blackberry nightshade.

Herbicide suitability

Soil conditions

- Best applied to dry, weed free soil prior to weed germination.
- Crop damage will occur on light sandy or peat soils.
- May be applied to hot dry soil.
- Do not use in waterlogged areas.
- Control may be limited on Krasnozem or red brown Ferrosol soils where moisture is not maintained in the top 5 cm of soil.
- Control may be limited on soils with pH < 5.0 and/or which contain high concentrations of iron and/or aluminum.

Sand
- Leaching with excessive rainfall may cause crop damage.

Clay
- Soil crusting can reduce the depth of herbicide incorporation.

Incorporation

- Dry soil profile: no immediate incorporation required as imazapic is stable on the soil surface.
- Apply and incorporate with rainfall or overhead irrigation to wet soil to a depth of 5 cm. If no rainfall occurs within 10-14 days, mechanically incorporate.
- Apply at early spike stage with paraquat 1 L/ha to control emerged weeds and improve crop safety.

Crop stage

- Do not apply over sugarcane where true leaves have emerged.
- Broadcast at early spike stage with paraquat.
- Broadcast over ratoon cane from harvest to sugarcane emergence.
- In emerged cane, apply as a directed spray, mixed with paraquat.

Cultivation and irrigation

- Do not disturb soil. Flood irrigation and cultivation may expose soil and reduce the length of control.
- Heavy rain and/or irrigation within 2 days of application may concentrate herbicide in the furrow and cause temporary yellowing and stunting of cane leaves.

Variety susceptibility

- Damage may occur from foliar absorption or root uptake.
- Symptoms appear as yellowing of the inter-vein for up to 6 weeks after application. Crop stunting may also occur.
- Refer to QCANESelect™ for variety sensitivity information.

Withholding period/risk to other crops

- Avoid drift onto non-target areas/crops.
- Do not plant horticultural crops within 36 months of application.
- Do not plant legumes for 4 months after application.
- Do not graze or cut for stockfeed for 6 weeks after application.
- Refer to product label for replant times for other crops.

Environmental risk

- Relatively immobile in soil due to binding with clay and organic matter.
- Do not spray within 50 m of wetlands or waterways.

Herbicide resistance

- High risk (Group B).

FLAME®, SPARK®

Signal heading and risk

Unscheduled classification	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Compatibility

- Atrazine, diuron, glyphosate, paraquat, Spray.Seed, Stomp Xtra, 2,4-D amine.

Formulation

- Soluble liquid.

Water quality

- Use good quality water with little organic matter or clay.
- Avoid water with high iron content.

Application equipment

- Broadcast or banded spray.
- Do not apply by aircraft.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
FLAME, SPARK	300 - 400 mL	$8 - $10	200 L minimum	• Add paraquat (250 g/L) at 1.2 - 1.6 L/ha when applying to spiked sugarcane and/or emerged weeds are present. Use a higher rate of paraquat for dense, more mature weeds. • Do not add crop oils or other adjuvants.
FLAME, SPARK + STOMP XTRA	400 mL + 2.2 L	$10 + $41		• Use mixture when crowsfoot grass present (imazapic alone will not control crowsfoot grass).

Imazapic will also suppress nutgrass, either applied before or after nutgrass emergence.

Imazapic + hexazinone

Broad-spectrum residual herbicide

BOBCAT® i-MAXX

Imazapic – 25 g/L, hexazinone – 125 g/L

Broad spectrum pre-emergent herbicide for control of a wide range of grasses and broadleaf weeds.

Controls awnless barnyard grass, barnyard grass, green summer grass, Guinea grass, liverseed grass, summer grass, blackberry nightshade, blue top, calopo vine, common sida, pigweed, green amaranth, Ipomea vines, milkweed, sowthistle.

Herbicide suitability
Soil conditions
• Soil pH < 5 limits availability to weeds. • Soil pH 5-7 allows for good availability to weeds. • Soil should be as clod-free as possible. • Application to weed free, moist soil within 3-4 days of incorporation provides best results. • Avoid high rates on soils with low CEC and low organic carbon. • If applying as a band over drills, avoid throwing untreated soil onto treated band if cultivating the inter-row. • Prolonged wet soil and/or cool conditions may increase crop damage. • Control may be reduced on Krasnozem or red brown Ferrosol soils where moisture is not maintained within the top 5 cm of soil. • Control may be reduced if heavy rain falls within 24-48 hours of application.
Incorporation
• Incorporate by rainfall or irrigation from 3-4 after application, to wet soil to a minimum depth of 5 cm before weed emergence. • Light cultivation of treated soil above the setts can improve results in dry conditions.
Targeted weed conditions
• Apply as a pre-emergent. • Mix with paraquat if weeds have germinated.
Crop stage
• Will cause crop injury – always apply with paraquat in emerged cane. • In plant cane, apply only after final hill-up.
Withholding period/risk to other crops
• Do not apply to blocks that are to be replanted soon after harvest. • Do not graze or cut for stockfeed for 6 weeks after application. • Do not plant mung beans, peanuts, soy within 24 months of application (see label for complete list).
Environmental risk
• PSII herbicide. • Do not allow spray drift onto non-target areas/crops. • Do not contaminate streams, rivers or waterways.
Herbicide resistance
• High (Group B), Moderate (Group C).

BOBCAT® i-MAXX

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW, DO NOT INDUCE VOMITING. • May cause eye and skin irritation. • PPE as per Safety Data Sheet.

Compatibility

- Paraquat, diuron, metribuzin, 2,4-D amine.

Formulation

- Soluble liquid.

Water quality

- Use ammonium sulphate water conditioner (e.g. Liase) if water is hard or Ca/Mg levels are high.

Application equipment

- Boom, banded or directed spray.
- Use nozzles that produce medium to coarse droplet size.

Application rates

Crop stage	Product	Rate L/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
Plant cane (after weed emergence).	BOBCAT i-MAXX + PARAQUAT (250 g/L)	2.9 - 3.8 L + 1.6 L	$65 - $86 + $7	400 - 600 L	• Apply after final hill-up. • Apply as directed spray to base of plants and to inter-row. • Avoid contact with sugarcane leaves. • Do not cultivate within 1 hour of application. • Use a non-ionic wetter when using paraquat. • Do not apply more than 3.8 L/ha/year.
Ratoon cane (before cane and weed emergence).	BOBCAT i-MAXX	2.9 - 3.8 L	$65 - $86		• Apply with paraquat if cane is emerged. • Do not apply more than 3.8 L/ha/year.
Ratoon cane (after cane and weed emergence).	BOBCAT i-MAXX + PARAQUAT (250 g/L)	2.9 - 3.8 L + 1.6 L	$65 - $86 + $7		• Apply as directed spray to base of plants and to inter-row. • Avoid contact with sugarcane leaves. • Do not cultivate within 1 hour of application • Use a non-ionic wetter when using paraquat • Do not apply more than 3.8 L/ha/year.

Isoxaflutole

Broad-spectrum residual herbicide

BALANCE®

isoxaflutole – 750 g/kg

Selective pre-emergent herbicide for control of certain grasses and broadleaf weeds.

Controls summer grasses, barnyard grasses, green summer grass, Guinea grass, blue top, crowsfoot grass, thick head and blackberry nightshade.

Herbicide suitability

Soil conditions

- May be applied to hot dry soils. Balance is UV stable and can remain inactive on the soil surface without breakdown from sunlight.
- Do not apply to soil with Cation Exchange Capacity (CEC) less than 4.5 meq/100 g. These soils have low binding potential for Balance which increase the risk of herbicide movement and adverse crop effect.
- If Organic Carbon (OC) is less than 1%, do not apply Balance unless CEC is greater than 9 meq/100 g of soil.
- Crop safety increases with higher CEC and OC levels.
- Do not apply to areas with poor drainage or poor root development e.g.: sodic soils, saline soils, soils with hard sub-soil pans.
- Do not apply to newly limed soils without specific advice.

Incorporation

- Balance is UV stable and therefore does not require immediate soil incorporation. However, weeds can germinate in sub-soil moisture through an inactive (dry soil crust) herbicide band if no follow-up rainfall/irrigation has occurred. Do not cultivate the soil after Balance has been applied.

Target weed conditions

- Where germinated weeds are present at spraying apply Balance in a tank mixture with label rates of paraquat OR
- Knockdown with paraquat after the initial Balance application if germinated weeds are not controlled.

Crop stage

- Plant cane - boomed over the top of plant cane up to the 4-leaf stage.
  - > Tank mix with paraquat where sugarcane leaf or weeds have emerged at the time of spraying.
  - > Apply to a consolidated soil profile to prevent soil movement resulting in weed escapes.
  - > Make sure there is sufficient soil cover over the sett (at least 60 mm) to reduce the risk of treated soil contacting the sett.
- Ratoon cane - boomed over the top of ratoon cane up to the 2-leaf stage.
  - > Tank mix with paraquat where sugarcane leaves or weeds have emerged at the time of spraying.
  - > Can be applied to burnt or trash-blanketed ratoons.
- Prior to out of hand stage in plant or ratoon cane.
  - > Apply as a directed inter-row spray to the soil surface after the last working.
  - > Do not apply to sugarcane less than 0.75 m in height.
  - > Apply to a consolidated soil profile to prevent soil movement resulting in weed escapes.

Irrigation

- Do not apply Balance in the cutaway situation if irrigating by flood.

Herbicide suitability

Variety susceptibility

- Damage may occur under some conditions from foliar absorption or root uptake.
- Symptoms appear as bleaching of growing points which generally grow out within 4-6 weeks in good growing conditions.
- To minimise the risk of adverse crop effects, do not allow spray drift onto to sugarcane foliage, and do not apply outside of the recommended soil parameters.

Risk to other crops/plant back period

- Avoid drift onto non-target areas/crops.
- Do not plant mung bean or soy bean within 7 months of application and following at least 250 mm rainfall.

Environmental risk

- Relatively immobile in soil due to low solubility.

Herbicide resistance

- Moderate risk (Group H).

BALANCE®

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: LOW.	• PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale spray mist.

Compatibility

- Balance is physically compatible with atrazine, diuron, metrabuzin and paraquat.
- When mixing, always add Balance to the tank first, followed by other compatible herbicides.

Formulation

- Wettable granule.

Water quality

- Can settle out if left standing in solution without agitation. If the spray solution is allowed to settle for one hour or more, re-agitate the spray solution for a minimum of 10 minutes before application if allowed to settle for longer periods, then agitation prior to spraying will need to be longer.
- Do not allow Balance to remain in a spray solution over-night.

Application equipment

- Broadcast or banded spray depending on crop stage.
- Do not apply by aircraft.

Application rates

Product	Soil category	Rate g/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
BALANCE	Light: clay content < 15%	100 - 125 g	$18 - $22	Minimum 250 L	• Add paraquat at appropriate label rates once cane has emerged even if weeds are not present at time of application. • Do not apply with wetting agents, crop oils or other adjuvants.
	Medium: clay content 15-33%	100 - 150 g	$18 - $26		
	Heavy: clay content > 33 %	100 - 200 g	$18 - $35		

MCPA

Broadleaf systemic knockdown herbicide

AGRITONE® 750, MCPA 750

MCPA – 750 g/L

Selective systemic herbicide for post-emergent control of broadleaf including Ipomea vines, convolvulus vines, jute, fleabanes, blue top and cobblers pegs.

Herbicide suitability
Weather conditions
• Rainfast after 6 hours. • Do not use unless wind speed is more than 3 km/h and less than 15 km/h.
Target weed conditions
• Apply to actively growing weeds with good soil moisture. • Seedling weeds are easily controlled when small. • Perennial weeds should be sprayed just prior to flowering. • Avoid extremes of cold or drought and waterlogging.
Crop stage
• Safe at any crop stage.
Variety susceptibility
• Refer to QCANESelect™ for variety sensitivity information.
Withholding period
• Do not cut for stock food for 7 days after application.
Risk to other crops
• Avoid drift onto non-target areas/crops • MCPA is a member of the Phenoxys herbicide group and can cause severe damage to susceptible crops such as cotton, tomatoes, fruit trees, vegetables, lucerne, legumes and many ornamentals.
Environmental risk
• Low hazard to bees. • Do not contaminate dams, rivers or streams.
Herbicide resistance
• Moderate risk (Group I).

AGRITONE® 750, MCPA 750

Signal heading and risk

poison	• Dermal risk: CAUSES SKIN IRRITATION. • Oral risk: SWALLOWING IS HARMFUL. • Eye risk: CAUSES SERIOUS EYE DAMAGE. • PPE as per Safety Data Sheet. • Avoid contact with skin and eyes.

Compatibility

- Kamba, Flowable diuron, Sprayseed, Tordon.

Formulation

- Soluble liquid.

Water quality

- Generally tolerant of salinity, turbidity, pH and bicarbonates.

Application equipment

- Directed inter-row spray.

Application rates

Product	Active concentration	Product/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha
AGRITONE 750 MCPA 750	750 g/L	0.93 - 1.45 L	$11 - $18	30 - 120 L

Metolachlor

Grass residual herbicide

CLINCHER® PLUS, METOLACHLOR, BOUNCER

Clincher Plus – metolachlor 960 g/L

Metolachlor 720, Bouncer – metolachlor 720 g/L

Pre-emergent herbicide for control of many annual grasses and broadleaf weeds when mixed with atrazine as per label instructions.

Herbicide suitability
Soil conditions
• Best applied to moist soil with follow up incorporation. • Use rates towards higher end on heavy soils. • Do not apply to waterlogged soils. • Do not use on soils with less than 5% clay in the top 30 cm.
Incorporation
• If conditions remain dry for a period of 10 days after spraying, irrigation (15 mm) or a shallow cultivation (2.5 cm) may assist results. • In North Queensland, incorporation by rainfall or irrigation should occur within 24 hours of application.
Targeted weed conditions
• Apply before weeds and grasses have germinated.
Crop stage
• Pre or early post-emergent application to crop.
Cultivation and irrigation
• Do not irrigate to point of run-off for at least 2 days after application. • Do not throw untreated soil onto treated areas as this will reduce weed control.
Variety susceptibility
• Some varieties may show slight phytotoxocity. • Refer to QCANESelect™.
Withholding period/risk to other crops
• Do not apply under weather conditions, or from spray equipment that may cause spray drift onto nearby susceptible plants/crops, cropping lands or pastures. • Do not graze or cut for stockfeed for 13 weeks after application. • Do not plant susceptible crops for 6 months after an application (see product label).
Environmental risk
• Do not contaminate streams, rivers or waterways with chemical or used containers. • Do not apply under weather conditions or from spraying equipment which could be expected to cause spray drift onto adjacent areas, particularly wetlands, water bodies or water courses. • Do not apply if heavy rains or storms, that are likely to cause run-off are forecast within 2 days of application.
Herbicide resistance
• Moderate risk (Group K).

CLINCHER® PLUS, METOLACHLOR, BOUNCER®

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: HARMFUL IF SWALLOWED AND ENTERS AIRWAYS. DO NOT INDUCE VOMITING. • Eyes: LOW. • Skin: MAY CAUSE ALLERGIC SKIN REACTION. • PPE as per Safety Data Sheet.

Compatibility

- Atrazine, glyphosate, paraquat.
- Note: Tank mix solutions should not be left standing overnight.

Formulation

- Soluble liquid.

Water quality

- Recommended water pH: 8 or lower.
- Avoid hard water.

Application equipment

- Ground application.
- Do not apply by aircraft.
- Thoroughly flush spray equipment with water after use.

Application rates

Region	Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
SOUTHERN (BUNDABERG SOUTH)	CLINCHER PLUS	1.65 - 2.175 L +1.5 - 2 kg atrazine (900 g/kg)	$22 - $39 + $15 - $21	200 L	• Apply as a pre or post emergent application to crop. • Apply once per year only. Application should be made to a moist soil before weeds and grasses have germinated. • Use rates toward the higher end of the range on heavy soils, where a high grass population is expected.
	METOLACHLOR 720, BOUNCER	2.2 - 2.9 L +1.5 - 2 kg atrazine (900 g/kg)			
NORTHERN QLD	CLINCHER PLUS	2.175 - 2.7 L + 2.0 - 2.5 kg atrazine (900 g/kg)	$30 - $49 + $21 - $26		• In northern QLD, application must be made to moist soil and rainfall or irrigation should occur within 24 hours of application. • Use rates toward the higher end of the range where high Green Summer grass population is expected. • Where broadleaf weeds and grasses have emerged, and are in the 2-4 true leaf stage, knockdown herbicides such as diuron or paraquat applied as a post directed spray can be added. • Where broadleaf weeds only have emerged, and are at the 2-4 true leaf stage, then a 2,4-D amine should be added. • In all cases add a suitable non-ionic surfactant.
	METOLACHLOR 720, BOUNCER	2.9 - 3.6 L + 2.0 - 2.5 kg atrazine (900 g/kg)			

Metribuzin

Broad-spectrum knockdown and residual herbicide

TOMAHAWK®, MENTOR®

Metribuzin – 750 g/L

Selective herbicide for pre-emergence and early post-emergence control of grass and broadleaf weeds.

Controls crowfoot grass, summer grass, green summer grass, awnless barnyard grass and many broadleaf weeds and vines - , convolvulus, star of Bethlehem.

