Sugar Research Australia

WEED MANAGEMENT MANUAL

SRA Limited, 2021 edition

CONTENTS

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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 October 2020, 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 October 2020; 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.

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. 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 and use of band spraying. Choosing the right strategy will result in effective weed control and minimise off-farm impacts.

Figure 1: Effect of delayed nutgrass control in plant cane (Aitken RL. 2011)

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.

In plant cane 20% extra yield (Tonnes cane/ha) is possible with good weed control until stalk height is approximately 12cm. A gain of 20 T/ha is worth approximately $990/ha industry value (assuming $416 T sugar and 13 CCS)

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.

REDUCING THE WEED SEEDBANK

Controlling weeds before seed-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 (by 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 has 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) will minimise the introduction of weed seed to your farm.

USING APPROPRIATE CULTURAL PRACTICES

Trash blanketing in ratoons will suppress weeds, especially grasses.

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 are an important tool in preventing herbicide resistance developing.

USING MECHANICAL CONTROL

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

PREVENT WEED SPREAD BY MACHINERY

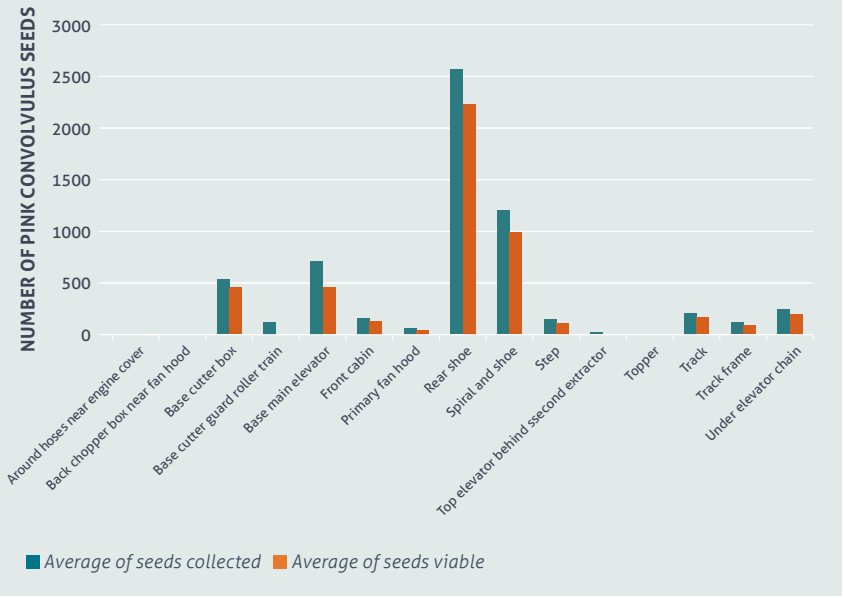
Unclean machinery is a major way of weed seed dispersal, both from block to block on farms and between farms. Growers should clean-down machinery especially when moving from known weedy blocks onto other parts of the farm. They should also have clean down agreements with contractors.

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 will remove most of these seeds.

Use this cleaning opportunity to also disinfect the harvester for Ratoon Stunting Disease (RSD).

Figure 2: Location of vine seeds on a harvester (Fillols E & Staier T. 2015).



Basic machine hygiene helps prevent weed seed spread!

Img. 1

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

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). Key points to reduce the risk of weed resistance developing include:

- 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 to a good thing - don't stick to it!

Resistance is present in weed populations before herbicides are used.

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 it is essential that growers fully understand the principles of herbicide resistance and implement strategies to prevent, or at least, 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.

TAKE HOME MESSAGE

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.

Img. 2

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: Steve Sutherland.

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

Herbicides kill weeds through various mechanisms within the plant or germinating seed. The way a particular herbicide affects a plant at the 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	Spark, Bobcat i-MAXX, Impose	Taken up by developing roots and translocated to growing tips.
	trifloxysulfuron – sodium	Krismat	Translocates from roots and foliage.
	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	Krismat, Ametrex 800WG	Translocates from roots and foliage.
	amicarbazone	AmiTron	Uptake by roots and leaves.
	atrazine	Farmozine WG, Gesaprim Granules	Upward translocation with the transpiration stream. Older leaves show most injury.
	terbuthylazine	Palmero TX	Uptake mainly by roots; some foliar uptake.
	terbutryn	Agtryne MA	Absorbed by leaves and roots.
	hexazinone	Bobcat Combi, Bobcat i-MAXX	Upward translocation with the transpiration stream. Older leaves show most injury.
	metribuzin	Mentor	Upward translocation with the transpiration stream. Older leaves show most injury.
	diuron	Diurex, Bobcat Combi	Upward translocation with the transpiration stream. Older leaves show most injury.
Group D	pendimethalin	Stomp Xtra, Rifle 440	Growing point inhibitor that mainly prevents root development and to a lesser extent growing point of shoots. Does not translocate.
	trifluralin	TriflurX	
Group E	No products registered for use in sugarcane		
Group F			
Group G	flumioxazin	Valor 500 WG	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 some fallow crops, not sugarcane.
Group H	isoxaflutole	Balance, Palmero TX	Taken up by germinating seedlings roots and shoots.