Herbicide suitability
Soil conditions
• Rapidly rainfast. • Best applied to moist soil. • Do not apply to hot, dry soil. Ideally, do not apply until soil is well wetted by the first good soil settling rain. • Safe on all soil types. • Soil must not be cloddy or have excessive crop residue from a preceding crop. Trash blankets must be thoroughly compacted and broken down for best pre-emergence control. • Do not apply to plant cane up to 3 leaf stage on very light sandy soil.
Incorporation
• Not UV stable. Incorporation by rain or irrigation from 2 to 7 days after application is necessary for best results. If possible, do not irrigate for 48 hours after application. Light rain (less than 12.5 mm) will provide sufficient incorporation.
Targeted weed conditions
• Apply to actively growing weeds. Do not spray plants under stress from drought, waterlogging, frost or disease. • If weeds are larger than the 2-leaf stage at application, add a suitable contact herbicide.
Crop stage
• Safe over sugarcane as a pre or early post emergent spray (up to 3 leaf stage). • Apply as a directed spray where sugarcane stage is more than 3 leaves.
Cultivation and irrigation
• For early application in conventional plantings, ensure that the drill profile is broadly shaped so that loose soil slippage from the sides will not occur. • Do not disturb treated soil surface after application. Flood irrigation and cultivation may expose untreated soil and allow escapes.
Variety susceptibility
• No varieties tested to date have shown crop effects likely to limit yield. Generally, only negligible colour effects can be detected, if at all, and the effect is very short-term. Nil effects from directed sprays. • Refer to QCANESelect™ for variety sensitivity information.
Withholding period/risk to other crops
• Do not harvest for 21 weeks after application. • Prevent drift of spray to sensitive plants. Do not apply under weather conditions, or from spraying equipment, that may cause spray to drift onto nearby susceptible plants/crops, cropping lands or pastures. • Do not plant susceptible crops such as brassicas, capsicums, cotton, cucurbits, lettuce or sunflowers within 12 months. of application.

Herbicide suitability

Environmental risk

- PSII herbicide.
- Application should be planned to avoid run-off within 48 hours of application. Application should not be made to wet/waterlogged soils. Application should not be made if heavy rains or irrigation are expected within 48 hours.
- Do not irrigate crop to the point of run-off unless it can be retained on-farm.
- Do not apply in channels or drains.
- Do not apply within 30 m of a downwind waterway for all ground spray applications without droppers.
- Do not apply within 75 m of downwind non-target vegetation for all ground spray applications without droppers.

Herbicide resistance

- Moderate risk (Group C).

TOMAHAWK®, MENTOR®

Signal heading and risk

poison	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: HARMFUL IF SWALLOWED.	• PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale dust or spray mist.

Compatibility

- paraquat, 2,4-D amine, diuron, Stomp, Tordon 75D, Spraymate™, imazapic, trifluralin, isoxaflutole.

Formulation

- Dry flowable granule.

Water quality

- Use good quality water, with no clay particles.

Application equipment

- Broadcast application up to early post emergent crop stage.
- Directed spray over established sugarcane.
- Do not apply by aircraft.
- Use directed spray equipment (Irvin legs, droppers, etc) for drift management. Apply with medium to coarse spray droplets.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
TOMAHAWK MENTOR	Short term residual 640 - 800 g	$23 - $29	Minimum 250 L	• Provides residual weed control for 4-12 weeks or more depending on rate and soil type. Use the higher rates where heavy weed pressure exists, or in heavier soils, or where longer term control is required. • Can be used alone or in mixtures with other residual herbicides. Control of difficult species can be improved in tank mixtures. • Local factors such as soil type, precipitation, weed spectrum, trash cover, etc will influence the longevity of residual effect. • Add a suitable contact herbicide if weeds present are larger than 2 leaf stage. • Do not use on plant cane up to 3 leaf stage on very light sandy soil.
	Medium term residual 0.8 - 1.5 kg	$29 - $54		
	Long term residual 1.5 - 2.0 kg	$54 - $72		

MSMA

Grass knockdown herbicide

DACONATE 720®, MONOPOLY

MSMA – 720 g/L

Contact herbicide for post-emergent control of hard to kill grass.

Controls summer grass, barnyard grasses, vasey grass, itch grass, volunteer sorghum, *johnson grass, and *paspalum (*repeat application may be required for best results).

Herbicide suitability
Weather conditions
• Rainfast after 6 hours. • Best applied under hot, dry conditions (air temperature >25°C). • Do not apply under cool overcast conditions, as poor weed control will result.
Target weed conditions
• Controls grass up to mature stage.
Crop stage
• Apply as a directed spray where sugarcane has emerged and is 50-80 cm high. • Broadcast spray in ratoon cane from harvest to sugarcane emergence. • Broadcast spray over sugarcane may be possible over thick grass stands where grass cover is reducing the herbicide contact with sugarcane. Visual damage is to be expected.
Variety susceptibility
• Most varieties will suffer crop damage. • Visual leaf burn will occur but usually grow out within 3 weeks. • Refer to QCANESelect™ for variety sensitivity information.
Withholding period
• Do not graze or cut for stockfeed for 5 weeks following application.
Risk to other crops
• Avoid drift onto non-target areas/crops.
Environmental risk
• Harmful to fish. • Do not contaminate dams, rivers, drains or streams.
Herbicide resistance
• Moderate risk (Group Z).

DACONATE 720®, MONOPOLY

Signal heading and risk

dangerous poison

- Dermal risk: POISONOUS IF ABSORBED.
- Inhaled risk: WILL CAUSE IRRITATION TO THE THROAT.
- Oral risk: HIGHLY DANGEROUS IF SWALLOWED. (If more than 15 minutes from a hospital induce vomiting, preferably using Ipecac Syrup APF).
- PPE as per Safety Data Sheet.
- Avoid contact with eyes and skin.
- Do not inhale spray mist.
- Emergency telephone number: National Poisons Information Centre - 13 11 26.
- Poisoning requires urgent medical attention.

Compatibility

- Agtryne, atrazine, Compatriot, diuron, Barrage, 2,4-D (amine and ester).

Formulation

- Soluble liquid.

Water quality

- Avoid water containing dirt, algae and high levels of dissolved salts.

Application equipment

- Directed or spot spray where sugarcane has emerged.
- Broadcast spray on ratoon cane prior to sugarcane emergence.
- Do not apply by aircraft.

Application rates

Product	Weed target	Rate	Indicative cost (GST inclusive)	Water rate	Comments
DACONATE 720, MONOPOLY	Small annual grass	6.6 L/ha	$118/ha	300 L/ha minimum	• Ensure thorough coverage of weeds. • Add non-ionic wetting agent.
	Perennial grass	1.1 L / 100 L	$20 / 100 L	Spot spraying	

Paraquat

Broad-spectrum contact knockdown herbicide

GRAMOXONE®, NUQUAT®, PARAQUAT, SPRAYTOP®

Gramoxone 250, Nuquat 250, Paraquat 250, Spraytop 250 – paraquat 250 g/L

Non-selective contact herbicide controlling most annual grasses and broadleaf weeds.

Herbicide suitability
Weather conditions
• Rainfast within 30 minutes. • Best time of application is during periods of low sunlight intensity such as late afternoon or night. • Avoid spraying sugarcane which is under any stress.
Target weed conditions
• Most effective on weeds up to 5 cm high. • Ensure good spray coverage on all green plant tissue. • Do not spray if weeds are covered with dust or heavy dew. • Some broadleaf weeds are tolerant, such as blackberry nightshade.
Crop stage
• Directed spray after 3-4 leaf stage of plant cane. • Directed spray on ratoon cane over 10 cm in height. • Avoid broadcast application over sugarcane in Southern QLD/NSW during winter months.
Variety susceptibility
• All varieties are sensitive. • All green plant material is scorched. Actively growing sugarcane sprayed at the 3-4 leaf stage will recover within 10-14 days without effecting yield.
Risk to other crops
• Avoid drift onto non-target areas/crops.
Environmental risk
• Negligible mobility in soil due to strong binding to clay.
Herbicide resistance
• Moderate (Group L). • Resistance has been confirmed in mixed sugarcane/vegetable farming systems for cudweed, blackbery nightshade and crowsfoot grass (Southern Queensland).

GRAMOXONE®, NUQUAT®, PARAQUAT, SPRAYTOP®

Signal heading and risk

dangerous poison

- Dermal risk: MEDIUM.
- Inhaled risk: HIGHLY DANGEROUS.
- Oral risk: HIGHLY DANGEROUS IF SWALLOWED. (If more than 15 minutes from a hospital induce vomiting, preferably using Ipecac Syrup APF).
- PPE as per Safety Data Sheet.
- Avoid contact with eyes and skin.
- Do not inhale spray mist.
- Paraquat includes a stench agent, which may cause headaches.
- Emergency telephone number: National Poisons Information Centre - 13 11 26.
- Paraquat poisoning requires urgent medical attention.

Compatibility

- Atrazine, Cadence, diuron, Flame, trifluralin, Kamba, Spray.Seed, Stomp Barrage, 2,4-D amine, MCPA.

Formulation

- Soluble liquid.

Water quality

- Avoid water containing clay, silt and algae.
- Hard or saline water may be used.
- Active up to water pH 8.

Application equipment

- Directed spray where plant cane is greater than 3-4 leaf stage, or ratoons are greater than 10 cm.
- Do not apply by aircraft.

Application rates

Product	Weed size	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
GRAMOXONE 250 NUQUAT 250 PARAQUAT 250 SPRAYTOP 250	Up to 5 cm	1.2 - 1.6 L + 0.275 - 0.5 kg diuron	$5 - $7 + $4 - $7	250 - 350 L	• Diuron may be added to enhance activity on larger weeds. • Apply diuron tank mixtures as a directed spray only. • Ensure diuron applied as per district specific spray conditions as per label.
	Up to 10 cm	1.2 - 1.6 L + 1 kg diuron	$5 - $7 + $14		

Paraquat + diquat

Broad-spectrum contact knockdown herbicide

SPRAY.SEED®, REVOLVER®

Paraquat – 135 g/L, diquat – 115 g/L

Non-selective contact herbicide controlling most annual and broadleaf weeds.

Controls a broader spectrum of weeds than paraquat alone.

Herbicide suitability
Weather conditions
• Rainfast in less than 30 minutes. • Best timing is during low light intensity such as late afternoon or during overcast conditions. • The addition of diuron at label rates will enhance performance during sunny conditions.
Target weed conditions
• Controls seedling weeds only. • Most effective on weeds up to 5 cm high. • Ensure good coverage. • Do not spray if weeds are covered with dust or heavy dew. • Key weeds include sicklepod, blue top, phyllanthus, calopo. With the addition of diuron: awnless barnyard grass, summer grass, guinea grass, hamil grass, green summer grass.
Variety susceptibility
• Avoid spraying sugarcane which is under stress of any kind. • All plant material will be scorched. • Actively growing sugarcane sprayed at the 3-4 leaf stage will recover within 10-14 days without affecting yield. • Directed spray where the sugarcane is at 3-4 leaf stage, or ratoons are greater than 10 cm.
Withholding period
• Do not cut for stock feed for 1 day.
Risk to other crops
• Avoid drift onto non-target areas/crops. • Plantback period – nil.
Environmental risk
• Immobile in soil.
Herbicide resistance
• Moderate risk (Group L).

SPRAY.SEED®, REVOLVER®

Signal heading and risk

dangerous poison

- Dermal risk: MEDIUM.
- Inhaled risk: HIGHLY DANGEROUS.
- Oral risk: HIGHLY DANGEROUS.
- Avoid contact with skin and eyes.
- Do not inhale spray mist.
- PPE as per Safety Data Sheet.
- paraquat/diquat products contain a stench agent which may cause headaches.
- Emergency telephone number: National Poisons Information Centre - 13 11 26.
- Paraquat poisoning requires urgent medical attention.

Compatibility

- Atrazine, Kamba 500, diuron, Bouncer, Agritone 750 (refer to label), Triflur X, Rifle, Flame, Barrage, 2,4-D amines.

Formulation

- Soluble liquid.

Water quality

- Hard water, saline water is not a problem.
- Avoid muddy water.
- Avoid highly alkaline water.

Application equipment

- Directed spray where the sugarcane is at 3-4 leaf stage or more, or ratoons are greater than 10 cm.
- Ground application only.
- A coarse droplet is recommended if water volumes are greater than 100 L/ha and good coverage is being achieved.

Application rates

Product	Weed	Weed size	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
SPRAY. SEED REVOLVER	Annual grass	2 leaf to pre-tillering	1.2 - 1.6 L	$14 - $19	250 L minimum	• Add 0.5 - 1 kg/ha diuron (900 g/kg) to enhance knockdown (apply as a directed spray where sugarcane has emerged). • Add suitable non-ionic wetter.
		early tillering			250 - 350 L	
	Broadleaf	seedling 1-4 leaf	1.6 - 2.4 L	$19 - $28	250 L minimum	• Add 2,4-D at 1 L/ha to enhance vine control in fallow. • Add 0.5 - 1 kg/ha diuron (900 g/kg) to enhance knockdown (apply as a directed spray where sugarcane has emerged). • Add suitable non-ionic wetter.
		mature	2.4 - 3.2 L	$28 - $38	250 - 400 L	

Pendimethalin

Grass residual herbicide

STOMP® XTRA, RIFLE® 440

Stomp Xtra – pendimethalin 455 g/L,
Rifle 440 – pendimethalin 440 g/L

Pre-emergent selective herbicide for control of summer grass, barnyard grasses, crowsfoot, Guinea grass and green summer grass.

Herbicide suitability	
Soil conditions	
• Best applied to seedbeds free of weeds, trash and clods. • Do not apply where waterlogging is likely.	Sand • Soil slippage into the planting furrow may cause reduced weed control by exposing untreated soil. Clay • Chemical binding may occur on heavy clay or soil with high levels of organic matter. Use the higher rates on these soils.
Incorporation	
• Incorporation by 12-25 mm of overhead irrigation or rainfall is required within 3 to 5 days. Do not disturb by cultivation for the expected period of control. • Mechanically incorporate with finger rakes to a shallow depth if no rainfall or irrigation occurs.	
Crop stage	
• Safe at any crop stage. • Best results on bare soil at any stage from planting to stooling. Can be applied after stooling if incorporation is possible. • Ratoon cane should be stool raked to prevent herbicide tie-up.	
Cultivation and irrigation	
• Flood irrigation and cultivation may expose soil and reduce the length of control. • Flood irrigation on variable soil types or difficult to wet soils may not adequately incorporate the herbicide.	
Variety susceptibility	
• Safe on all varieties.	
Risk to other crops/plant back period	
• Avoid drift onto non-target areas/crops. • Plant back periods exist for certain vegetable crops – refer to label.	
Environmental risk	
• Relatively immobile in soil due to binding with clay and organic matter. • Dangerous to fish and aquatic life. • Do not contaminate streams, rivers or waterways.	
Herbicide resistance	
• Moderate risk (Group D).	

STOMP® XTRA, RIFLE® 440

Signal heading and risk

caution	• Dermal risk: MODERATELY IRRITATING. • Inhaled risk: CAN BE TOXIC IN HIGH CONCENTRATIONS. • Oral risk: HARMFUL IF INGESTED. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale spray mist.

Compatibility

- Ametryn, atrazine, paraquat, glyphosate, imazapic.

Formulation

- Capsule suspension concentrate (Stomp Xtra), emulsifiable concentrate (Rifle 440).

Water quality

- Recommended pH range: 6-8.
- Avoid hard water.
- Do not use water containing high clay or organic matter levels.

Application equipment

- Broadcast or directed spray.
- Atrazine or diuron tank mixtures should have nozzle screens greater than 50 mesh.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
STOMP XTRA	2.2 - 3.3 L	$41 - $63	200 L	• Use high rate where: - More than 8 weeks weed control is required. - Incorporation is delayed longer than 5 days. - High grass pressure exists (e.g. ground previously sown to pasture). • Use the lower rate plus atrazine or diuron at 1.5 kg ai/ha where broadleaf weed control is required. • Alternatively use the lower rate plus 400 mL/ha Flame (imazapic) where broadleaf weeds are present. • Do not use on heavy clay soils when mixed with atrazine.
RIFLE 440	2.25 - 3.4 L			

S-metolachlor

Grass residual herbicide

DUAL GOLD®, BOUNCER® 960S

S-metolachlor – 960 g/L

Pre-emergent selective herbicide for control of many important annual grasses and some broadleaf weeds when mixed with Gesaprim (Atrazine) as per label instructions.

Herbicide suitability
Soil conditions
• Best applied to moist soil with follow up incorporation. • Use rates towards higher end on heavy soils. • Do not apply to waterlogged soils. • Do not apply if heavy rains or storms that are likely to cause run-off are forecast within 2 days of application.
Incorporation
• If conditions remain dry for a period of 10 days after spraying, irrigation (15 mm) or a shallow cultivation (2.5 cm) may assist results.
Target weed condition
• Apply before weeds and grasses have germinated.
Crop stage
• Pre or early post-emergent application to crop.
Cultivation and irrigation
• Do not irrigate to point of run-off for at least 2 days after application. • Do not throw untreated soil onto treated areas as this will reduce weed control.
Variety susceptibility
• Safe on all varieties.
Risk to other crops/plant back period
• Do not apply under weather conditions, or from spray equipment that may cause spray drift onto nearby susceptible plants/crops, cropping lands or pastures. • Do not plant susceptible crops for 6 months after an application of Dual Gold (see product label).
Environmental risk
• Toxic to fish. Do not contaminate streams, rivers or waterways with chemical or used containers. • Do not apply under weather conditions or from spraying equipment which could be expected to cause spray drift onto adjacent areas, particularly wetlands, water bodies or water courses.
Herbicide resistance
• Moderate risk (Group K).

DUAL GOLD®, BOUNCER® 960S

Signal heading and risk

caution

- Dermal risk: LOW.
- Inhaled risk: LOW.
- Oral risk: LOW.
- Eyes: DAMAGING.
- Skin: NON IRRITANT - POTENTIAL SENSITISER. AVOID CONTACT.
- PPE as per Safety Data Sheet.

Compatibility

- Flowable Gesagard, Flowable Gesaprim, Gesaprim Granules 900WG, Spray.Seed and Roundup (Glyphosate).
- Note: Tank mix solutions should not be left standing overnight.

Formulation

- Emulsifiable concentrate.

Water quality

- Recommended water pH: 8 or lower.
- Avoid hard water.

Application equipment

- Ground application: apply in a minimum 60 L/ha of water.
- Do not apply by aircraft.
- Thoroughly flush spray equipment with water after use.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
DUAL GOLD BOUNCER 960S SOUTHERN QLD	1.1 - 1.45 L + 1.5 - 2.0 kg Gesaprim WG 900	$18 - $21 + $15 - $26	200 L	• Apply as a pre or post emergent application to crop. • Apply once per year only. Application should be made to a moist soil before weeds and grasses have germinated. • If conditions remain dry for a period of 10 days after spraying, irrigation or a shallow cultivation (2.5 cm) may assist results. • Do not throw untreated soil onto treated areas as this will reduce weed control. • Use rates toward the higher end of the range on heavy soils where a high grass population is expected.
DUAL GOLD BOUNCER 960S NORTH QLD	1.45 - 1.8 L + 2.0 - 2.5 kg Gesaprim WG 900	$24 - $30 + $21 - $26		• In northern QLD, application must be made to moist soil and rainfall or irrigation should occur within 24 hours of application. • Use rates toward the higher end of the range where high green summer grass population is expected. Where broadleaf weeds and grasses have emerged, and are in the 2-4 true leaf stage, knockdown herbicides such as diuron or paraquat applied as a post directed spray can be added. • Where broadleaf weeds only have emerged, and are at the 2-4 true leaf stage, then a 2,4-D amine should be added. • In all cases add a suitable non-ionic surfactant. • Follow all instructions and restrictions on the Gesaprim labels.

S-metolachlor + atrazine

Broad-spectrum early post emergent and residual herbicide

Primextra Gold®

S-metolachlor – 290 g/L, atrazine – 370 g/L

Pre-emergent herbicide for control of certain grasses and broadleaf weeds, including awnless barnyard grass, barnyard grass, crowsfoot grass, green summer grass, summer grass, Guinea grass, liverseed grass, bell vine, blue top, blackberry nightshade, Mexican clover, passionfruit vines, pigweed, square weed, star of Bethlehem, wild rose.

Herbicide suitability
Soil conditions
• Apply to moist soil.
Incorporation
• If conditions remain dry for 10 days after application, irrigation or a shallow cultivation (2.5 cm) may improve results.
Target weed condition
• Apply before weeds have germinated.
Crop stage
• Apply either pre or post crop emergence.
Cultivation and irrigation
• Do not throw untreated soil onto treated area. • Do not irrigate to the point of runoff for at least 2 days after application.
Variety susceptibility
• Refer to QCANESelect™ for variety sensitivity information.
Withholding period/risk to other crops
• Avoid drift onto non-target areas/crops. • Do not graze or cut for stock feed for 28 days after application. • For rates up to 3.2 L/ha, do not plant susceptible crops for 6 months (see label). • For rates above 3.2 L/ha do not plant susceptible crops for 18 months after application (see label).
Environmental risk
• PSII herbicide. • Do not mix, load or apply within 20 m of any well, sink hole, or waterway. • Do not apply within 60 m of natural or impounded lakes or dams. • Do not use in channels and drains. • Do not contaminate streams, rivers or waterways.
Herbicide resistance
• Moderate risk (Group K and C).

PRIMEXTRA GOLD®

Signal heading and risk

caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: DANGEROUS IF SWALLOWED. Do not induce vomiting. • EYE RISK: DAMAGING TO EYES. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale spray mist.

Compatibility

- 2,4-D amine, Dual Gold, ametryn, diuron, Gramoxone 250, Spray.Seed 250.

Formulation

- Suspension concentrate.

Water quality

- Use clean water.

Application equipment

- Boom, directed spray.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
PRIMEXTRA GOLD	3.6 - 4.8 L (Southern Queensland, NSW)	$55 - $73	200 L minimum	• In Southern Queensland use rates towards the higher end of the range on heavy soils where a high grass population is expected. • In North Queensland, application must be made to moist soil and rainfall or irrigation should occur within 24 hours of application. Use the higher rate where green summer grass is expected. • If weeds and grasses have germinated and are in the 2 to 4 true leaf stage, add a suitable broad spectrum knockdown herbicide. • If broadleaf weeds only have emerged and are in the 2 to 4 true leaf stage, add 2, 4-D amine. • Always ad a non-ionic surfactant if applying in a mix with knockdowns. • Do not apply more than 3 kg ai atrazine/ha per year.
	4.8 - 6.0 L (North Queensland)	$73 - $92		

Terbutryn + MCPA

Broadleaf systemic knockdown herbicide

AGTRYNE MA

Terbutryn – 275 g/L, MCPA 160 g/L

Selective systemic herbicide for post-emergent control of seedling broadleaf weeds including Ipomea vines, blackberry nightshade, square weed, calopo, rattlepod.

Herbicide suitability
Weather conditions
• Reduced control may occur when temperatures < 22°C.
Target weed conditions
• Apply to weeds up to 8 leaf stage or 30 cm diameter, vines to 1 m. • Apply to actively growing weeds.
Crop stage
• Safe at any crop stage (for Agtryne only). • Initial leaf yellowing and scorch may occur but cane normally recovers within 4 weeks.
Variety susceptibility
• Refer to QCANESelect™ for variety sensitivity information.
Withholding period
• Do not cut for stock food for 7 days. • Do not apply tank mixes with ametryn later than 9 months before harvest.
Risk to other crops
• Avoid drift onto non-target areas/crops. • Susceptible crops include cotton, vegetables, vines, fruit trees and ornamentals.
Environmental risk
• Dangerous to fish. • Do not contaminate streams, rivers or waterways.
Herbicide resistance
• Moderate risk (Group C and I).

AGTRYNE MA

Signal heading and risk

caution	• Dermal risk: SKIN IRRITANT. • Oral risk. HARMFUL IF SWALLOWED. • Eye risk: CAUSES SERIOUS EYE DAMAGE. • PPE as per Safety Data Sheet.

Compatibility

- 2,4-D amine, ametryn.

Formulation

- Soluble liquid.

Water quality

- Use clean water.

Application equipment

- Boom.
- Directed spray when mixed with ametryn.

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
AGTRYNE MA	2.0 - 4.0 L	$38 - $76	200 - 400 L	• Use lower rate on weeds < 4 leaf stage and higher rate on larger weeds. • Will only suppress blue top – use a minimum of 3 L/ha on weeds < 10 cm. • For common sensitive plant use a minimum of 3 L/ha. • Always add non-ionic wetter.
AGTRYNE + AMETRYN (800 g/kg)	2.0 - 4.0 L + 1.8 - 2.3 kg	$38 - $76 + $49 - $63		• Apply when broadleaf weeds are between 1-4 leaf stage and 30 cm diameter. • If grasses are present apply before 20 cm height (15 cm for Guinea grass and summer grass). • Always add non-ionic wetter. • DO NOT APPLY MIX OVER THE TOP OF CANE.

Trifluralin

Grass residual herbicide

TRIFLURALIN, TREFLAN™, TRIFLUR X®

Trifluralin – 480 g/L

Pre-emergent selective herbicide for control of annual grasses and certain broadleaf weeds. Barnyard grasses, summer grass, urochloa, Guinea grass, Johnson grass and black pigweed.

Herbicide suitability	
Soil conditions	
• Rapidly broken down by sunlight. • Apply to bare soil, free of weeds.	Sand • Risk of root damage from excessive rainfall concentrating herbicide into the furrow. Clay • High organic matter levels may reduce control.
Incorporation	
• Generally, must be incorporated within 4 hours by rainfall, irrigation or mechanical cultivation. • Mechanical - thoroughly incorporate to a depth of 7-13 cm. Several passes may be required for complete incorporation.	
Target weed conditions	
• Apply to weed free soil prior to germination.	
Crop stage	
• Best results on bare soil any stage from planting to stooling. Can be applied after stooling if incorporation is possible. • Ratoon cane should be stool raked to prevent herbicide tie-up.	
Cultivation and irrigation	
• Do not disturb soil. Flood irrigation and cultivation may expose soil and reduce the length of control.	
Variety susceptibility	
• Safe on all varieties. • Root stunting and poor germination may result from herbicide concentration in the furrow.	
Risk to other crops	
• Avoid drift onto non-target areas/crops.	
Environmental risk	
• Short persistence on soil, rapidly broken down by sunlight. • Do not contaminate streams, rivers or waterways.	
Herbicide resistance	
• Moderate risk (Group D).	

TRIFLURALIN, TREFLAN™, TRIFLUR X®	
Signal heading and risk	
caution	• Dermal risk: LOW. • Inhaled risk: LOW. • Oral risk: HARMFUL IF SWALLOWED. • PPE as per Safety Data Sheet. • Avoid contact with eyes and skin. • Do not inhale spray mist.
Compatibility	
• Ametryn, atrazine, diuron, paraquat, metribuzin.	
Formulation	
• Emulsifiable concentrate.	
Water quality	
• Hard water has no effect on efficacy.	
Application equipment	
• Broadcast or banded spray.	

Application rates

Product	Rate/ha	Indicative cost/ha (GST inclusive)	Water rate L/ha	Comments
TRIFLURALIN 480 TREFLAN TRIFLUR X	2.3 - 3.0 L	$24 - $31	300 - 400 L	• Use higher rate after plant cane emergence to out of hand stage. • Use the lower rate for late season application and the higher rate for early season application.

Herbicide application

Herbicide application

Nozzle selection guide

Application system	Nozzle type (examples)	Coverage	Droplet size	Drift risk	Herbicide suitability			Comments
					Post-emergent		Soil residual	
					Contact	Systemic		
Broadcast spraying 	Pre-orifice tapered flat fan 	Very good	Medium to coarse	Low	Excellent	Excellent	Excellent	• Example: DG TeeJet® (Drift Guard). • Recommended operating pressure range 2-4 bar. • Provides uniform spray coverage along the length of the boom. • Reduce drift by decreasing pressure and lower boom height. • Up to 50% drift reduction compared to conventional nozzles such as Extended Range (XR) flat nozzles. • 015 nozzles will still produce fine droplets.
	Air-inducted low pressure (low drift) 	Very good (air mixed with droplets)	Medium to coarse	Low	Good	Excellent	Very good	• Example: Agrotop Airmix®. • Recommended operating pressure range 3-5 bar. • Essential when applying Group I products (e.g. 2,4-D, Starane, Tordon). • Use in drift sensitive situations. • Up to 90% drift reduction.
	Air-inducted (extra low drift) 	Good	Extra coarse	Very low	Not the best option	Excellent	Excellent	• Example: Turbo TeeJet® Induction (TTI). • Recommended operating pressure range 2-7 bar. • Not recommended for use with low water volumes on small weed sizes, unless drift control is more important than weed kill. • Up to 99% drift reduction.
	Twin air-inducted (low drift) 	Good (air mixed with droplets)	Coarse to very coarse	Low	Good	Excellent	Excellent	• Example: Air Induction Turbo TwinJet (AITTJ60). • Recommended operating pressure range 2-7 bar. • Essential when applying Group I products (e.g. 2,4-D, Starane, Tordon). • Use in drift sensitive situations. • Increase target coverage.

Application system	Nozzle type (examples)	Coverage	Droplet size	Drift risk	Herbicide suitability			Comments
					Post-emergent		Soil residual	
					Contact	Systemic		
Band spraying Most even fan nozzles will be 95° or less as they are not intended to overlap. 	Pre-orifice even flat fan	Good	Medium to coarse	Low	Good	Good	Good	• Example: DG TeeJet® (Drift Guard). • Recommended operating pressure range 2-4 bar. • Provides even spray coverage over the treated area. • Will still produce fines with 015 nozzles.
	Air induction even flat fan	Good	Coarse to extra coarse	Low	Good	Excellent	Very good	• Example: AI TeeJet®. • Recommended operating pressure range 2-7 bar.
Directed spraying 	As for band spraying							
	Flood jet 	Poor	Variable droplet size	Low	Good	Not the best option	Good	• Recommended operating pressure 1-3 bar. • Large droplets have less drift off-site and onto sugarcane leaves. • Increase water rate to increase target coverage.
Octopus bar 	Pre-orifice or air-inducted low pressure even flat fan (low drift)	See above notes for pre-oriface and air-induction nozzles						
Dual-spray bar 	Centre nozzle: Air-inducted 95 to 110 degree angle even fan	Very good	Extra coarse to very coarse	Very low	Good	Very good	Not the best option	• This dual spray bar is a dual tank system with twin circuits – one to the centre nozzle for inter-row spraying and one to the two wing nozzles for spraying into the row. • The centre nozzle can be used to apply non-residual herbicides to the inter-row whilst the wing nozzles can apply a residual herbicide to the row. • A User Manual for the QDAF dual herbicide sprayer is available from QDAF. It includes design drawings and nozzle recommendations.
	Wing nozzles: 80 to 95 degree angle even fan Air-inducted nozzles can be used		Very coarse to coarse	Low	Good	Very good (do not use non-selective systemics through wing nozzles)	Very good	

Selecting a nozzle

There is no point in calibrating a spray rig if it is fitted with incorrect nozzles. Selecting the most appropriate nozzle for the particular spray job you want to do is the first step in calibration.

Selecting a nozzle involves 2 steps

1. Choosing a nozzle with the correct flow rate, for your operating pressure.
2. Choose a nozzle that produces the required droplet spectrum, at your operating pressure.

Example

What is a suitable nozzle for:

- boom-applied Roundup Ultra MAX
- spray volume of 80 L/ha
- Travel speed 8 km/h
- operating pressure 2.5 bar
- nozzle spacing 50 cm

Step 1

Nozzle size selection is done using the FLOW RATE formula:

Nozzle output (L/minute/nozzle) = L/ha x km/h x effective spray width (m) ÷ 600

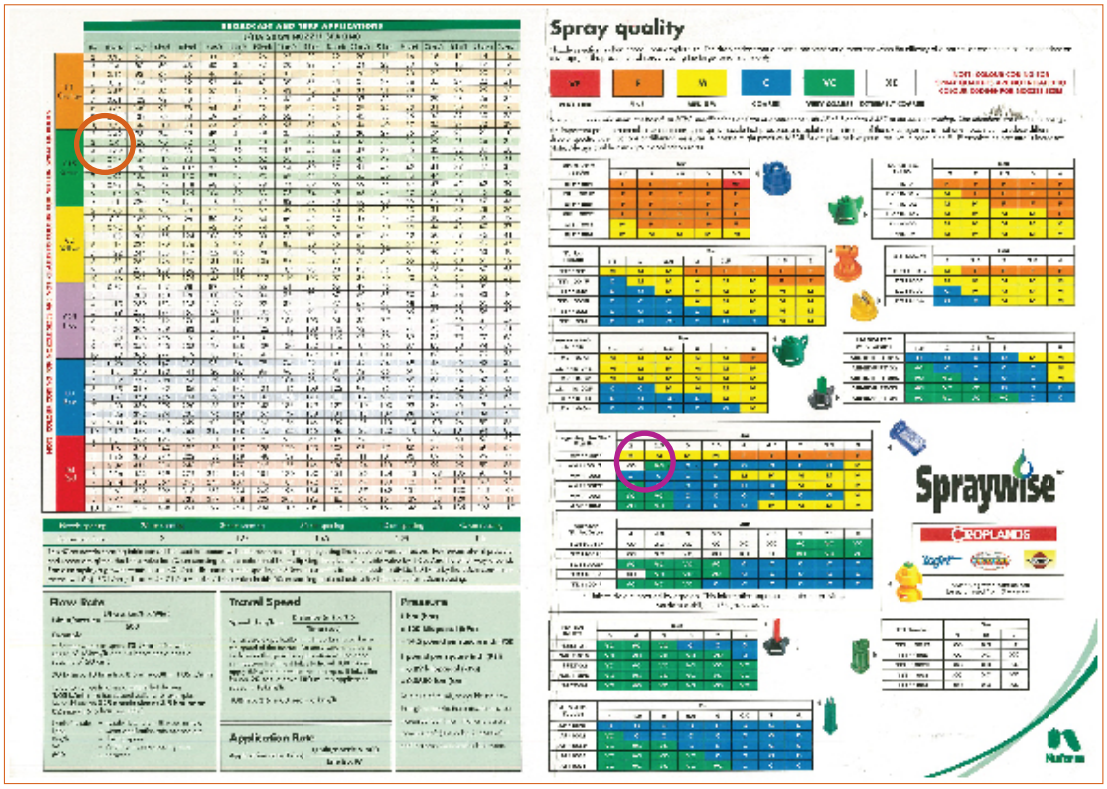
- L/ha = spray water volume/ha
- Km/h = intended travel speed while spraying
- Effective spray width (m):
  - o corresponds to nozzle spacing on a boom, if nozzles are 50 cm apart
  - o is the width (m) of a band from a single nozzle at the target (banded spraying)
  - o is the average sprayed width (m) per nozzle for band or shielded spraying where the rig uses more than one nozzle per spray band.