Group I	dicamba	Cadence, Kamba 750, 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 75-D	
	fluroxypr	Starane Advanced, Comet 400	
	MCPA	Agritone 750 , MCPA 750	
	picloram	Tordon 75D, Trooper 75-D	
Group K	S–metolachlor	Dual Gold, Bouncer 960S, Clincher Gold	Shoot inhibitor which prevents development of germinating shoot.
Group L	diquat	Spray.Seed 250, Reglone	Does not translocate. Coverage is important.
	paraquat	Spray.Seed 250, Shirquat, Revolver, Gramoxone 360 Pro	
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

It is very important that all on-farm activities have as little environmental impact as possible on downstream aquatic ecosystems, riparian zones, 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 (GBR) health and resilience. The plan includes ambitious reductions in pesticide, nutrient and sediment ***loads*** within the GBR, compared to baselines established in 2009.

Details of the Reef 2050 Plan and associated activities can be found at:

www.environment.gov.au/marine/gbr/long-term-sustainability-plan

Details of increased constraints on the use of diuron, hexazinone, atrazine and ametryn in Queensland can be found in *Appendix 3*.

Figure 3: Potential losses of herbicides in run-off when applied 48 hours before 80 mm/hr run-off event. (Fillols, E 2018). On average, approximately 13 percent of applied active ingredient was lost in surface run-off, except for flumioxazin and pendimethalin both of which showed lower losses.

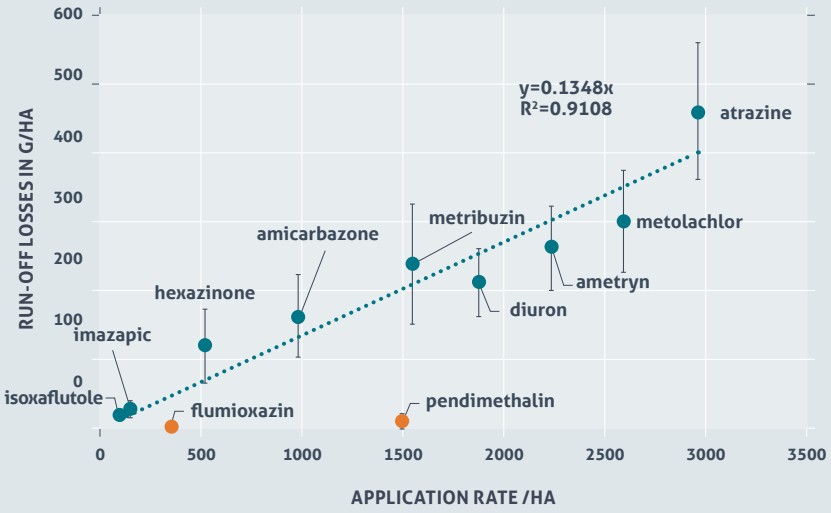
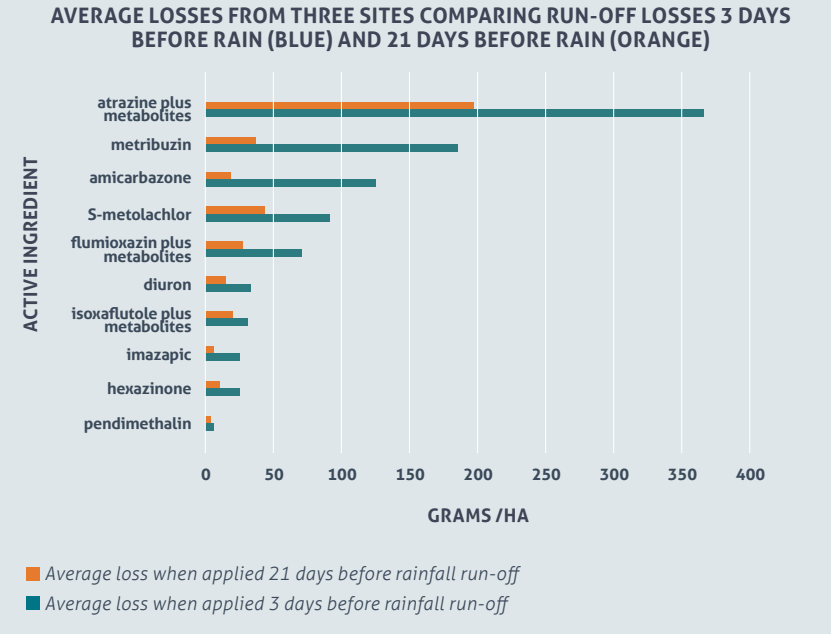


Figure 4: Effect of timing of first run-off on losses (Billing, B 2020). Extending the time from application to first run-off greatly reduced losses in surface run-off.



Application of herbicides

The key considerations are:

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.

Figure 3 shows the potential losses in run-off for a number of herbicides when applied just before rainfall. Apart from flumioxazin and pendimethalin, an average of approximately 13% of applied herbicide active ingredient was lost in run-off.

TIMING

Ensure products are not applied close to or during high risk periods, i.e. high rainfall events.

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 4)*.

Herbicide losses in run-off also approximately halved with every 50 mm of non-run-off-causing rainfall or irrigation, before the first run-off event. (Source: Rohde. K, McDuffie. S, Agnew. J, (2013).

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

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

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. The decrease in residual herbicide loss in run-off is directly proportional to the total area treated.

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 (DAF) dual herbicide sprayer.

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 over 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 DAF non-shielded dual sprayer must be set-up and operated correctly to avoid crop injury. A user manual for the dual herbicide sprayer is available from DAF. This manual includes drawings for those wanting to build their own sprayer.

RESIDUAL VERSUS KNOCK-DOWN HERBICIDES ON TRASH BLANKETED RATOONS

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

Herbicide losses in run-off are proportional to the volumes applied. Band spraying can reduce potential residual herbicide loads in run-off by half.