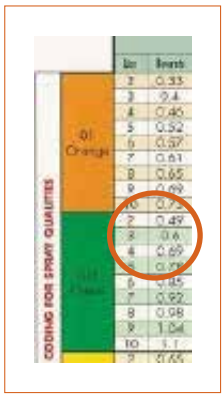
Using the FLOW RATE formula:

Nozzle output (L/minute/nozzle) = (80 x 8 x 0.5) ÷ 600

= 0.53 L/minute/nozzle

Go to the nozzle chart and choose a nozzle size that produces closest output at your desired operating pressure.

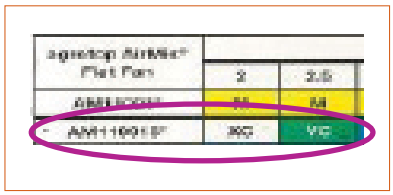




Above: Nufarm nozzle chart.

Step 2

From the spray quality section of a nozzle chart, select a 015 nozzle that produces a coarse to very coarse droplet spectrum at 2.5 bar.



The agrotop Airmix° flat fan AM110015 is a suitable nozzle.

There will always be more than one nozzle that meets your criteria, depending on brand and design.

Nozzle charts and specifications

The following pages contain nozzle data from Hardi®, Teejet® and Lechler®. These are not the only nozzles available.

There are other nozzle manufacturers who produce excellent products that are available from your local rural supplier or via the web.

It is important to remember that most nozzles are manufactured to ISO standards and colour codes.

In theory all nozzles of the same ISO colour should produce the same output for any given pressure.

Experience has demonstrated that there are slight variations in the field, particularly when changing from one nozzle type to another.

Example: Replacing a low drift fan with a flood jet. Remember always calibrate your sprayer after fitting new nozzles.

Checking nozzles for wear and replacing nozzles

As a general rule, 5 percent variation either side of the manufacturer's stated output is enough to replace the nozzle. This general figure should also take into account and make allowances for the following:

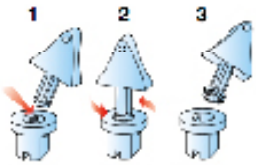
- Ensure the pressure gauge in the usable range for the sprayer. Use a gauge that has a 0 to 5 or 0 to 10 bar range when using herbicides. Do not use a 0 to 25 bar gauge.
- There will be some pressure drop from the pump and pressure gauge to the nozzle. Expect a range from almost nothing to 0.5 bar depending on the sprayer design.
- There will be some drop in pressure along the boom. Nozzles at the end of the boom will have lower outputs than those closest to feeder lines. If anything, this will only be around 0.1 bar.

HARDI ISO LD-110 - LowDrift nozzles

LowDrift nozzles are recommended when optimum spraying conditions cannot be achieved (risk of drift) and spraying cannot be postponed.

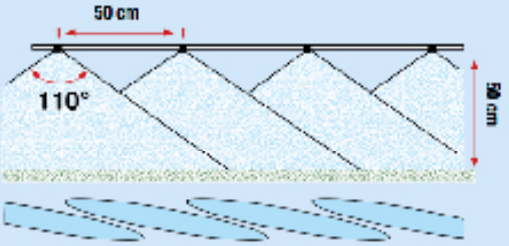
- ISO – flow, colour and outer dimensions
- Working pressure – 1.5 to 5 bar
- Restrictor designed for minimum chemical residues
- SYNTAL – precision moulded thermoplastic
- CERAMIC – extremely high durability
- COLOR TIPS – for safe and easy handling

This nozzle will give you excellent and uniform liquid distribution at boom heights from 35 to 70 cm (50 cm recommended to take care of uneven terrain or boom movements).



Turn-&-Clean with the HARDI key – easily removable restrictor.

To ensure that the boom distribution is not disturbed by interference, the nozzles are set at an angle of 8° to the boom. This feature is built into all HARDI COLOR TIP and SNAP-FIT caps. This angle has to be set manually if single nozzles are used.



	bar	l/min		Vha at km/h 6	7	8	10	12	16	20	25
01-Orange	1.5	0.24	M	57	48	42	34	28	25	17	14
	2.0	0.33	M	86	56	49	39	33	26	20	16
	2.5	0.37	M	73	63	55	44	37	29	22	18
	3.0	0.40	M	90	69	60	48	40	32	24	19
	4.0	0.46	M	92	79	69	55	46	37	28	22
	5.0	0.52	F	103	89	77	62	52	41	31	25
				SYNTAL-01 [illegible] (12 pcs. [illegible]) SYNTAL-5 [illegible] (12 pcs. [illegible]) CERAMIC-01 [illegible] (12 pcs. [illegible]) CERAMIC-5 [illegible] (12 pcs. [illegible])							
015-Green	1.5	0.42	M	95	73	84	51	42	34	25	20
	2.0	0.44	M	98	84	73	59	49	39	29	24
	2.5	0.55	M	110	94	82	66	55	44	33	26
	3.0	0.60	M	120	103	90	72	60	48	36	29
	4.0	0.69	M	139	119	104	83	69	55	42	33
	5.0	0.77	M	155	133	116	93	77	62	46	37
				SYNTAL-01 [illegible] (12 pcs. [illegible]) SYNTAL-5 [illegible] (12 pcs. [illegible]) CERAMIC-01 [illegible] (12 pcs. [illegible]) CERAMIC-5 [illegible] (12 pcs. [illegible])							
02-Yellow	1.5	0.57	M	113	97	85	68	57	46	34	27
	2.0	0.65	M	13	112	98	78	65	52	39	31
	2.5	0.73	M	146	125	110	88	73	58	44	35
	3.0	0.80	M	160	137	120	96	80	64	48	38
	4.0	0.92	M	186	158	138	111	92	74	55	44
	5.0	1.03	M	207	177	155	124	103	83	62	50
				SYNTAL-01 [illegible] (12 pcs. [illegible]) SYNTAL-5 [illegible] (12 pcs. [illegible]) CERAMIC-01 [illegible] (12 pcs. [illegible]) CERAMIC-5 [illegible] (12 pcs. [illegible])							
025-Lilac	1.5	0.71	C	14	12	106	85	71	57	42	34
	2.0	0.82	C	163	140	122	98	82	65	49	39
	2.5	0.91	M	183	156	137	110	91	73	55	44
	3.0	1.00	M	200	17	150	120	100	80	60	48
	4.0	1.15	M	23	198	173	139	115	92	69	55
	5.0	1.29	M	258	221	194	155	129	103	77	62
				SYNTAL-01 [illegible] (12 pcs. [illegible]) SYNTAL-5 [illegible] (12 pcs. [illegible])							

	bar	l/min		Vha at km/h 6	7	8	10	12	16	20	25
03-Blue	1.5	0.86	C	170	145	127	102	85	66	51	41
	2.0	0.99	C	198	169	147	118	99	76	59	47
	2.5	1.10	C	219	188	164	131	110	88	66	53
	3.0	1.20	C	240	206	180	144	120	96	72	58
	4.0	1.39	M	277	238	208	166	139	111	83	67
	5.0	1.55	M	310	266	232	186	155	124	93	74
				SYNTAL-01 [illegible] (12 pcs. [illegible]) SYNTAL-5 [illegible] (12 pcs. [illegible]) CERAMIC-01 [illegible] (12 pcs. [illegible]) CERAMIC-5 [illegible] (12 pcs. [illegible])							
04-Red	1.5	1.13	C	226	194	170	136	113	91	68	54
	2.0	1.31	C	261	224	196	157	131	105	78	63
	2.5	1.46	C	292	250	219	175	146	117	88	70
	3.0	1.60	C	320	274	240	192	160	128	96	77
	4.0	1.85	C	370	317	277	222	185	148	111	89
	5.0	2.07	M	413	354	310	248	207	166	124	99
				SYNTAL-01 [illegible] (12 pcs. [illegible]) SYNTAL-5 [illegible] (12 pcs. [illegible]) CERAMIC-01 [illegible] (12 pcs. [illegible]) CERAMIC-5 [illegible] (12 pcs. [illegible])							
05-Brown	1.5	1.41	C	283	242	212	170	141	113	85	68
	2.0	1.63	C	327	280	245	196	163	131	98	78
	2.5	1.83	C	365	313	274	219	183	146	110	88
	3.0	2.00	C	400	343	300	240	200	160	120	96
	4.0	2.31	C	462	396	346	277	231	185	139	111
	5.0	2.58	C	516	443	387	310	258	207	155	124
				SYNTAL-01 [illegible] (12 pcs. [illegible]) SYNTAL-5 [illegible] (12 pcs. [illegible]) CERAMIC-01 [illegible] (12 pcs. [illegible]) CERAMIC-5 [illegible] (12 pcs. [illegible])							

– Spray quality:
Fine (F), Medium (M), Coarse (C), Very Coarse (VC).

The nozzles are available both as single nozzles (S) and as COLOR TIPS (CT), where the nozzle is integrated in the SNAP-FIT.

Acknowledgement: Hardi.

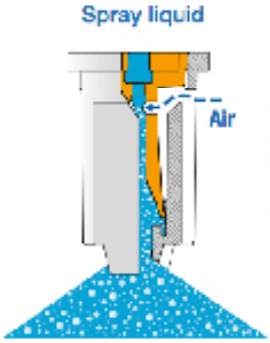
HARDI ISO MINIDRIFT air inclusion nozzles

The HARDI MINIDRIFT nozzles can be used for spraying at sub-optimal weather conditions, when spraying cannot be postponed. The MINIDRIFT nozzle will at low pressures reduce drift to a minimum.

- Air inclusion nozzle
- Working pressure – 1 to 6 bar
- ISO – flow, colours, sizes and nomenclature
- Application rates from 60 to 430 l/ha (at 8 km/h)
- SYNTA_ – precision moulded thermoplastic

This nozzle will give you excellent and uniform liquid distribution at boom heights from 40 to 90 cm.

The droplet spectrum is coarse to very coarse; safe for drift control but without risking poor coverage and deposition on eaves.
The venturi can easily be removed for cleaning the nozzle.



Two big air inlets reduce the risk of clogging.

Compact design reduces impact damage.

Meets full ISO specifications.

	bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
015-Green	1.5	0.42	C	85	73	64	51	42	34	26	20
	2.0	0.49	C	98	84	73	59	49	39	29	24
	2.5	0.55	C	110	94	82	66	55	44	33	26
	3.0	0.60	C	120	103	90	72	60	48	36	29
	4.0	0.69	M	139	119	104	83	69	56	42	33
	5.0	0.77	M	155	133	116	93	77	62	46	37
	6.0	0.85	M	170	146	127	102	85	68	51	41
				SYNTA-CT 372121 (12 pcs. 7308310); SYNTA-S 372111 (12 pcs. 7308310)							
02-Yellow	1.5	0.67	VC	113	97	85	68	57	46	34	27
	2.0	0.65	C	131	113	98	78	65	52	39	31
	2.5	0.73	C	146	125	110	88	73	58	44	35
	3.0	0.80	C	160	137	120	96	80	64	48	38
	4.0	0.92	C	185	158	139	111	92	74	55	44
	5.0	1.03	M	207	177	155	124	103	83	62	50
	6.0	1.13	M	225	194	170	136	113	91	68	54
				SYNTA-CT 372121 (12 pcs. 7308310); SYNTA-S 372111 (12 pcs. 7308310)							
025-Lilac	1.5	0.71	VC	141	121	106	85	71	57	42	34
	2.0	0.82	VC	163	140	122	98	82	65	49	39
	2.5	0.91	C	183	156	137	110	91	73	55	44
	3.0	1.00	C	200	171	150	120	100	80	60	48
	4.0	1.15	C	231	198	173	139	115	92	69	55
	5.0	1.29	M	258	221	194	155	129	103	77	62
	6.0	1.41	M	283	242	212	170	141	113	85	68
				SYNTA-CT 372121 (12 pcs. 7308310); SYNTA-S 372111 (12 pcs. 7308310)							

	bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
03-Blue	1.5	0.85	VC	170	145	127	102	85	68	51	41
	2.0	0.98	VC	196	168	147	118	98	78	59	47
	2.5	1.10	VC	219	188	164	131	110	88	66	53
	3.0	1.20	C	240	206	180	144	120	96	72	58
	4.0	1.39	C	277	238	208	166	139	111	83	67
	5.0	1.55	C	310	265	232	186	155	124	93	74
	6.0	1.70	M	339	291	255	204	170	136	102	81
				SYNTA-CT 372121 (12 pcs. 7308310); SYNTA-S 372111 (12 pcs. 7308310)							
04-Red	1.5	0.92	VC	185	159	139	111	92	74	55	44
	1.5	1.13	VC	225	194	170	136	113	91	68	54
	2.0	1.31	VC	261	224	196	157	131	105	78	63
	2.5	1.46	VC	292	250	219	175	146	117	88	70
	3.0	1.60	VC	320	274	240	192	160	128	96	77
	4.0	1.85	C	370	317	277	222	185	148	111	89
	5.0	2.07	C	413	354	310	248	207	165	124	99
	6.0	2.26	C	453	388	339	272	226	181	136	109
				SYNTA-CT 372121 (12 pcs. 7308310); SYNTA-S 372111 (12 pcs. 7308310)							
05-Brown	1.0	1.15	VC	231	198	173	139	115	92	69	56
	1.5	1.41	VC	283	242	212	170	141	113	85	68
	2.0	1.63	VC	327	280	245	196	163	131	98	78
	2.5	1.83	VC	365	313	274	219	183	146	110	88
	3.0	2.00	VC	400	343	300	240	200	160	120	96
	4.0	2.31	C	462	396	346	277	231	185	139	111
	5.0	2.58	C	516	443	387	310	258	207	156	124
	6.0	2.83	C	565	485	424	339	283	226	170	136
				SYNTA-CT 372121 (12 pcs. 7308310); SYNTA-S 372111 (12 pcs. 7308310)							

- Spray quality: Fine (F), Medium (M), Coarse (C), Very Coarse (VC)

The nozzles are available both as single nozzles (S) and as COLOR TIPS (CT), where the nozzle is integrated in the SNAP-FIT.

Acknowledgement: Hardi.

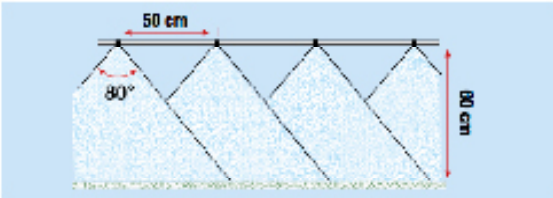
HARDI ISO F-80 – Flat fan nozzles

This nozzle has an 80° spray angle. On boom sizes from 24 to 36 m the boom height is often higher than 50 cm above the target. 80° nozzles provide good coverage with reduced drift risk at these higher boom heights and are also adaptable to band spraying.

- ISO – flow, colour and outer dimensions
- Spray angle – 80°
- Working pressure – 1.5 to 5 bar
- SYNTAL – precision moulded thermoplastic
- CERAMIC – extremely high durability

The 80° nozzle is suitable for big booms or row crop / band spraying with either low boom or nozzles at droplegs.

For use in cotton, sugar cane, sugar beets etc. The 80° nozzles can be fitted on HARDI sprayers using the 334083 ISO/INJET cap.



	bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
01-Orange	1.5	0.28	–	67	48	42	34	28	23	17	14
	2.0	0.33	–	81	56	49	39	33	26	20	16
	2.5	0.37	–	73	63	55	44	37	29	22	18
	3.0	0.40	–	80	69	60	48	40	32	24	19
	4.0	0.46	–	92	79	69	55	46	37	28	22
	5.0	0.52	–	103	89	77	62	52	41	31	25
			SYNTAL-S 371021 (12 pcs. 720041)								

	bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
02-Yellow	1.5	0.57	–	113	97	85	68	57	40	34	27
	2.0	0.66	–	131	112	98	78	65	52	39	31
	2.5	0.73	–	146	125	110	88	73	58	44	35
	3.0	0.80	–	160	137	120	96	80	64	48	38
	4.0	0.92	–	185	158	139	111	92	74	56	44
	5.0	1.03	–	207	177	155	124	103	83	62	50
			SYNTAL-S 371022 (12 pcs. 720042) DRAMIC-S 371007 (12 pcs. 720010)								

	bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
015-Green	1.5	0.42	–	85	73	64	51	42	34	25	20
	2.0	0.49	–	99	84	73	59	49	39	29	24
	2.5	0.55	–	110	94	82	66	55	44	33	26
	3.0	0.60	–	120	103	90	72	60	48	36	29
	4.0	0.69	–	138	119	104	83	69	55	42	33
	5.0	0.77	–	155	133	116	93	77	62	46	37
			SYNTAL-S 371020 (12 pcs. 720041) DRAMIC-ST 371007 (12 pcs. 720010) DRAMIC-S 371020 (12 pcs. 720020)								

	bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
03-Blue	1.5	0.86	–	170	145	127	102	85	68	51	41
	2.0	0.98	–	196	168	147	118	98	78	59	47
	2.5	1.10		219	188	164	131	110	88	66	53
	3.0	1.20		240	206	180	144	120	96	72	58
	4.0	1.39	–	277	238	208	166	139	111	83	67
	5.0	1.55	–	310	266	232	186	155	124	93	74
			SYNTAL-S 371024 (12 pcs. 720043) DRAMIC-ST 371007 (12 pcs. 720010) DRAMIC-S 371403 (12 pcs. 720011)								

– Spray quality:
Fine (F), Medium (M), Coarse (C), Very Coarse (VC).

The nozzles are available both as single nozzles (S) and as COLOR TIPS (CT), where the nozzle is integrated in the SNAP-FIT.

Acknowledgement: Hardi.

ISO Nozzle Application Rate Chart (l/ha)

LECHLER

ISO Standard Colour & Size	ID	IDK	IDKT	AD	LU	kpa	50 Spacing (cm) l/min	ISO Nozzle Application Rate Chart (l/ha) Speed (km/hr) 6	8	10	12	14	16	18	20	22	25	30	35	40
.03 Blue					M	100	0.50	136	102	82	68	58	51	45	41	37	33	27	23	20
		VC	C	C	M	150	0.85	170	128	102	85	73	64	57	51	46	41	34	29	26
		VC	C	C	F	200	0.98	196	147	118	98	84	74	65	59	53	47	39	34	29
		VC	C	C	F	250	1.10	220	166	132	110	94	83	73	66	60	53	44	38	33
	VC	C	C	M	F	300	1.20	240	180	144	120	103	90	80	72	65	58	48	41	36
	VC	C	M	M	F	350	1.30	260	196	156	130	111	98	87	78	71	62	52	45	39
	VC	C	M	M	F	400	1.39	278	208	167	139	119	104	93	83	76	67	56	48	42
	VC	M	M	M	F	500	1.55	310	233	186	155	133	116	103	93	85	74	62	53	47
	C	M	F	F	F	600	1.70	340	255	204	170	146	128	113	102	93	82	68	58	51
	C	M	F	F	F	700	1.84	368	276	221	184	158	138	123	110	100	88	74	63	55
	C					800	1.91	382	287	229	191	164	143	127	115	104	92	76	65	57
	C					900	2.03	406	305	244	203	174	152	136	122	111	97	81	70	61
	C					1000	2.14	428	321	257	214	183	161	143	128	117	103	86	73	64
						1100	2.24	448	336	269	224	192	168	149	134	122	108	90	77	67
						1200	2.34	468	351	281	234	201	176	156	140	128	112	94	80	70.2
.04 Red		XC	VC	C	M	100	0.91	182	137	109	91	78	68	61	55	50	44	36	31	27
		VC	VC	C	M	150	1.13	226	170	136	113	97	85	75	68	62	54	45	39	34
	XC	VC	C	C	M	200	1.31	262	197	157	131	112	98	87	79	71	63	52	45	39
	XC	VC	C	C	M	250	1.46	292	219	175	146	125	110	97	88	80	70	58	50	44
	XC	VC	C	C	M	300	1.60	320	240	192	160	137	120	107	96	87	77	64	55	48
	VC	C	C	C	F	350	1.73	346	260	208	173	149	130	115	104	94	83	69	59	52
	VC	C	M	M	F	400	1.85	370	278	222	185	159	139	123	111	101	88	74	63	56
	VC	C	M	M	F	500	2.07	414	311	248	207	177	155	138	124	113	99	83	71	62
	VC	M	M	M	F	600	2.27	454	341	272	227	195	170	151	136	124	109	91	78	68
	C	M	M	M	F	700	2.45	490	368	294	245	210	184	163	147	134	118	98	84	74
	C					800	2.54	508	381	305	254	218	191	169	152	139	122	102	87	76
	C					900	2.68	536	402	322	268	230	201	179	161	146	128	107	92	80
	VC					1000	2.83	566	425	340	283	243	212	189	170	154	138	113	97	85
						1100	2.97	594	446	356	297	255	223	198	178	162	143	119	102	89
						1200	3.1	620	465	372	310	266	233	207	186	169	149	124	106	93
.05 Brown		XC	VC			100	1.14	228	171	137	114	98	86	76	68	62	55	46	39	34
		VC	VC		M	150	1.41	282	212	169	141	121	106	94	85	77	68	56	48	42
	XC	VC	VC		M	200	1.63	326	245	196	163	140	122	109	98	89	78	65	56	49
	XC	VC	C		M	250	1.82	364	273	218	182	156	137	121	109	99	87	73	62	55
	XC	VC	C		M	300	2.00	400	300	240	200	171	150	133	120	109	96	80	69	60
	XC	VC	C		M	350	2.16	432	324	259	216	185	162	144	130	118	104	86	74	65
	VC	C	C		M	400	2.30	460	345	276	230	197	173	153	138	125	110	92	79	69
	VC	C	M		M	500	2.58	516	387	310	258	221	194	172	155	141	124	103	88	77
	VC	M	M		M	600	2.83	566	425	340	283	243	212	189	170	154	135	113	97	85
	VC	M	M		M	700	3.05	610	458	366	305	261	229	203	183	166	146	122	105	92
	VC					800	3.17	634	476	380	317	272	238	211	190	173	152	127	109	95
	C					900	3.38	672	504	403	336	288	252	224	202	183	161	134	115	101
	C					1000	3.54	708	531	425	354	303	266	236	212	193	170	142	121	106
						1100	3.71	742	557	445	371	318	279	247	223	202	178	148	127	111
						1200	3.88	776	582	466	388	333	291	259	233	212	186	155	133	116
.06 Grey	XC				C	200	1.94	388	291	233	194	166	146	129	116	106	93	78	67	58
	XC				M	300	2.37	474	356	284	237	203	178	158	142	129	114	95	81	71
	XC				M	400	2.74	548	411	329	274	235	206	183	164	149	132	110	94	82
	VC				M	500	3.06	612	459	367	305	262	230	204	184	167	147	122	105	92
	VC				M	600	3.35	670	502	402	335	287	251	223	201	183	161	134	115	101
	VC				M	700	3.62	724	543	434	362	310	272	241	217	197	174	145	124	109
	VC					800	3.87	774	581	464	387	332	290	258	232	211	186	155	133	116
	VC					900	4.02	804	603	482	402	345	302	268	241	219	193	161	138	121
	VC					1000	4.24	848	636	509	424	363	318	283	254	231	204	170	145	127
						1100	4.44	888	666	533	444	381	333	296	266	242	213	178	152	133
						1200	4.64	928	696	557	464	398	348	309	278	253	223	186	159	139
.08 White	XC				C	200	2.58	516	387	310	258	221	194	172	155	141	124	103	88	77
	XC				C	300	3.16	632	474	379	316	271	237	211	190	172	152	126	108	95
	XC				C	400	3.65	730	548	438	365	313	274	243	219	199	175	146	125	110
	XC				M	500	4.08	816	612	490	408	350	306	272	245	223	196	163	140	122
	VC				M	600	4.47	894	671	536	447	383	335	298	268	244	215	179	153	134
	VC				M	700	4.83	966	725	580	483	414	362	322	290	263	232	193	166	145
	VC					900	5.16	1032	774	619	516	442	387	344	310	281	248	206	177	155
	VC					800		0	0	0	0	0	0	0	0	0	0	0	0	0
	VC					1000		0	0	0	0	0	0	0	0	0	0	0	0	0
						1100		0	0	0	0	0	0	0	0	0	0	0	0	0
						1200		0	0	0	0	0	0	0	0	0	0	0	0	0

Acknowledgement: Mr Nozzle.

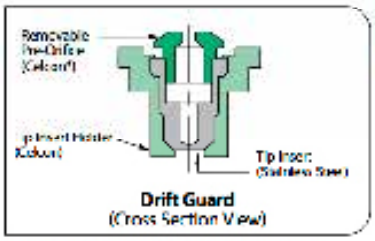
Nozzles

Lechler is a 130 year old German company producing high quality and precise nozzles for all agricultural applications. They back their products with useful readily available information including droplet spectra.

XX = NOZZLE SIZE	DESCRIPTION	PRODUCT CODE	SIZE	ANGLE	MATERIAL	EXAMPLE TIP NO.
	**LOW PRESSURE AIR INDUCTION NOZZLES**					
	• Low pressure air induction nozzle • Ideal for most broadacre applications • Very low drift potential • 1.5 to 6bar pressure range • Fits into standard cap ***Our Biggest Selling Nozzle in Australia***	IDK-120-XX-P IDK-120-XX-C	01 to 05 01 to 05	120 120	Polymer Ceramic	IDK-120-02P IDK-120-02C
	• 90° Ideal for airblast sprayers	IDK-90-XX-C	01 to 03	90	Ceramic	IDK-90-02C
	**HIGH PRESSURE AIR INDUCTION NOZZLES**					
	• High pressure air induction nozzle • Ideal for most broadacre applications • Very low drift potential • 3 to 10bar pressure range	IDC-120-XX	01 to 08	120	Ceramic	IDC-120-02C
	• 90° Ideal for airblast sprayers	IDK-90-XX-C	01 to 03	90	Ceramic	IDK-90-02C
	**OFF CENTRE NOZZLES**					
	• High pressure air induction nozzle • Very low drift potential • 2 to 8bar pressure range	IS-XX	02 to 06	80	Polymer	S-03
	• Low pressure air induction nozzle • Very low drift potential • 1.5 to 6bar pressure range • Uses standard cap	IDKS-XX	02 to 05	80	Polymer	IDKS-03
	• Commonly used in swivel nozzle bodies	CC-XX	02-16	80	Brass	CC-03
	**LOW PRESSURE AIR INDUCTION TWIN NOZZLES**					
	• Two fans 30° forward & 30° rearward • Improved coverage • Ceramic tip • Low drift potential • 1 to 6bar pressure range	IDKT-120-XX-C	03 to 05	120	Ceramic	IDKT-120-03C
	**PRE ORIFICE LOW DRIFT FLAT FAN NOZZLES**					
	• Pre Orifice low drift nozzle • Low drift potential • 1.5 to 6bar pressure range • Fits into standard cap	AD-120-XX-P AD-120-XX-C AD-90-XX-C	015 to 04 015 to 04 02 to 04	120 120 90	Polymer Ceramic Ceramic	AD-120-02P AD-120-02C AD-90-02C
	**STANDARD FLAT FAN NOZZLES**					
	• Flat fan nozzle • High drift potential • 1 to 5bar pressure range • Fits into standard cap	LU-120-XX-P LU-120-XX-C	01 to 08 01 to 08	120 120	Polymer Ceramic	LU-120-03P LU-120-03C

Acknowledgement: Mr Nozzle.

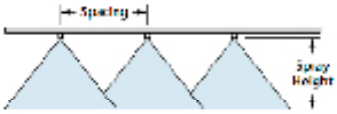
DG TeeJet® Drift Guard Flat Spray Tips



Note: Due to the pre-orifice design, this tip is not compatible with the 4193A check valve tip strainer.

Features:

- Pre orifice design produces larger droplets and reduces the small drift-prone droplets, minimizing off-target spray contamination.
- Tapered edge flat spray pattern provides uniform coverage when adjacent nozzle patterns are overlapped in broadcast spraying.
- The color coded pre orifice is removable for any necessary cleaning operations.
- Available in both 80° and 110° spray angles with a durable stainless steel orifice.
- Automatic spray alignment with 25612-*-NYR Quick TeeJet® cap and gasket. Reference page 57 for more information.



	bar	DROP SIZE 90%	DROP SIZE 10%	CAPACITY per nozzle l/min	4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	14 km/h	16 km/h	20 km/h	25 km/h	30 km/h	35 km/h
DG80015T DG110015 (100)	2.5	M	N	0.48	144	115	96.0	82.3	72.0	57.6	48.0	36.0	32.0	28.8	23.0	19.2	16.5
	3.5	M	F	0.54	162	130	108	92.6	81.0	64.8	54.0	40.5	36.0	32.4	25.9	21.6	18.5
	3.0	M	F	0.59	177	142	118	101	88.5	70.8	59.0	44.3	39.3	35.4	28.3	23.6	20.2
	4.5	M	F	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	5.0	F	F	0.76	228	182	152	130	114	91.2	76.0	57.0	50.7	45.6	36.5	30.4	26.1
DG8002T DG11002 (50)	2.5	C	N	0.65	195	156	130	111	97.5	78.0	65.0	48.8	43.3	39.0	31.2	26.0	22.3
	3.5	M	N	0.73	219	175	146	125	109	87.4	72.8	54.6	48.5	43.7	34.9	29.1	24.9
	3.0	M	N	0.79	237	190	158	135	118	94.8	79.0	59.3	52.7	47.4	37.9	31.6	27.1
	4.5	M	N	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	5.0	M	N	1.02	306	245	204	175	153	122	102	76.5	68.0	61.2	49.0	40.8	35.0
DG8003T DG11003 (50)	2.5	C	C	0.96	288	230	192	165	144	115	96.0	72.0	64.0	57.6	46.1	38.4	32.9
	2.5	M	N	1.08	324	259	216	185	162	130	108	81.0	72.0	64.8	51.8	43.2	37.0
	3.0	M	N	1.18	354	283	236	202	177	142	118	88.5	78.7	70.8	56.6	47.2	40.5
	4.0	M	N	1.36	408	326	272	233	204	163	136	102	90.7	81.6	65.3	54.4	46.6
	5.0	M	N	1.52	456	365	304	261	228	182	152	114	101	91.2	73.0	60.8	52.1
DG8004T DG11004 (50)	2.5	C	C	1.29	387	310	258	221	194	155	129	96.8	86.0	77.4	61.9	51.6	44.2
	2.5	C	C	1.44	432	346	288	247	216	172	144	108	96.0	86.4	69.1	57.6	49.4
	3.0	M	N	1.58	474	379	316	271	237	190	158	119	106	94.8	75.8	63.2	54.2
	4.0	M	N	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	5.0	M	N	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
DG8005T DG11005 (50)	2.5	C	C	1.61	483	386	322	276	242	193	161	121	107	96.6	77.3	64.4	55.2
	3.5	C	C	1.80	540	432	360	309	270	216	180	135	120	108	86.4	72.0	61.7
	3.0	C	C	1.97	591	473	394	338	296	236	197	148	131	118	94.6	78.8	67.5
	4.5	M	N	2.27	681	545	454	389	341	272	227	170	151	136	109	90.8	77.8
	5.0	M	N	2.54	762	610	508	435	381	305	254	191	169	152	122	102	87.1

Note: Always double check your application rates. Tabulations are based on spraying water at 70°F (21°C). See pages 12–100 for drop size classification, useful formulas and other information.

†Available in VisiFlo stainless steel only.

Optimum Spray Height

80°	75 cm
110°	50 cm

How to order:

Specify tip number.

Examples:

DG8002VS – Stainless Steel with VisFlo® color-coding

DG11002-VP – Polymer with VisiFlo color-coding

Acknowledgement: TeeJet® Technologies.

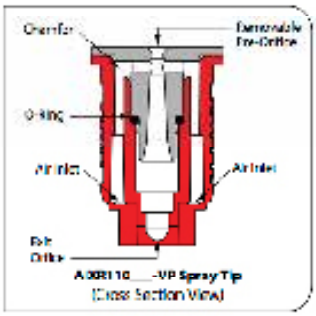
AIXR TeeJet® Air Induction XR Flat Spray Tips

Typical Applications:

See selection guide on page 2 for recommended typical applications for AIXR TeeJet tips.