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) but insufficiently to prevent crop competition. Trash blankets delay germination of convolvulus and centro vines, 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 (eg. Spark), isoxaflutole (e.g. Balance), diuron and hexazinone (e.g. BobCat Combi), imazapic and hexazinone (e.g. Bobcat i-MAXX SG) 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.

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

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.

(Below from top to bottom; left to right) ***Image 3:*** *A high clearance tractor can be useful when applying herbicide to crops past the out-of-hand stage.* ***Image 4:*** *Irvin Legs and other droppers allow the nozzles to operate below the level of the cane leaves.* ***Image 5:*** *Band spraying reduces applied herbicide and input costs.* ***Image 6:*** *Shielded spraying for inter-row applications.* ***Image 7:*** *DAF dual spray bar (dual circuit)*

Img. 3

Img. 4

Img. 5

Img. 6

Img. 7

Weed size

Small weeds (ie 2 to 3-leaf stage) are much easier to kill than large ones *(Image 8)* and, therefore, less herbicide is applied. The grass weeds below (bottom left) are far more easily controlled than the 'tillered' ones below (bottom 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 inadequate 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, fluroxypr or MCPA, that applicators must use nozzles which create a coarse to very coarse droplet, in order to minimise drift onto susceptible plants, or watercourses. Wind speeds must also be between 3 and 15km/h or between 2 and 20km/h, depending on product label.

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. Specific adjuvants are recommended on each herbicide product label to optimise the herbicide efficacy when conditions are required. See chart in *Appendix 5* for common adjuvants.

Image 9: *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).* ***Image 10:*** *Calibrating spray equipment is essential. Ensure tanks and circuits are thoroughly flushed.*

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 (>4 Bar, 58 psi)

RECOMMENDATIONS

1. Spray at the correct pressure

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 50cm, and 80° nozzles is 60cm.

__Image 11:__ Problem – Small droplets are prone to drift. __Image 12:__ Result – larger droplets result in less drift. __Image 13:__ Problem – drift onto sugarcane leaves may occur at high pressure. __Image 14:__ Result – Larger droplets result in less drift.

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 (>4 Bar, 58 psi)

RECOMMENDATIONS

1. Spray at the correct pressure

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.

PROBLEM: INCORRECT SPRAY QUALITY WITH INAPPROPRIATE DROPLET SPECTRUM

Most product labels now have specific requirements for spray quality to minimise risk of spray drift onto non-target sensitive areas.

E.g. DO NOT apply with spray droplets smaller than VERY COARSE spray droplets according to the ASAE S572.1 definition for standard nozzles.

RECOMMENDATIONS

Always check both the nozzle output and spray quality specifications of a nozzle, at the operating pressure you intend to use. Nozzles with the same nozzle flow rate at a given pressure can produce different spray droplet spectrums.

PROBLEM: BLOCKING OF AIR INDUCTED (AI) NOZZLES ON DROPERS OR IRVIN LEGS

The requirement for nozzles producing a spray quality of no smaller than VERY COARSE when applying 2,4-D based herbicides sometimes results in those nozzles becoming blocked with dirt and/or trash, due to their proximity to the ground.

RECOMMENDATIONS

1. Fabricate a nozzle guard to minimise blocking of the AI nozzle.
2. Modify the Irvin leg to replace the 6-nozzle spray platform with a swivel and 2 or 4 TF Turbo Floodjet® nozzles. These nozzles produce a VERY COARSE to ULTRA COARSE spray quality depending on pressure (Images 15 and 16).

   For fabrication of these dropper adapters contact:
   A & S Wilson Engineering Pty Ltd (Palmyra, Mackay)
   Mobile: 0407400903

	Pressure (bar)				
	1.0	1.5	2.0	2.5	3.0
TF-2	UC	XC	XC	XC	VC
TF-2.5	UC	UC	XC	XC	XC
TF-3	UC	UC	XC	XC	XC
TF-4	UC	UC	UC	XC	XC
TF-5	UC	UC	UC	UC	XC
TF-7.5	UC	UC	UC	UC	XC
TF-10	UC	UC	UC	UC	XC

(TeeJet® Technologies Catalog 51A-M)

3. Change to a "RayBar" dropper system to replace the trailing legs on Irvin spray systems (Image 17). TeeJet® AIUB8503 (85-degree offset, air inducted nozzles) are used for the spray arms with a TeeJet TTI Twinjet® TTI60-11006VP nozzle (110-degree, air inducted twin nozzle) used for the centre nozzle. Guards can be fitted to protect the two spray arm nozzles.

   Commercial arrangements for supply of these spray bars are being finalised. Details will be published when available.

Pressure (bar)	AIUB8503	TTI60-11006VP
1.5		UC
2.0	UC	UC
3.0	XC	UC
4.0	XC	XC

(TeeJet® Technologies Catalog 51A-M)

Img. 15

Img. 16

Image 15 and 16: *Farmacist, Project Bluewater Case Studies Directed Herbicide Spray in Sugarcane and Floodjet® Nozzles.*

Img. 17

Image 17: Dropper and side arms custom-designed to replace Irvin trailing legs. Ray Abela, Eton

Buffer zones

Some products now have mandatory buffer zones, which may differ by product, rate applied and method of application.