Features:

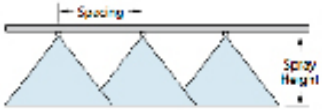
- 110° wide, tapered flat spray angle with air induction technology offers better drift management.
- Made of a two-piece UHMWPE polymer construction with VisiFlo® color-coding. UHMWPE provides excellent chemical resistance, including acids, as well as exceptional wear life.
- Compact size to prevent tip damage.
- Depending on the chemical, produces large air-filled drops through a Venturi air aspirator.
- Removable pre-orifice.
- Available in seven tip capacities with a wide operating pressure range: 15–90 PSI (1–6 bar)
- Automatic alignment when used with 25612-AIXR Quick TeeJet® cap and gasket. Reference page 57 for more information.



	bar	DROP SIZE	CAPACITY ONE NOZZLE IN l/min	Like Sieve													
				4 bends	5 bends	6 bends	7 bends	8 bends	10 bends	12 bends	16 bends	18 bends	20 bends	24 bends	30 bends	40 bends
AIXR110015 (100)	1.0	XC	0.34	102	81.6	69.0	61.1	51.0	40.8	34.0	25.5	22.7	20.4	16.3	13.6	11.7
	2.0	VC	0.48	144	115	96.0	82.3	72.0	57.6	48.0	36.0	32.0	28.8	23.0	19.2	16.5
	3.0	C	0.59	177	142	118	101	88.5	70.8	59.0	44.3	39.3	35.4	28.3	23.6	20.2
	4.0	C	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	5.0	M	0.76	228	182	152	130	114	91.2	76.0	57.0	50.7	45.6	36.5	30.4	26.1
	6.0	M	0.83	249	199	166	142	125	99.5	83.0	62.3	55.3	49.8	39.8	33.2	28.5
AIXR11002 (50)	1.0	XC	0.46	138	110	92.0	78.9	69.0	55.2	46.0	34.5	30.7	27.6	22.1	18.4	15.8
	2.0	VC	0.65	195	156	130	111	97.5	78.0	65.0	48.8	43.3	39.0	31.2	26.0	22.3
	3.0	C	0.79	237	190	158	135	119	94.8	79.0	59.3	52.7	47.4	37.9	31.6	27.1
	4.0	C	0.91	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	5.0	C	1.02	306	245	204	175	153	122	102	76.5	68.0	61.2	49.0	40.8	35.0
	6.0	M	1.12	336	269	224	192	168	134	112	84.0	74.7	67.2	53.8	44.8	38.4
AIXR110035 (50)	1.0	XC	0.57	171	137	114	97.7	85.5	68.4	57.0	42.8	38.0	34.2	27.4	22.8	19.5
	2.0	XC	0.81	243	194	162	139	122	97.2	81.0	60.8	54.0	48.6	38.9	32.4	27.8
	3.0	VC	0.99	297	238	198	170	149	119	99.0	74.3	66.0	59.4	47.5	39.6	33.9
	4.0	C	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	5.0	C	1.28	384	307	256	219	192	154	128	96.0	85.3	76.8	61.4	51.2	43.9
	6.0	C	1.40	420	336	280	240	210	168	140	105	93.3	84.0	67.2	56.0	48.0
AIXR11003 (50)	1.0	XC	0.68	204	163	136	117	102	81.6	68.0	51.0	45.3	40.8	32.6	27.2	23.3
	2.0	XC	0.96	288	230	192	165	144	115	96.0	72.0	64.0	57.6	46.1	38.4	32.9
	3.0	VC	1.18	354	283	236	202	177	142	118	88.5	78.7	70.8	56.6	47.2	40.5
	4.0	C	1.36	408	326	272	233	204	163	136	102	90.7	81.6	65.3	54.4	46.6
	5.0	C	1.52	456	365	304	261	228	182	152	114	101	91.2	73.0	60.8	52.1
	6.0	C	1.67	501	401	334	286	251	200	167	125	111	100	80.2	66.8	57.3
AIXR11004 (50)	1.0	UC	0.97	273	218	182	156	137	109	91.0	68.3	60.7	54.6	43.7	36.4	31.2
	2.0	XC	1.29	387	310	258	221	194	155	129	96.8	86.0	77.4	61.9	51.6	44.2
	3.0	VC	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
	4.0	VC	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	5.0	C	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
	6.0	C	2.23	669	535	446	382	335	268	223	167	149	134	107	89.2	76.5
AIXR11005 (50)	1.0	UC	1.14	342	274	228	195	171	137	114	85.5	76.0	68.4	54.7	45.6	39.1
	2.0	XC	1.61	483	386	322	276	242	193	161	121	107	96.6	77.3	64.4	55.2
	3.0	XC	1.97	591	473	394	338	296	236	197	148	131	118	94.6	78.8	67.5
	4.0	VC	2.27	681	545	454	389	341	272	227	170	151	136	109	90.8	77.8
	5.0	C	2.54	762	610	508	435	381	305	254	191	169	152	122	102	87.1
	6.0	C	2.79	837	670	558	478	419	335	279	209	186	167	134	112	95.7
AIXR11006 (50)	1.0	UC	1.37	411	329	274	235	206	164	137	103	91.3	82.2	65.8	54.8	47.0
	2.0	XC	1.94	582	466	388	333	291	233	194	146	129	116	93.1	77.6	66.5
	3.0	XC	2.37	711	569	474	406	356	284	237	178	158	142	114	94.8	81.3
	4.0	VC	2.74	822	658	548	470	411	329	274	206	183	164	132	110	93.9
	5.0	C	3.06	918	734	612	525	459	367	306	230	204	183	147	122	105
	6.0	C	3.35	1005	804	670	574	502	402	335	251	223	201	161	134	115

Note: Always double check your applicator or notes. Calculations are based on spraying water at 72°F (21°C).
See pages 136–140 for drop size classification, nozzle formulas and other information.

CONTACT PRODUCT	SYSTEMIC PRODUCT	DRIFT MANAGEMENT
GOOD	EXCELLENT	EXCELLENT



Optimum Spray Height

110°	50 cm

How to order:

Specify tip number.
Example:
AIXR11004VP – Polymer with VisiFlo color-coding

Acknowledgement: TeeJet® Technologies.

Turbo FloodJet® Wide Angle Flat Spray Tips

Typical Applications:

See selection guide on page 2 for recommended typical applications for Turbo FloodJet tips.

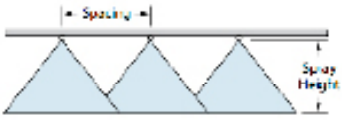
Features:

- Excellent spray distribution for uniform coverage along the boom.
- Nozzle design incorporates a pre-orifice to produce larger droplets for less drift.
- Large, round orifice reduces clogging.
- Stainless steel or polymer with VisiFlo® color-coding band for easy size identification.
- Can be used with CP2503D-*-NYR Quick TeeJet® cap and gasket for automatic alignment. Reference page 57 for more information.

QCT Cam Lever Coupling Adapter

- Provides easy changeover from high capacity to lower capacity nozzles.
- Adapter fits standard 4½" Cam lever coupling.
- Corrosion-resistant stainless steel and polypropylene construction.
- Rated up to 100 PSI (7 bar).
- Use QJT-NYB to retrofit to Quick TeeJet.

CONTACT PRODUCT	SYSTEMIC PRODUCT	DRIFT MANAGEMENT
—	VERY GOOD	EXCELLENT



	Bar	DROP SIZE	CAPACITY PER NOZZLE litres/min	Line 75 cm 4 km/h	6 km/h	8 km/h	10 km/h	12 km/h	16 km/h	20 km/h	25 km/h	Line 100 cm 4 km/h	6 km/h	8 km/h	10 km/h	12 km/h	16 km/h	20 km/h	25 km/h
TF-12 (50)	1.0	UC	0.91	182	121	91.0	72.8	60.7	45.5	36.4	29.1	137	91.0	68.3	54.6	45.5	34.1	27.3	21.8
	1.5	XC	1.11	222	148	111	88.8	74.0	55.5	44.4	35.5	167	111	83.3	66.6	55.5	41.6	33.3	26.6
	2.0	XC	1.28	256	172	128	103	86.0	64.5	51.6	41.3	194	129	96.8	77.4	64.5	48.4	38.7	31.0
	2.5	XC	1.44	288	192	144	115	96.0	72.0	57.6	46.1	216	144	108	86.4	72.0	54.0	43.2	34.6
	3.0	XC	1.58	316	211	158	126	105	79.0	63.2	50.6	237	158	119	94.9	79.0	59.3	47.4	37.9
TF-12.5 (50)	1.0	UC	1.14	228	152	114	91.2	76.0	57.0	45.6	36.5	171	114	85.5	68.4	57.0	42.8	34.2	27.4
	1.5	UC	1.40	280	187	140	112	93.3	70.0	56.0	44.8	210	140	105	84.0	70.0	52.5	42.0	33.6
	2.0	XC	1.61	322	215	161	129	107	80.5	64.4	51.5	242	161	121	96.6	80.5	60.4	48.3	38.6
	2.5	XC	1.80	360	240	180	144	120	90.0	72.0	57.6	270	180	135	108	90.0	67.5	54.0	43.2
	3.0	XC	1.97	394	263	197	158	131	98.5	78.8	63.0	296	197	148	118	98.5	73.9	59.1	47.3
TF-13 (50)	1.0	UC	1.37	274	183	137	110	91.3	68.5	54.8	43.8	206	137	103	82.2	68.5	51.4	41.1	32.9
	1.5	UC	1.68	336	224	168	134	112	84.0	67.2	53.8	252	168	126	101	84.0	63.0	50.4	40.3
	2.0	XC	1.94	388	259	194	155	129	97.0	77.6	62.1	291	194	146	116	97.0	72.8	58.2	46.6
	2.5	XC	2.17	434	289	217	174	145	109	86.8	69.4	326	217	163	130	109	81.4	65.1	52.1
	3.0	XC	2.37	474	316	237	190	158	119	94.8	75.8	356	237	178	142	119	88.9	71.1	56.9
TF-14 (50)	1.0	UC	1.82	364	243	182	146	121	91.1	72.8	58.2	273	182	137	109	91.0	68.3	54.6	43.7
	1.5	UC	2.23	446	297	223	178	149	112	89.2	71.4	335	223	167	134	112	83.6	66.9	53.5
	2.0	UC	2.57	514	343	257	206	171	129	103	82.2	386	257	193	154	129	96.4	77.1	61.7
	2.5	XC	2.88	576	384	288	230	192	144	115	92.2	432	288	216	173	144	108	86.4	69.1
	3.0	XC	3.15	630	420	315	252	210	158	126	101	473	315	236	189	158	118	94.5	75.6
TF-15 (50)	1.0	UC	2.28	456	304	228	182	152	114	91.2	73.0	342	228	171	137	114	85.5	68.4	54.7
	1.5	UC	2.79	558	372	279	223	186	140	112	89.3	419	279	209	167	140	105	83.7	67.0
	2.0	UC	3.22	644	429	322	258	215	161	129	103	483	322	242	193	161	121	96.6	77.3
	2.5	XC	3.60	720	480	360	288	240	180	144	115	540	360	270	216	180	135	108	86.4
	3.0	XC	3.95	790	527	395	316	263	198	158	126	593	395	296	237	198	148	119	94.8
TF-17.5 (50)	1.0	UC	3.42	684	456	342	274	228	171	137	109	513	342	257	205	171	128	103	82.1
	1.5	UC	4.19	838	559	419	335	279	210	168	134	628	419	314	251	210	157	126	101
	2.0	UC	4.84	968	645	484	387	323	242	194	155	725	484	363	290	242	182	145	116
	2.5	XC	5.41	1082	721	541	433	361	271	216	173	812	541	406	325	271	203	162	130
	3.0	XC	5.92	1184	789	592	474	395	296	237	189	888	592	444	355	296	222	178	142
TF-10 (50)	1.0	UC	4.56	912	608	456	365	304	228	182	146	684	456	342	274	228	171	137	109
	1.5	UC	5.58	1116	744	558	446	372	279	223	179	837	558	419	335	279	209	167	134
	2.0	UC	6.45	1290	860	645	516	430	323	258	206	967	645	484	387	323	242	194	155
	2.5	XC	7.21	1442	961	721	577	481	361	288	231	1082	721	541	433	361	270	216	173
	3.0	XC	7.90	1580	1053	790	632	527	395	316	253	1185	790	593	474	395	296	237	190

Note: Always double check your application rates. Tabulations are based on spraying water at 70°F (21°C).
See pages 124–140 for drop size classification, useful formulas and other information.

Optimum Spray Height

50 cm	60 cm*
75 cm	75 cm*
100 cm	100 cm*

*Wide angle spray nozzle height is influenced by nozzle orientation. The critical factor is to achieve a minimum 30% overlap.

How to order:

Specify tip number.

Examples:

TF-VS4 – Stainless Steel with VisiFlo color-coding

TF-VP4 – Polymer with VisiFlo color-coding

Acknowledgement: TeeJet® Technologies.

TeeJet® Even Flat Spray Tips

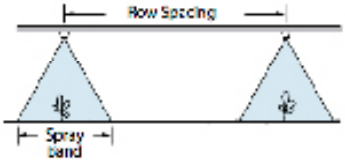
Typical Applications:

See selection guide on page 3 for recommended typical applications for TeeJet tips.

Features:

- Ideal for banding over the row or in row middles.
- Provides uniform distribution throughout the flat spray pattern.
- Easily mounted on spray boom or planter.
- Available with VisFlo® color-coding in stainless steel or all stainless steed, hardened stainless steel and brass.

	Psi	Capacity Oz/Min (Liters)	Lha 50cm Field Hectares						Lha 75 cm Field Hectares					
			4 km/h	6 km/h	8 km/h	10 km/h	15 km/h	20 km/h	4 km/h	6 km/h	8 km/h	10 km/h	15 km/h	20 km/h
TP4001E† TP6501E†	2.0	0.43	96.0	64.0	48.0	38.4	25.6	19.2	64.0	42.7	32.0	25.6	17.1	12.8
	2.5	0.46	108	72.0	54.0	43.2	28.8	21.6	72.0	48.0	36.0	28.8	19.2	14.4
TP8001E TP9501E (100)	3.0	0.50	117	78.0	58.5	46.8	31.2	23.4	78.0	52.0	39.0	31.2	20.8	15.6
	4.0	0.46	135	90.0	67.5	54.0	36.0	27.0	90.0	60.0	45.0	36.0	24.0	18.0
TP4015E† TP6515E†	2.0	0.48	144	96.0	72.0	57.6	38.4	28.8	96.0	64.0	48.0	38.4	25.6	19.2
	2.5	0.54	162	108	81.0	64.8	43.2	32.4	108	72.0	54.0	43.2	28.8	21.6
TP8015E TP9515E (100)	3.0	0.59	177	118	88.5	70.8	47.2	35.4	118	78.7	59.0	47.2	31.5	23.6
	4.0	0.68	204	136	102	81.6	54.4	40.8	136	90.7	68.0	54.4	36.3	27.2
TP4002E† TP6502E†	2.0	0.65	195	130	97.5	78.0	52.0	39.0	130	86.7	65.0	52.0	34.7	26.0
	2.5	0.72	216	144	108	86.4	57.6	43.2	144	96.0	72.0	57.6	38.4	28.8
TP8002E TP9502E (50)	3.0	0.79	237	158	119	94.8	63.2	47.4	158	105	79.0	63.2	42.1	31.6
	4.0	0.91	273	182	137	109	72.8	54.6	182	121	91.0	72.8	48.5	36.4
TP4003E† TP6503E†	2.0	0.96	288	192	144	115	76.8	57.6	192	128	96.0	76.8	51.2	38.4
	2.5	1.08	324	216	162	130	86.4	64.8	216	144	108	86.4	57.6	43.2
TP8003E TP9503E (50)	3.0	1.18	354	236	177	142	94.4	70.8	236	157	118	94.4	62.9	47.2
	4.0	1.36	408	272	204	163	109	81.6	272	181	136	109	72.5	54.4
TP4004E† TP6504E†	2.0	1.29	387	258	194	155	103	77.4	258	172	129	103	68.8	51.6
	2.5	1.44	432	288	216	173	115	86.4	288	192	144	115	76.8	57.6
TP8004E TP9504E (50)	3.0	1.58	474	316	237	190	126	94.8	316	211	158	126	84.3	63.2
	4.0	1.82	546	364	273	218	145	109	364	243	182	146	97.1	72.8
TP4005E† TP6505E†	2.0	1.61	483	322	242	193	129	96.6	322	215	161	129	85.9	64.4
	2.5	1.80	540	360	270	216	144	108	360	240	180	144	96.0	72.0
TP8005E TP9505E (50)	3.0	1.97	591	394	295	236	158	118	394	263	197	158	105	78.8
	4.0	2.27	681	454	341	272	182	136	454	303	227	182	121	90.8
TP4006E† TP6506E†	2.0	1.94	582	388	291	233	155	116	388	259	194	155	103	77.6
	2.5	2.16	648	432	324	259	173	130	432	288	216	173	115	86.4
TP8006E TP9506E (50)	3.0	2.37	711	474	356	284	190	142	474	316	237	190	126	94.8
	4.0	2.74	822	548	411	329	219	164	548	365	274	219	146	110
TP6508E† TP10008E†	2.0	2.58	774	516	387	310	206	155	516	344	258	206	138	103
	2.5	2.88	864	576	432	346	230	173	576	384	288	230	154	115
TP8008E TP9508E (50)	3.0	3.16	948	632	474	379	253	190	632	421	316	253	169	126
	4.0	3.65	1095	730	548	438	292	219	730	487	365	292	195	146
TP4010E† TP6510E† TP8010E† TP10010E† (24)	2.0	3.23	969	646	485	388	258	194	646	431	323	258	172	129
	2.5	3.61	1083	722	542	433	289	217	722	481	361	289	193	144
	3.0	3.95	1185	790	593	474	316	237	790	527	395	316	211	158
	4.0	4.56	1368	912	684	547	365	274	912	608	456	365	243	182
TP6515E† TP8015E† TP10015E†	2.0	4.84	1452	968	726	580	387	290	968	645	484	387	258	193
	2.5	5.40	1620	1080	810	648	432	324	1080	720	540	432	288	216
	3.0	5.92	1776	1184	888	710	474	355	1184	789	592	474	316	237
	4.0	6.84	2052	1368	1026	821	547	410	1368	912	684	547	365	274



					Lha CONVERSION FACTORS*	
40°	65°	80°	95°	110°	50 cm	75 cm
20 cm 27 cm	16 cm	12 cm	9 cm	7 cm	2.50	3.75
25 cm 34 cm	20 cm	15 cm	11 cm	9 cm	2.00	3.00
30 cm 41 cm	24 cm	18 cm	14 cm	11 cm	1.67	2.50
40 cm 55 cm	31 cm	24 cm	18 cm	14 cm	1.25	1.88

*To find Lha rate on band widths, multiply the tabulated Lha for ROW SPACING by conversion factors.