In 2019 the APVMA clarified the requirement for buffer zones when herbicides are applied below the cane canopy:

Some products do not require a spray drift risk assessment when the proposed product label limits their use to:

- application with specialised equipment in cropping situations where the **nozzles are orientated below the horizontal of the top of the crop canopy and spray is released at a height below the top of the crop canopy (e.g. drop nozzles used to direct the spray to the furrows between emerged crops)**, or small booms used to spray inter-row areas in tree and vine crops), but excluding sprayers where air is used to aid in the spray penetrating the canopy as these are defined as 'vertical sprayers' (eg air blast sprayers in orchards)."

(APVMA Spray drift assessment manual Stage one July 2019)

This means that downwind buffer zone requirements listed on chemical labels are no longer a requirement when using droppers such as Irvin legs which meet the above requirements.

Refer to individual herbicides in the Herbicide Suitability section for buffer zones that apply when the above conditions are not met.

RECORD KEEPING

Record keeping requirements under the *Chemical Usage (Agriculture and Veterinary) Control Regulation 2017* (Queensland legislation) and the *Agricultural and Veterinary Chemical Code Act 1994* (Commonwealth legislation) include:

- Full name, contact details (address and phone number) of:
  - User (includes an aircraft pilot)
  - Land owner or occupier
  - Supervisor (if relevant)
- Qualifications (user and supervisor if relevant)
- Product
  - Trade name
  - APVMA Registration number and label number
  - Manufacturer
  - Name and amount of active constituent
- Exact location applied, e.g. Real Property Description Number plus paddock name or number
- Date(s) of application (plus start and finish times for 2.4-D based herbicides)
- Equipment and methods used (e.g. boomsprayer, handgun, type of nozzle)
  - plus nozzle brand, model, size, type and spray system pressure (for 2,4-D based herbicides)
  - plus height of boom above the ground (for 2,4-D based herbicides)
- Weather conditions – record before, during and after application
  - Temperature and relative humidity or Delta T
  - Wind speed and direction
  - Cloud cover
  - Amount of any rain
- Rate of product applied (plus total area sprayed for 2,4-D based herbicides)
- Crop treated or situation the chemical was used in
- Purpose of application (e.g. control of sicklepod)
- Any additional requirement listed on label or permits

Make the record within 2 days and keep for a minimum of 2 years (for 2,4-D based herbicides, make the record within 24 hours of application)

Additional record keeping requirements apply to prescribed products used in agricultural environmentally relevant activities (ERA) within the following Great Barrier Reef catchments:

- the Wet Tropics Region
- the Burdekin Region
- the Mackay Whitsunday Region

For sugarcane, the prescribed chemicals are those containing diuron, hexazinone, ametryn or atrazine. The additional record keeping requirements are:

- a receipt or other record of acquisition of the product
- a copy of any chemical application qualifications held by the chemical user
- make the record within 3 days of using the chemical and keep for a minimum of 2 years.

Not all items are required to be recorded every time product is sprayed. For example, full contact details and qualifications may be recorded for all relevant persons once, and then referred to by name in subsequent records. Likewise, when using identical spray mixes, the user may write down all required information once, and refer to this in subsequent records. Items such as weather conditions must be recorded each time you spray, at a minimum before, during and after application to ensure weather conditions are suitable for spraying the product(s).

Spray contractors must also record

- **the registration mark of the aircraft being used (if applicable)**
- **total area covered by the chemical application**
- **description and amount of any diluent or additives to the spray mixture**

As there are some slight differences in record keeping requirements, depending on the relevant legislation, it may be simpler for growers to keep records that detail all of the above details for all products used.

This information is current as at October 2020. Ensure you refer to current legislation and label requirements.

Reference

https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/chemical-controls/using-chemicals/keeping-records

SELECTION GUIDE

Guide to herbicide selection at different crop stages

Note: the following recommendations are not exhaustive. Refer to local productivity services' or consultants' recommendations for site-specific recommendations.

PLANT CANE AND RATOON ON BARE SOIL

OTHER CROP SITUATIONS

PROBLEM WEEDS

Some herbicides may be registered with APVMA but are not readily available to purchase. 2,2-DPA (e.g. Dalapon 740 SP Systemic Grasskiller, Atlapon 2,2-DPA Systemic Grasskiller) has not been included in this manual although it is registered for use in sugarcane.

STAGE 1:
EARLY EMERGENCE

Important factors in herbicide selection

SOIL TYPE AND 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	Apply residual herbicides to provide weed control after the out-of-hand stage, and to reduce weed pressure in ratoons. Residual herbicide application provides weed control on mound planting and in between 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 5–7cm 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 EMERGENCE	Herbicide absorption into sugarcane at this stage is minimal provided leaves are still unfurled in the spike.	

Residual control*

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	SOIL TYPE	INCORPORATION TIME
ametryn (800g/kg) + atrazine (900g/kg)	2500g + 3300g	$60 + $30	All soils	<10 days
pendimethalin (Stomp Xtra) + atrazine (900g/kg)	2200mL + 1500g	$36 + $14	Do not use on heavy clay soils	3–5 days
amicarbazone (AmiTron)	500–1000 g	$36–$72	Use lighter rate on lighter soils. Do not use on very sandy soils (>90%)	UV stable but early incorporation (At least 48 hours after application with light irrigation recommended to minimise risk of loss in run-off)
diuron (900g/kg)	1900g**	$30	Avoid very light sandy soils	<10 days
imazapic (Spark)	300–400 mL	$8–$11	May be less effective in some soil types (refer to label)	>10 days
isoxaflutole (Balance)	100–200g	$18–$35	Soil test required	>10 days

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	SOIL TYPE	INCORPORATION TIME
imazapic + hexazinone (Bobcat i-MAXX SG) **(Only apply in ratoons at this crop stage)**	500–630g	$58–$73	Use low rate on sandy soil	3–4 days
isoxaflutole + terbuthylazine (Palmero TX) **(Only apply in ratoons at this crop stage)**	1000–2000g	$42–$84	Soil test required	>10 days
metribuzin (Mentor)	640–2000g	$31–$97	Avoid light sandy soils	<7 days
S-metolachlor (Dual Gold) + atrazine (900 g/kg)	1100–1450mL + 1500–2000g	$16–$20 + $14–$18	Southern region (Bundaberg south)	<10 days
	1450–1800mL + 2000–2500g	$20–$25 + $18–$23	North Qld only (Mackay north)	
S-metolachlor + atrazine (Primextra Gold)	3600–4800mL	$70–$93	Southern region (Bundaberg South)	<10 days
	4800–6000mL	$93–$117	Northern region (Mackay North)	
trifluralin (TriflurX)	2300–3000 mL	$21–$27	All soils	<4 hours

**Recommendations provide approximately 6–10 weeks control of grass and broadleaf weeds.*
***Check Queensland legislative constraints for diuron.*

Broad-spectrum knockdown control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
paraquat (250g/L)	1200–1600mL	$11–$15	Use lower paraquat rate for control of grass with small root system. Add diuron for control of grass with more advanced root system.
paraquat (250g/L) + diuron (900g/kg)	1200–1600mL + 275–500g	$11–$15 + $4–$8	This rate of diuron can be used in all sugarcane regions all year long. Apply directed spray only.
diquat + paraquat (Spray.Seed 250)	1200–2000mL	$13 – $22	Provides better broadleaf weed control than paraquat alone.
diquat + paraquat (Spray.Seed 250) + diuron (900g/kg)	1200–2000mL + 500–1000g	$13–$22 + $8–$16	Addition of diuron improves broadleaf and grass weed control.
metribuzin (Mentor)	640–2000 g	$31–$97	Three ways of translocation (taken up by roots, shoots and leaves). Rapidly rain-fast.

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 Extra, Dual Gold, Balance, Mentor, Spark or TriflurX will provide residual grass control until 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.

Knockdown grass control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
paraquat (250g/L)	1200–1600mL	$11–$15	Use lower rate for grass with small root system. For larger grasses, add diuron 900 at 275–500g/ha and apply directed spray.
paraquat + diquat (Spray. Seed)	1200–2000mL	$13–$22	

Knockdown broadleaf control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
MCPA (Agritone 750)	930mL	$13	Apply as a directed inter-row spray.
2,4-D amine (625 g/L)	1800–3500mL	$13–$25	Avoid use near hormone sensitive crops. Must be applied using a coarse spray quality or larger. Refer to product labels.
2,4-D amine (700g/L) (Amicide Advance 700)	1600mL–3100mL	$12–$24	
terbutryn + MCPA (Agtryne MA)	2000–4000mL	$39–$78	Non-volatile and, therefore, safer near horticultural crops.
trifloxysulfuron sodium + ametryn (Krismat)	1500–2000g	$63–$84	Can be applied over the top until 6-leaf stage. Refer to phytotoxicity guide for varieties susceptible to ametryn.
fluroxypyr (Starane Advanced) (Comet 400) + 2,4-D amine 625	Ground application 780mL 650mL + 800mL	 $31 $32 + $6	Fluroxypyr is a low-volatile ester and safer near horticultural crops. Spray quality must be coarse to very coarse. Refer to product labels.

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
dicamba (Cadence WG) + atrazine (900 g/kg)	370–740g + 560–1100g	$7–$13 + $5–$10	Add atrazine for residual control

Residual broad-spectrum control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
amicarbazone (AmiTron)	500–1000g	$36 – $72	Use lower rates on lighter soils. Do not use in very sandy soil (>90%). UV stable but early incorporation (at least 48 hours after application) with light irrigation is recommended to minimise risk of loss in run-off. Apply directed spray to minimise the risk of crop injury.
imazapic (Spark) + paraquat (250g/L)	300–400mL + 1200mL	$8–$11 + $11	Use low rate on light soils. Incorporation time >10 days. Add paraquat to prevent cane leaf uptake. **Only apply to ratoons at this stage.**
imazapic + hexazinone (Bobcat i-MAXX SG) + paraquat (250g/L)	500–630g + 1200mL	$58–$73 + $11	
isoxaflutole (Balance) + paraquat (250g/kg)	100–200mL + 1200mL	$18–$35 + $11	Soil test required. Use low rate on light soils. Incorporation time >10 days. Add paraquat to prevent cane leaf uptake. **Only apply to ratoons at this stage.**
diuron + hexazinone (Bobcat Combi) + paraquat (250 g/kg)	600–900g + 1200–1600mL	$14–$20 + $11–$15	Apply as directed spray only.

Residual grass control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
pendimethalin (Stomp Xtra)	2200 – 3300 mL	$36 – $54	Incorporate within 10 days. Soils containing a high percentage of organic matter, trash or stubble cover can result in poor control.
trifluralin (TriflurX)	2300 – 3000 mL	$21 – $27	Requires incorporation within 4 hours. Trash or crop cover stubble can bind trifluralin, reducing its effectiveness.

STAGE 3:
STOOLING

Important factors in herbicide selection

GRASS CONTROL	There are limited grass control options from this stage until a directed spray is possible. Prevent grass establishment in the row as large grasses cause significant yield loss.
CROP DAMAGE	Refer to individual product labels for more specific information.
RESIDUAL GRASS CONTROL	Spray contact with the soil surface may be difficult due to the canopy height.