How to order:

Specify tip number.

Examples:

TP8002EVS – Stainless Steel with VisFlo color-coding

TP8002E-HSS – Hardened Stainless Steel

TP8002E-SS – Stainless Steel

TP8002E – Brass

Acknowledgement: TeeJet® Technologies.

Quick calibrations

Broadcast spraying

Drive tractor in field conditions for 100 meters

0 m — 100 m

Measure time (seconds)

Test all nozzles on boom to ensure output is similar. Replace nozzles if variation is greater than 5%.

Collect output (L) for same time from one nozzle

output (L) x 100 ÷ spacing between 2 nozzles (m) = water rate (L/ha)

tank size (L) ÷ water rate (L/ha) = hectares / tank

label rate (kg or L/ha) x hectares / tank = amount to add / tank

Band spraying

Drive tractor in field conditions for 100 meters

0 m — 100 m

Measure time (seconds)

Test all nozzles on boom to ensure output is similar. Replace nozzles if variation is greater than 5%.

Collect output (L) for same time from one nozzle

output (L) x 100 ÷ spray width of one band (m) = water rate (L/ha)

tank size (L) ÷ water rate (L/ha) = sprayed hectares / tank

label rate (kg or L/ha) x sprayed hectares / tank = amount to add / tank

sprayed hectares / tank x row spacing (m) ÷ one band spray width (m) = hectares driven

Directed spraying

Drive tractor in field conditions for 100 meters

0 m — 100 m

Measure time (seconds)

Collect output for same time (L) from all nozzles on one head (for droppers or any other configuration)

total output from all nozzles on one head (L) x 100 ÷ spray width of one head (m) = water rate (L/ha)

tank size (L) ÷ water rate (L/ha) = hectares / tank

label rate (kg or L/ha) x hectares / tank = amount to add / tank

Water rate selection

Using good quality water is very important, especially when applying glyphosate. Hard water (water that does not easily lather) is high in calcium and magnesium ions. This water will 'tie-up' glyphosate and reduce the efficacy of the product.

If water quality is in doubt, a water sample should be sent for analysis. There are commercially available products that can remedy water quality problems. See adjuvant chart in Appendix 2.

Target	Water rate (L/ha)	Comments
Small emerged weeds  	50 - 100 L	Low water rates are effective on small grass (2-3 leaf stage) and broadleaf weeds (less than 4 leaves).
Established seedlings  	100 - 200 L	Increase the water rate for grass which has tillered and mature broadleaf weeds.
Large grass  	200 - 300 L	High water rates are required to ensure good coverage on all leaves
Nutgrass in fallow (glyphosate)  	25 - 200 L	Water rates depend on the glyphosate product used. Different products have different surfactant packages which influence the optimum water rate. Glyphosate is more effective at low water rates.
Ratoon spray-out (glyphosate)  	75 - 200 L	
Residual application to soil  	200 - 400 L	High water rates are required to give adequate coverage of the soil surface to maximise the length of residual control.

Water spray quality

Spray water quality can have a large impact on how well certain herbicides work. Growers using bore water and surface supplies especially should check their water quality. Bore water quality can change across the season, depending on groundwater levels and recharge.

pH

The pH of water tells you whether it is acid, neutral or alkaline and is measured on a scale from 0 to 14, with 7 being neutral. This scale is logarithmic, meaning that each one-unit change in the pH scale corresponds to a ten-fold change in pH. For example, compared to pure water (pH 7):

- a pH of 6 is 10 times more acidic
- a pH of 5 is 100 times more acidic
- a pH of 4 is 1000 times more acidic

Most herbicides work best in a pH range of 3 to 6. Acidifying adjuvants may be required if spray water has a pH above this range; especially for:

- Glyphosate
- Paraquat
- 2,4-D

Glyphosate formulations generally include acidifiers but the surfactant included may vary widely across different products. Check the label to see if extra acidification is necessary.

Exceptions are the Group B sulfonylurea herbicides like Sempra®, which work better in alkaline water. Do not add acidifiers to these herbicides.

Spray water pH can be measured with simple test strips (Image 12), a pH meter, or as part of a full water analysis.

Image 12:
pH test strip kit.

Hardness

Hardness refers to a high level of positively charged metal ions like calcium, magnesium, sodium or iron. These positively charges ions attach themselves to negatively charged herbicide molecules; reducing the effectiveness of the herbicide. The problem is compounded with alkaline water. Hard water may be managed by using an ammonium sulphate adjuvant, such as Liase™.

Glyphosate and 2,4-D amine are particularly susceptible to hard water.

Water hardness can be measured with test strips (Image 13) or part of a full water analysis.

Image 13:
Total hardness test strip kit.

Bicarbonates

Bicarbonate is antagonistic to 2,4-D amine. Addition of ammonium sulphate (e.g. Liase) does not fix this problem and the addition of a non-ionic surfactant like LI 700 is also unreliable.

The best strategy is to use a 2,4-D LV ester formulation or switch to a MCPA product. Bicarbonates can only be measured with a laboratory analysis.

Muddiness

Glyphosate, paraquat and diquat can bind very tightly to suspended clay or organic matter particles; reducing their effectiveness. Water is classified as muddy if you cannot see a 20 cent coin on the bottom of a filled 9 L laundry bucket. If using muddy water is unavoidable for these herbicides, using the higher label rates and/or reducing water volume may help.

Mixing order

Mixing order	Additive	Example
1	60-80 % of required water volume	
2	Water conditioners	Liase. LI700
3	Water Dispersible powders[1]	
4	Water Soluble Granule (WSG)[1] Wettable Granule (WG)[1] Dry Flowable (DF)[1]	Gesapax Combi WG Balance Diuron DF, Tomahawk
5	Suspension Concentrates	Gesapax Combi
6	Wetter if using ECs[2]	
7	Emulsifiable Concentrate (EC) Including capsule suspension (CS)	Gesapax Combi Triflur X
8	Soluble Liquids (SL)[3] Includes aqueous solutions	Paraquat, Flame, Amicide Advance
9	Fill spray tank to nearly full	
10	Glyphosate based products	Roundup, Weedmaster
11	Adjuvants[4]	Activator

[1] Allow 10 minutes for thorough dispersion.

[2] Add wetter at stage 6 if using ECs or at stage 9 if not using ECs.

[3] Apart from glyphosate.

[4] Oils must be added last.

Minimising spray drift

Problem: Broadcast spray drift

Broadcast spraying at excessive pressure increases the proportion of small droplets from a nozzle which are prone to drift. Small droplets can travel long distances in air currents and can cause damage to other crops, and the environment.

High pressure

Image 14:
Small droplets are prone to drift.

Recommendations

1. Spray at the correct pressure

Image 15:
Larger droplets result in less drift.

Select the lowest pressure within the operating range for the nozzle (provided by nozzle manufacturer). As a general rule pre-orifice nozzles work best at 2-3 bar. Air-inducted nozzles generally work best at 3 bar or higher. Consult the manufacturers' charts for individual nozzle pressure ranges.

Conventional nozzles (such as XR TeeJet or Albuz AXI) often do not meet new label requirements for spray quality and should be replaced.

2. Reduce boom height

Set the minimum boom height which still provides effective target coverage. Minimum height recommended for 110° nozzles is 50 cm, and 80° nozzles is 60 cm above target.

Problem: Directed spray drift

Unnecessary sugarcane damage may occur from directed spraying at excessive pressure and incorrectly directed equipment. Spraying with non-selective herbicides at high pressure may cause drift of small droplets onto sugarcane leaves.

High pressure

Image 16:
Drift onto sugarcane leaves may occur at high pressure.

Recommendations

1. Spray at the correct pressure

Image 17:
Larger droplets result in less drift.

Nozzle technology has changed in recent years. Select the lowest pressure within the operating range for the nozzle (provided by nozzle manufacturer). Air inducted nozzles operate best with a minimum pressure of 3 bar. Flood jets provide large droplets and are less prone to drift. As a general rule do not spray greater than 1.2 bar (18 psi) with a flood jet nozzle.

2. Correct nozzle direction

Aim dropper or octopus head to maximise weed or soil coverage and minimise spray onto sugarcane leaves.

References

References

Blair A, Robertson J. 2014. User manual – dual herbicide sprayer Version 1.1. Queensland Department of Agriculture, Fisheries and Forestry. Brisbane. Qld.

Fillols, EF, Staier, T. 2016. Efficacy of alternative pre-emergent herbicides applied in trash-blanketed ratoons in the Wet Tropics. Proceedings of the Australian Society of Sugar Cane Technologists 38 p 216.

Fillols, EF, Callow, B. 2010. Efficacy of pre-emergent herbicides on fresh trash blankets - results on late-harvested ratoons. Proceedings of the Australian Society of Sugar Cane Technologists 33.

Fillols, EF, Callow, B. 2010. Efficacy of pre-emergent herbicides on fresh trash blankets - results on late-harvested ratoons. Proceedings of the Australian Society of Sugar Cane Technologists 33.

Fillols EF. 2010. Impact of nutgrass on sugarcane yield. Proceedings of the Australian Society of Sugar Cane Technologists 32.

Fillols EF. 2012. Weedicide properties of trash blankets and timing of application of pre-emergent herbicides on trash. Proceedings of the Australian Society of Sugar Cane Technologists 34.

Fillols EF. 2013. Nutgrass herbicide management: results of two pot trials. Proceedings of the Australian Society of Sugar Cane Technologists 37.

Fillols, EF. 2013. Weedicide properties of trash blankets and timing of application of pre-emergent herbicides on trash. International Sugar Journal Vol 115 Issue 1370 February 2013.

McMahon GG, Williams RC, McGuire PJ. 1989. The effects of weed competition on ratoon sugarcane yield. Proceedings of the Australian Society of Sugar Cane Technologists 11.

McMahon G, Lawrence P, and O'Grady T. 2000. Weed control in sugarcane. In: Manual of cane growing. (eds Hogarth DM and Allsopp PG), pp 241-261, BSES Brisbane. Qld.

Oliver DP, Anderson JS, Davis A, Lewis S, Brodie J, Kookana R. 2014. Banded applications are highly efficient in minimising herbicide migration from furrow-irrigated sugar cane. In: Science of the Total Environment 466-467 (2014) 841- 848.

Heap I. 2006. The International survey of Herbicide-Resistant Weeds. Weed Science (weedscience.com)

Kitt JT. 2014. Broadacre application handbook. 2nd edition. Nufarm Australia Limited.

Queensland Government. 2012. Work health and safety laws Guide for Queensland's rural industry. Workplace Health and Safety Queensland. Queensland Government. Brisbane. Qld.

Queensland Government. 2013. Managing risks of hazardous chemicals in the workplace. Code of practice 2013. Workplace Health and Safety Queensland. Queensland Government. Brisbane. Qld.

Queensland Government. 2015. Chemical Usage (Agricultural and Veterinary) Control Act 1988 – Chemical Usage (Agricultural and Veterinary) Control Regulation 1999 current as at 1 July 2015. Queensland Government. Brisbane. Qld.

Rohde. K, McDuffie. S, Agnew. J.2013 Paddock to Sub-catchment Scale Water Quality Monitoring of Sugarcane Management Practices. Final Report 2009/10 to 2011/12 Wet Seasons, Mackay Whitsunday Region. Department of Natural Resources and Mines, Queensland Government for Reef Catchments (Mackay Whitsunday Isaac) Limited Australia.

Rohde K, McDuffie K, Agnew J, Billing B. 2013. First 20 days after herbicide application is the high risk period for runoff in the Mackay Whitsunday region. Queensland Government Reef Water Quality protection Plan Secretariat.

Rohde. K, McDuffie. K, Robins. S, Agnew. J, Billing, B 2012 Overview of herbicide results – P2R and reef protection R & D trial, Mackay. DNRM, Queensland Government. Brisbane. Qld.

Silburn M, Rojas-Ponce S, Fillols E, McHugh J, Baille C. 2013. Comparing residual versus knockdown herbicides in sugarcane in the Mackay Whitsunday region. Queensland Government Reef Water Quality protection Plan Secretariat.

Wood N. 2005. Agricultural chemical users' manual – Guidelines and principles for responsible agricultural chemical use. Queensland Department of primary Industries and Fisheries. Brisbane. Qld.

2012. Adjuvants – Oils, surfactants and other additives for farm chemicals – revised 2012 edition. (compiled by Somervaille A, Betts G, Gordon B, Green V, Burgis M and Henderson R.), Grains Research and Development Corporation. Kingston. ACT.

Appendices

Appendix 1

Regional time-of-spraying constraints for herbicides containing diuron (these are label instructions)

Wet Tropics Region						
Calendar month	Products containing diuron only		Products containing diuron and hexazinone			
	Up to 450 g diuron active /ha (mixed with paraquat)	More than 450 g up to 1.8 kg diuron active/ha	Up to 450 g diuron active /ha (mixed with paraquat)	1.4 to 1.8 kg diuron active/ha		1 kg product/100 L spot spray for Guinea grass Maximum 5% of total farm area
	Plant and ratoons Blanket spray	Plant and ratoons after cane emergence Directed band spray over maximum 60% of crop area	Plant and ratoons Directed spray	Ratoons Before cane and weed emergence	Plant and ratoons After cane emergence Directed band spray over maximum 60% of crop area	
All year	Spray	No-spray	Spray	No-spray	No-spray	Spray

Burdekin/Dry Tropics Region						
Calendar month	Products containing diuron only		Products containing diuron and hexazinone			
	Up to 450 g diuron active /ha (mixed with paraquat)	More than 450 g up to 1.8 kg diuron active/ha	Up to 450 g diuron active /ha (mixed with paraquat)	1.4 to 1.8 kg diuron active/ha		1 kg product/100 L spot spray for Guinea grass Maximum 5% of total farm area
	Plant and ratoons Blanket spray	Plant and ratoons after cane emergence Directed band spray over maximum 60% of crop area	Plant and ratoons Directed spray	Ratoons Before cane and weed emergence	Plant and ratoons After cane emergence Directed band spray over maximum 60% of crop area	
December	Spray	Spray	Spray	No-spray	Spray	Spray
January and February	Spray	No-spray	Spray	No-spray	No-spray	Spray
March to November	Spray	Spray	Spray	Spray	Spray	Spray

Mackay/Whitsunday Region						
Calendar month	Products containing diuron only		Products containing diuron and hexazinone			
	Up to 450 g diuron active /ha (mixed with paraquat)	More than 450 g up to 1.8 kg diuron active/ha	Up to 450 g diuron active /ha (mixed with paraquat)	1.4 to 1.8 kg diuron active/ha		1 kg product/100 L spot spray for Guinea grass Maximum 5% of total farm area
	Plant and ratoons Blanket spray	Plant and ratoons after cane emergence Directed band spray over maximum 60% of crop area	Plant and ratoons Directed spray	Ratoons Before cane and weed emergence	Plant and ratoons After cane emergence Directed band spray over maximum 60% of crop area	
November	Spray	Spray	Spray	No-spray	No-spray	Spray
December to April	Spray	No-spray	Spray	No-spray	No-spray	Spray
May	Spray	Spray	Spray	No-spray	No-spray	Spray
June to October	Spray	Spray	Spray	Spray	Spray	Spray

Mary/Burnett Region						
Calendar month	Products containing diuron only		Products containing diuron and hexazinone			
	Up to 450 g diuron active /ha (mixed with paraquat)	More than 450 g up to 1.8 kg diuron active/ha	Up to 450 g diuron active /ha (mixed with paraquat)	1.4 to 1.8 kg diuron active/ha		1 kg product/100 L spot spray for Guinea grass Maximum 5% of total farm area
	Plant and ratoons Blanket spray	Plant and ratoons after cane emergence Directed band spray over maximum 60% of crop area	Plant and ratoons Directed spray	Ratoons Before cane and weed emergence	Plant and ratoons After cane emergence Directed band spray over maximum 60% of crop area	
November to February	Spray	No-spray	Spray	No-spray	No-spray	Spray
March to May	Spray	Spray	Spray	No-spray	Spray	Spray
June to October	Spray	Spray	Spray	Spray	Spray	Spray

NSW Region						
Calendar month	Products containing diuron only		Products containing diuron and hexazinone			
	Up to 450 g diuron active /ha (mixed with paraquat)	More than 450 g up to 1.8 kg diuron active/ha	Up to 450 g diuron active /ha (mixed with paraquat)	1.4 to 1.8 kg diuron active/ha		1 kg product/100 L spot spray for Guinea grass Maximum 5% of total farm area
	Plant and ratoons Blanket spray	Plant and ratoons after cane emergence Directed band spray over maximum 60% of crop area	Plant and ratoons Directed spray	Ratoons Before cane and weed emergence	Plant and ratoons After cane emergence Directed band spray over maximum 60% of crop area	
November to March	Spray	No-spray	Spray	No-spray	No-spray	Spray
April	Spray	No-spray	Spray	No-spray	Spray	Spray
May to October	Spray	Spray	Spray	Spray	Spray	Spray

Products containing diuron only include: Diurex® WG, Diuron 900DF, Diuron® 900 WDG

Products containing diuron plus hexazinone include Barrage, Bobcat® Combi.

Appendix 2

Additional legislative requirements for the use of products containing diuron, hexazinone, atrazine or ametryn

In Queensland, the Great Barrier Reef Protection Amendment Act 2009, amended both the Chemical Usage (Agricultural and Veterinary) Control Act 1988 and the Environmental Protection Act 1994.