Knockdown grass control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
asulam (Asulox, Rattler)	8500mL	$174	Safe to apply over sugarcane. A band spray may be a suitable option for cost-effective grass control in the row. Ensure use of high water volume (200–400 L/ha).
MSMA (Daconate)	6600mL	$108	May only be applied in circumstances where grass population is very dense. Crop damage will occur where Daconate contacts the sugarcane leaf. Spray when cane is 50–80cm high.

Knockdown broadleaf control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
MCPA (Agritone 750)	930–1450mL	$13–$21	Apply as a directed inter-row spray.
2,4-D amine 625	1800–3500mL	$13–$25	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)	1600–3100mL	$12–$24	
terbutryn + MCPA (Agtryne MA)	2000–4000mL	$39–$78	Non-volatile and, therefore, safer near horticultural crops.
trifloxysulfuron sodium + ametryn (Krismat)	1500–2000g	$63–$84	Use a directed spray to minimise contact with cane foliage.
fluroxypyr (Starane Advanced) (Comet 400) + 2,4-D amine 625	Ground application 780mL 650mL + 800mL	 $31 $32 + $6	Fluroxypyr is non-volatile and safer near horticultural crops.

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
dicamba (Cadence WG) + atrazine (900 g/kg)	370–740g + 560–1100g	$7–$13 + $5–$10	Add atrazine for residual control.

Residual broad-spectrum control (applied as a directed spray)

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	SOIL TYPE	INCORPORATION TIME
trifluralin 480 (TriflurX)	3000mL	$27	All soils	<4 hours
pendimethalin (Stomp XTRA) + atrazine or + metribuzin (Mentor)	2200mL + 1500g or + 1500–2000g	$36 + $14 or + $72–$97		<7 days
S-metolachlor (Dual Gold) + atrazine (900g/kg) or + metribuzin (Mentor)	1100–1450g + 2200g or + 1500–2000g	$16–$20 + $14 or + $72–$97	Southern region (Bundaberg South)	<10 days
S-metolachlor (Dual Gold) + atrazine (900g/kg) or + metribuzin (Mentor)	1450–1800mL + 2000–2500g or + 1500–2000 g	$20–$25 + $18–$23 or + $72–$97	Northern Qld only (Mackay North)	
imazapic (Spark) + paraquat (250g/L)	300–400mL + 1200mL	$8–$11 + $11	Avoid light sandy soil	>10 days
isoxaflutole (Balance) + paraquat (250g/L)	100–200g + 1200mL	$18–$35 + $11	Soil test required	>10 days
isoxaflutole (Balance) + metribuzin (Mentor) + paraquat (250g/L)	100–200g + 800–2000g + 1200mL	$18–$35 + $40–$97 + $11		<7 days
imazapic + hexazinone (Bobcat i-MAXX SG) + paraquat (250g/L)	500–630g + 1600mL	$58 –$73 + $15	Use lower rate on lighter soils	3–4 days
amicarbazone (AmiTron) + (+paraquat 250g/L, for knockdown effect)	500–1000g + 1200mL	$36–$72 + $11	Use lower rate on lighter soils. Do not use on very sandy soil (>90%)	UV stable but early incorporation (at least 48 hours after application) with light irrigation recommended to minimise risk of loss and run-off.
flumioxazin (Valor 500 WG) + (+paraquat 250g/L, for knockdown effect)	350–700g + 1200mL	$56–$113 + $11	Apply to moist soil	<21 days

STAGE 4:
ESTABLISHED SUGARCANE

Important factors in herbicide selection

SOIL TYPE AND 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 reduce 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.	

Residual broad-spectrum control – applied directed spray

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	SOIL TYPE	INCORPORATION TIME
hexazinone + diuron (Bobcat Combi)	3000–4000g	$69 –$91	Do not use on light sandy soil. Observe district-specific spray constraints for diuron. Add paraquat for additional knockdown effect. Add MSMA only if grasses are well established (crop damage will occur).	<10 days
diuron (900g/kg) + paraquat (250g/L) or + MSMA (Monopoly)	1900g + 1200mL or + 6600mL	$30 + $11 or + $49		
imazapic + hexazinone (Bobcat i-MAXX SG) + paraquat (250g/L)	500–630g + 1600mL	$58–$73 + $15	Use low rate on sandy soils.	3–4 days
flumioxazin (Valor 500 WG) + paraquat (250g/L)	350–700g + 1200mL	$56–$113 + $11	May be applied to sandy soils.	<21 days
terbuthylazine + isoxaflutole (Palmero TX) + paraquat (250g/L)	1000–2000g + 1200–1600mL	$42–$84 + $11–$15	Refer to label for specific soil constraints.	<21 days
isoxaflutole (Balance) + paraquat (250g/L)	100–200g + 1200mL	$18–$35 + $10	Soil test required.	>10 days
isoxaflutole (Balance) + metribuzin (Mentor) + paraquat (250g/L)	100–200g + 800–2000g + 1200mL	$18–35 + $40–$97 + $11		<7 days

Knockdown broad-spectrum control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
paraquat + diquat (Spray.Seed 250)	1200–1600mL	$13–$18	Directed application.
glufosinate-ammonium (Basta)	1000–3000mL	$16–$49	Directed application.
	1000–5000mL	$16–$81	Shielded/hooded application. Avoid contact with cane leaves and especially the growing point.