In the Wet Tropics, Burdekin Dry Tropics, Mackay/Whitsunday catchments in Queensland there are additional legislative regulations for herbicides containing the active ingredients diuron, hexazinone, ametryn and atrazine:

- Growers in these catchments, who apply or supervise the application of herbicides containing diuron, hexazinone, ametryn or atrazine must hold the minimum qualifications of:
  - o RTC3401A (superseded) or AHCPMG301A – Control weeds
  - o RTC3704A (superseded) or AHCCHM303A – Prepare and apply chemicals
  - o RTC3705A (superseded) or AHCCHM304A – Transport, handle and store chemicals

  Or

  - o Hold an unrestricted Commercial Operator's license or a pilot chemical rating license under the Agricultural Chemicals Distribution Control Act 1988.

  Should Regulations be amended in the future to require users or supervisors to hold a current Unit of Competency (i.e. not a superseded qualification), growers may have to update their qualifications.

- Ametryn – the maximum rate of active ingredient per hectare per calendar year is 2.3 kg.

- Atrazine – the maximum rate of active ingredient per hectare per calendar year is 3 kg (and is now noted on labels).

- Diuron – the maximum rate of active ingredient per hectare per calendar year is 1.8 kg (and is now noted on labels).

- Additional constraints for products containing ametryn that may not appear on labels:
  - o Do not prepare or apply:
    - > At a place susceptible to runoff
    - > Within 20 m of a waterbody
    - > Within 20 m of a sinkhole or well.
  - o Do not apply within 20 m of all down-slope water bodies, or at the time of spraying, have a 5 m effective vegetated treatment area between the edge of the down-slop water body and any point where low-flow run-off exits the inter-rows.
  - o Do not apply on waterlogged soils.
  - o Do not apply within 30 m of a water body unless:
    - > Using a shielded sprayer, or
    - > Applying below the canopy level, or
    - > The water body is upwind of the application site.
  - o Only apply using spray equipment capable of producing spray droplets no smaller than coarse, unless:
    - > The product is applied below a canopy of at least 600 mm high and the nozzles are directed at the ground, or a shielded sprayer is used; and
    - > The product is applied using no smaller than medium droplets.
  - o Do not apply in wind speeds:
    - > greater than 20 km/h; and
    - > less than 3 km/h unless using a shielded sprayer or spraying below the canopy.
  - o Do not irrigate to the point of run-off within 48 hours
  - o Do not use if moderate to heavy rain is forecast during the 48 hours after use
  - o Do not use if Bureau of Meteorology (BOM) forecasts moderate to heavy rain within a 50 km radius, within 2 hours of the intended spray time.

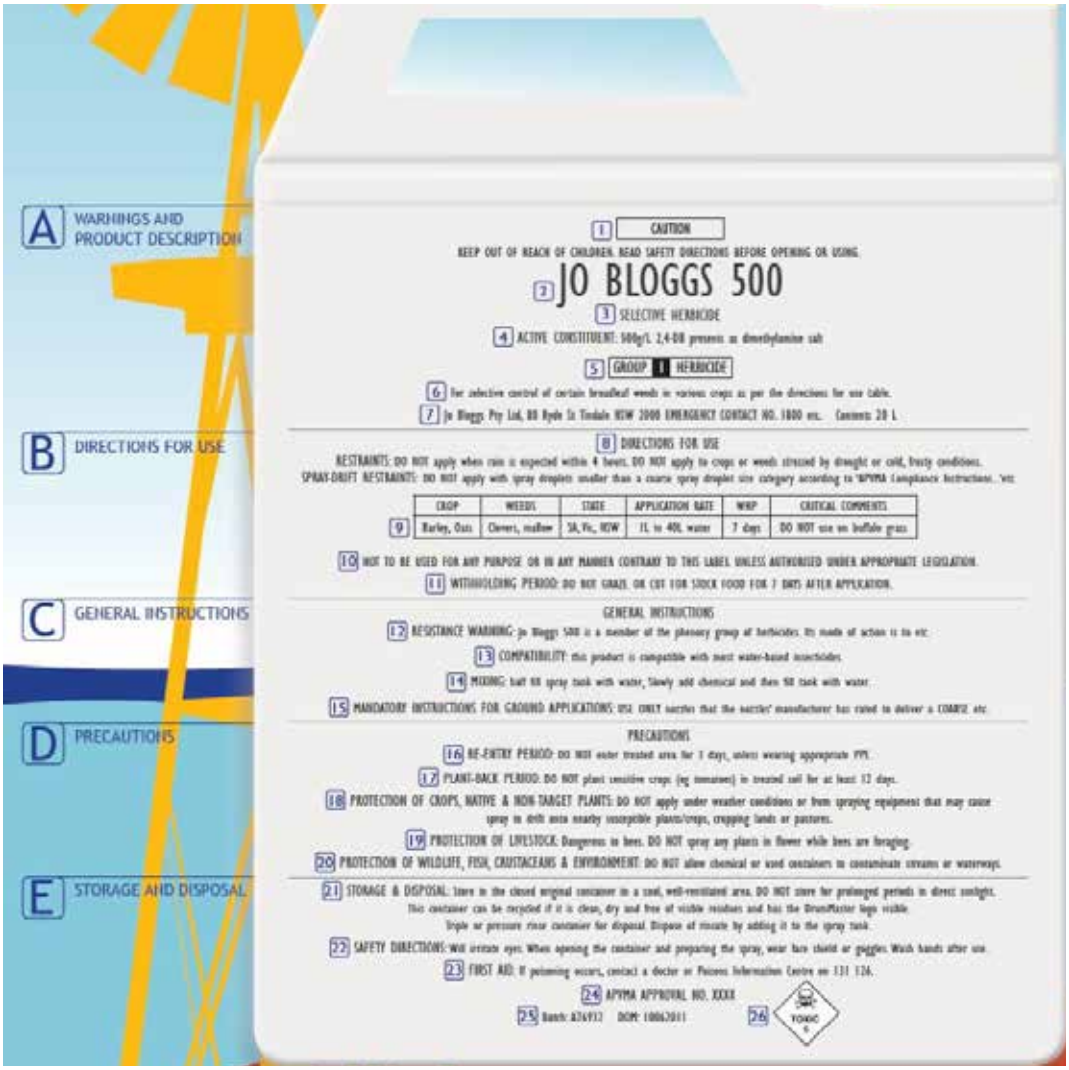
See also Record Keeping on page 22.

Source: Chemical Usage (Agricultural and Veterinary) Control Act 1988. Chemical Usage (Agricultural and Veterinary) Control Regulation 1999. Queensland Government 2015.

Appendix 3 Understanding pesticide labels

Product labels

Product labels contain important information. It is anticipated that from 2017 the way labels describe hazardous chemicals will change. This is due to Australia being a signatory to the Globally Harmonised System of Classification and Labelling of Chemicals (GHS). The GHS is designed to introduce a global standard for labelling. The example label below shows what information current (July 2016) labels contain, with a description on the next page.



Safety Data Sheets

A Safety Data Sheet (SDS) details information on the properties of hazardous chemicals and how they affect workplace health and safety. Every herbicide and adjuvant will have a SDS. Information includes product identification, hazard identification, toxicological, and environmental information, first aid measures. Emergency procedures, safe handling and storage procedures and disposal considerations.

Users of herbicides should have a current SDS for all the products used on farm. Under Workplace Health and Safety regulations, a supplier of pesticides must provide a current SDS for the hazardous chemical on first supply or upon request. SDS's can also be downloaded from manufacturer's or suppliers' websites.

A Warnings and product descriptions

1. Signal heading: Products are currently described as:
   - Dangerous Poison: Very hazardous to user and highly toxic
   - Poison: Still quite hazardous to the user and moderately toxic
   - Caution: Low to moderate hazard to user
   - No signal heading: Relatively safe and low toxicity
2. Product trade name.
3. Brief description of product.
4. The active constituent: The component responsible for controlling the pest.
5. Chemical Group: The grouping is a resistance management tool. Chemicals of the same group work in the same way.
6. What the chemical is registered to do.
7. The Manufacturers details.

B Directions for use

8 to 11. Directions for use including table: Tell you the rates of application, registered crops, withholding periods and critical comments. READ THIS SECTION CAREFULLY.

C General instructions

12 to 15. Gives details of any resistance issues, restraints and compatibility concerns.

D Precautions

16. Time between application and people being allowed in to the area sprayed: This is common on some nematicides and high toxicity insecticides.
17. Plant-back is the time from first application until seedlings or other crops can be planted: Common for soil fumigants and some residual herbicides.
18. This section gives details of avoiding damage to other crops and non-target plants: There may be drift management statements.
19. Protection of livestock including bees: Suggestions and statements restricting application around flowering plants, cattle, sheep etc.
20. Environmental section: This part is becoming bigger and more important each year. Please read all directions associated with this section.

E Storage and disposal

21. Information on storage temperatures, ventilation. Dispose of container through "Drummuster".
22. Human health and safety directions: Under the GHS there may be reference to the MSDS or SDS. It is advisable to have a copy. Label will give a summary of potential health effects. For example: eye or skin irritant.
23. First Aid Emergency directions: Make sure you have the SDS as well as the label.
24. APVMA approval numbers: Evidence that the chemical has been through the Australian registration process.
25. Batch numbers, manufacture dates: Are handy to record in unlikely event that the chemical doesn't work.
26. Dangerous goods information: For transport, storage and handling. The diamonds show the possible hazards. Growers do not usually store enough chemicals to fall under the Dangerous Goods regulations.

Future changes to labels

The main changes to labelling under the GHS will be:

Signal heading

The current Schedule will be replaced with the signal words DANGER or WARNING.

Hazard statements

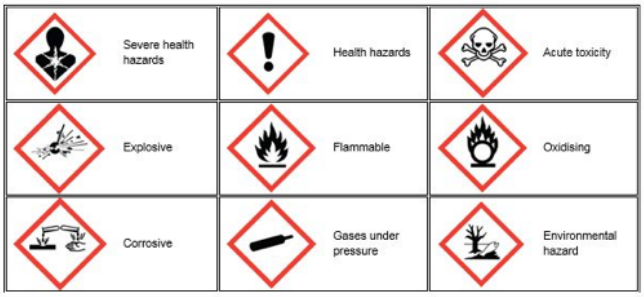
Hazard statements will describe the nature and the degree of a hazard. For example: Fatal if swallowed.

Precautionary statements

Precautionary statements will describe the recommended measures that should be taken to minimise or prevent adverse effects resulting from exposure to, or improper storage or handling of, a hazardous chemical. For example: Do not eat, drink or smoke when using this product. If swallowed: immediately call a POISON CENTRE or doctor. Store locked up.

Hazard pictograms

Hazard pictograms will describe the chemical in terms of physical, health and environmental hazards:



Sources: Description of current labelling has been licensed from the Australian Pesticides and Veterinary Medicines Authority (APVMA) under a Creative Commons Attribution 3.0 Australia Licence. This material is an extract from Understanding pesticide chemical labels, first published by the APVMA in 2011. Safe Work Australia. 2013. Understanding Hazardous Chemicals Labels: Fact Sheet.

Appendix 4 Setting up spray shields and hoods

Spray shields and hoods are a means of applying glyphosate or other non-residual herbicides to the inter-row. When using a non-selective systemic herbicide like glyphosate it is important to make sure that the cane is not accidently affected.

The most common problems with spray shields and hoods are excess dripping on the skirts or edges of the shield or hood and small droplets escaping from the shield or hood. Although glyphosate is deactivated on contact with soil, it may be taken up by fine cane feeder roots in or just under the trash. This may occur if incorrect nozzle set-up results in a continuous dripline of glyphosate off the side curtains.

Correct nozzle selection and set-up is critical.

GC Agriculture GCA – 1050 Shielded Sprayer

Image 18: GCA-1050 4 row shielded sprayer.

GC shielded sprayers should have correct nozzle setup from the factory. Although no longer manufactured, there are quite a few of these sprayers in operation in cane. They use two spray circuits; one to deliver one spray mixture (usually glyphosate) to the inter-rows through a nozzle under the shield and a second circuit to deliver a different spray mix to the rows. They have one nozzle under each shield and two side nozzles above each shield.

Ex-factory the nozzle configuration is:

Under shield nozzle

Agrotop TurboDrop® TD015 injector; fitted with 04 Turbo TeeJet 110⁰ nozzle.

The nozzle configuration should be angled backwards so that the spray swath hits the ground just clear of the side curtains of the shield. Shield width is adjustable and if changed the nozzle angle will also need to be altered to keep the spray swath just below the side curtains.

The injector part (TurboDrop® TD015) is a venturi AirMix® design and determines the flow rate while the Turbo TeeJet 04 nozzle acts as a distribution tip and provides a desirable spray pattern.

At 8 km/h travel speed and an operating pressure of 2 to 3 bar, this set-up will deliver approximately 40 to 60 L/sprayed hectare (depending on width of spray swath), with a very to extra coarse spray quality.

Image 19 and 20: Combination venturi injector and spray tip commonly used with GCA-1050 shielded sprayers (top) and exploded view (bottom).

Other nozzle configurations may be used and should ideally produce a minimum of very coarse spray quality at your chosen operating pressure.

Image 21: The nozzle angle must be adjusted to ensure the spray does not hit against the shield side curtains.

Side nozzles (2 per shield)

Standard side nozzle configuration is:

Agrotop TurboDrop® TD01 injector; fitted with 02 80⁰ TeeJet even fan nozzle.

Image 22 and 23: 01 injector fitted with 02 80⁰ flat fan nozzle (top) and fitted on sprayer to spray into cane (bottom).

Image 24: Side nozzles mounted on an arm off the support leg. Nozzles are sometimes mounted straight on the shield top surface.

Boomerang spray hoods

Boomerang spray hoods are generally supplied with three flat fan 110 degree 02 (yellow) XR TeeJet® nozzles, operating at 2 bar pressure. This setup results in excess dripping off the skirts at the edges of the hood as well as small droplets being produced and escaping the hood.

Department of Agriculture and Fisheries (DAF) recommendations to overcome these limitations are to replace the supplied nozzles with 80 degree 02 low drift fans (e.g. Teejet Driftguard®) and operate at 2 to 3 bar pressure.

Image 25: Boomerang spray hoods. Acknowledgements: Allan Blair, Jack Robertson (DAF).

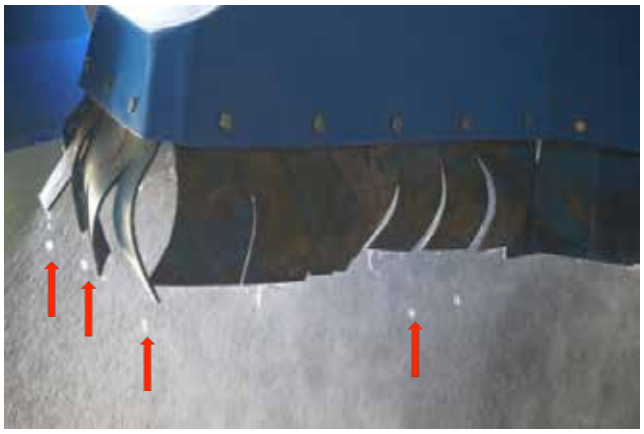


Image 26: Standard setup of sprayer showing droplets coalescing on skirt. Note also smaller droplets and potential for drift (XR type fan nozzle at 2.0 bar pressure).

Image 27: Close-up of hood with no droplets coalescing on the skirt. (Low drift, Driftguard® fan nozzles at 2.0 bar pressure).

Non-shielded Dual Herbicide Sprayer

Image 28: Non-shielded dual herbicide sprayer.

This sprayer uses two spray circuits, one to deliver a spray mixture (usually glyphosate) to the inter-row and a second circuit for a different spray mix to the rows. As the glyphosate is delivered without a spray shield or hood, specific nozzles must be used and the nozzle angle must be adjusted to ensure no glyphosate contacts cane foliage or shoots.

Centre nozzles should be air-inducted 95-110^0 even fan nozzles.

Wing nozzles should be 80 to 95^0 even fan nozzles, either air-inducted or conventional.

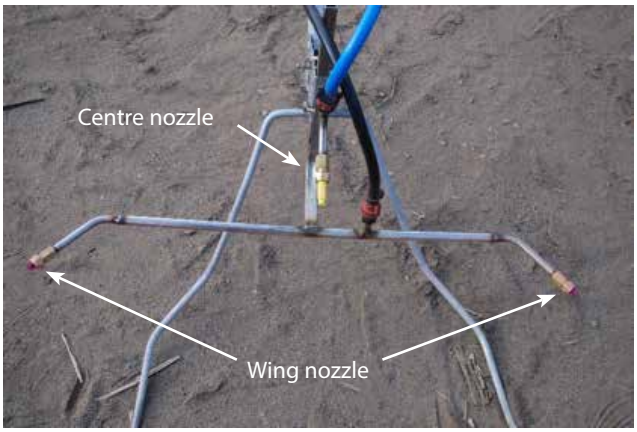


Image 29: Spray arm of the dual sprayer.

Design and operating instructions can be found in a User Manual available from Department of Agriculture and Fisheries (DAF). This manual includes a range of recommended nozzles and their performance at given pressures and travel speed.

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