Knockdown broadleaf control

TREATMENT	RATE/HA		INDICATIVE COST/HA (GST INCLUSIVE)		COMMENTS
MCPA (Agritone 750)	930–1450mL		$13–$21		Apply as a directed inter-row spray.
2,4-D amine 625	1800–3500mL		$13–$25		Avoid use near hormone-sensitive crops. Must be applied using a minimum of very coarse droplets. Refer to product labels.
2,4-D amine 700 (Amicide Advance 700)	1600–3100mL		$12–$24		
terbutryn + MCPA (Agtryne MA)	2000–4000mL		$39–$78		Use a directed spray to minimise contact with cane foliage. Non-volatile and therefore safer near horticultural crops.
fluroxypyr (Starane Advanced) (Comet 400) + 2,4-D amine 625	Ground application 780mL 650mL + 800mL	Aerial application 900mL 750mL + 800mL	Ground application $31 $32 + $6	Aerial application $35 $37 + $6	Fluroxypyr is a low-volatile ester and safer near horticultural crops. Must be applied using a coarse to very coarse droplet for aerial application. Refer to product labels.
trifloxysulfuron sodium + ametryn (Krismat WG)	1500–2000g		$63–$84		Apply as a directed spray only.
dicamba (Cadence WG) + atrazine (900 g/kg)	370–740g + 560–1100g		$7–$13 + $5–$10		Add atrazine for residual control.

STAGE 5:
RATOON CANE ON GCTB

Important factors in herbicide selection

GCTB	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.
BROADLEAF WEED CONTROL	Refer to individual product labels for more specific information.

Residual broad-spectrum control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	SOIL TYPE	INCORPORATION TIME
hexazinone + diuron (Bobcat Combi)	3000–4000g	$69–$91	Do not use on light sandy soil. (Observe district-specific spray constraints – *appendix 1*).	Regularly used 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. Mix with paraquat when emerged weeds are present or when contact with cane foliage is likely.
diuron (900g/kg) + paraquat (250g/L)	1900g + 1200mL	$30 + $11		
imazapic (Spark) + paraquat (250g/L)	300–400mL + 1200mL	$8–$11 + $11	Do not use on light sandy soil.	
isoxaflutole (Balance) + paraquat (250g/L)	100–200g + 1200mL	$18–$35 + $11	See label for specific soil constraints.	
imazapic + hexazinone (Bobcat i-MAXX SG) + paraquat (250g/L)	500–630g + 1600mL	$58–$73 + $15	Use low rate on sandy soils.	
trifloxysulfuron sodium + ametryn (Krismat)	1500–2000g	$63–$84	May be applied on sandy soil.	
flumioxazin (Valor 500 WG) + paraquat (250g/L)	560–700g + 1200mL	$90–$113 + $11	Apply to moist soil. May be applied on sandy soil.	
amicarbazone (AmiTron 700 WG)	500–1000g	$36–$72	Use low rate on sandy soil. Do not apply on very sandy soil (>90% sand).	
isoxaflutole + terbuthylazine (Palmero TX) + paraquat (250g/L)	1000–2000g + 1200–1600mL	$42–$84 + $11–$15	See label for specific soil constraints.	

Knockdown broad-spectrum control

TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
glufosinate-ammonium (Basta)	1000–3000mL (directed application) 1000–5000mL (shielded/hooded application)	$16–$49 $16–$81	Do not apply until cane is 100cm overall height or 20cm to growing point. Avoid contact with cane growing points. Minimise contact with green foliage.
glyphosate (Roundup Ultra Max) (Weedmaster ARGO)	1100–4700mL 1200–5000mL	$10–$42 $10–$43	Apply using spray shield/hood. Apply early before formation of cane. Do not apply more than 3 applications. Avoid contact with all parts of the cane plant.
paraquat (Gramoxone 250)	1200–1600mL	$11–$14	Add 275–500g Diurex for improved control of weeds to 5cm high. Add non-ionic wetting agent. Apply as a directed spray.
paraquat (Gramoxone 360)	835–1100mL	$6–$8	Can be applied over the top of ratoon cane up to 10cm high – cane leaves will be scorched but new leaves will appear in 7 to 10 days. Add non-ionic or oil/non-ionic wetting agent as per label

Knockdown broadleaf control

TREATMENT	RATE/HA		INDICATIVE COST/HA (GST INCLUSIVE)		COMMENTS
MCPA (Agritone 750)	930mL		$13		Apply as a directed inter-row spray.
2,4-D amine 625	1800–3500mL		$13–$25		Avoid use near hormone sensitive crops. 2,4-D amine must be applied using a minimum of very coarse droplets. Refer to product labels.
2,4-D amine 700 (Amicide Advance 700)	1600–3100mL		$12–$24		
terbutryn + MCPA (Agtryne MA)	2000–4000mL		$39–$78		Do not apply by air. Do not apply over the top of cane.
fluroxypyr (Starane Advanced) (Comet 400) + 2,4-D amine 625	Ground application 780mL 650mL + 800mL	Aerial application 900mL 750mL + 800mL	Ground application $31 $32 + $6	Aerial application $35 $37 + $6	Low-volatile ester and safer near horticultural crops.
dicamba (Cadence WG) + atrazine (900g/kg)	370–740g + 560–1100g		$7–$13 + $5–$10		Add atrazine for residual control. Can be applied over the top of cane.

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	4000–9000mL	$28–$63	Apply to actively growing ratoons 60 to 120cm tall. Use lower rate for suppression or where cultivation is to follow.
glyphosate 360 – dual salt (Weedmaster DUO)	6000–9000mL	$52–$78	
glyphosate 450 (Gladiator)	4800–7200mL	$30–$45	
glyphosate 470 – dual salt (weedmaster DST)	4600–6900mL	$33–$50	
glyphosate 540 – dual/single salts (Weedmaster ARGO/ Glyphosate 540 K)	4000–6000mL	$34–$52	
glyphosate 570 (Roundup Ultra Max)	3800–5700mL	$34–$51	

Legume herbicide options

PRE-PLANT RESIDUAL HERBICIDES

CROP	WEED	TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
Soybeans Cowpeas Mungbeans	Grasses	pendimethalin (Stomp Xtra)	1800–2200mL	$29–$36	Mechanically incorporate to a depth of 2 to 5cm within 24 hours of application. Use higher rate on heavier soils.
Soybeans Cowpeas Mungbeans Lablab	Grasses	trifluralin (TriflurX)	1200–2300mL	$11–$21	Incorporate mechanically within 6 hours of application.
Soybeans Peanuts	Grasses	S-metolachlor (Dual Gold)	1000–2000mL	$14–$28	Apply before or immediately after planting and before weeds germinate. Incorporate within 10 days with rain or irrigation, or alternatively mechanically incorporate to 3 to 4cm.
Soybeans Mungbeans Peanuts	Broadleaf weeds and grasses	imazethapyr (Spinnaker*)	100–140g	$10–$14	Rainfall or irrigation is required to incorporate to a depth of 5cm prior to weed emergence. Apply post emergence in crusting soils (not for mungbeans).
Peanuts	Broadleaf weeds and grasses	imazapic (Spark)	300–400mL	$8–$11	Apply pre or post emergence to the crop. Rainfall or irrigation is required to incorporate to a depth of 5cm prior to weed emergence.
Peanuts Soybeans	Broadleaf weeds and grasses	flumioxazin (Valor)	210–280g	$33–$44	Apply pre or post sowing. Add knockdown herbicide like glyphosate or paraquat/diquat if weeds are present (refer to label).

This list of herbicide options is not exhaustive.

POST-PLANT KNOCKDOWN HERBICIDES

CROP	WEED	TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
Soybeans Peanuts	Broadleaf weed	bentazone (Basagran)	1500–2000mL	$52–$70	Do not harvest within 21 days for peanuts. Do not harvest for 8 weeks for soybeans.
	Grasses	fluazifop-P (Fusilade forte)	1240–1650mL (Peanuts) 820–1650mL (Soybeans)	$87–$116 $58–$116	Apply the lower rate to actively growing pre-tillering grasses at the 3 to 5-leaf stage. Apply the higher rate to perennial grasses above the 6-leaf stage. Apply in a minimum of 100L/ha. Withholding period before harvest: 6 weeks (peanuts), 17 weeks (soybeans).
Soybeans Mungbeans Peanuts	Broadleaf weed	imazethapyr (Spinnaker*)	100–140g	$10–$14	Apply to actively growing weeds in the 2 to 4-leaf stage. Withholding period harvest 14 days, grazing 28 days. Add non-ionic wetting agent 200mL/100L.
		acifluorfen (Blazer)	1000–2000mL	$70–$140	Can be applied as pre-emergent treatment on soybeans and peanuts: apply post sowing at 3 to 4L/ha. Apply to actively growing weeds up to the 4-leaf stage.
	Grasses	butroxydim (Factor)	120–180g	$20–$31	Use lower rate for seedlings at the pre-tiller stage. Use higher rate for grasses at early tillering (2 to 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 1L/100L spray solution for ground application. Do not graze or cut for stockfood for 14 days after application.
		haloxyfop (Verdict 520)	100–150mL	$6–$8	Nil withholding period before harvest, 28 days for grazing. Apply from crop 2nd leaf to flowering (pegging for peanuts). Always add an adjuvant – Add Uptake Spraying Oil at 500mL/100L of spray solution. Alternatively add non-ionic wetting agent at 200mL/100L and use the higher rate of Verdict 520. Do not add Uptake Spraying Oil if tank mixing with Blazer or Basagran.
		quizalofop (Quizalofop 200EC)	250–500mL	$6–$12	Withholding periods before harvest: mungbeans 12 weeks, peanuts 11 weeks, soybeans 12 weeks. Do not graze or cut for stockfood for 4 weeks (mungbeans), 11 weeks (peanuts), 4 weeks (soybeans) after application. Always add a surfactant/wetting agent when applying to weeds that have started to tiller.
		clethodim (Clethodim 240EC)	250–500mL	$4–$16	Always apply with D-C-Trate at 2000 mL/100L or Hasten or Supercharge at 1 L/100L or Uptake at 500 mL/100 L spray volume. For peanuts, do not apply after the pod full stage. For mungbeans and soybeans, do not apply after first flower buds are visible.
Group A herbicides (e.g. Fusilade forte®, Verdict™ 520, Clethodim 240EC, Quizalofop 200EC) 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 170–180ppm. Ammonium sulphate may help improve performance if water quality is suspect.					

**Refer to label for detail on plant back periods – all crops*
This list of herbicide options is not exhaustive.

PRE-HARVEST DESICCATES FOR LEGUMES

CROP	TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
Soybeans Mungbeans	diquat (Reglone)	2000–3000mL	$44–$66	**SOYBEANS** Spray when 80% of pods are yellow/brown and seeds are ripe – yellow and pliable. Harvest 4 to 7 days after spraying. **MUNGBEANS** Spray when 80–90% of pods are black or brown. Harvest 2 to 5 days after spraying. Desiccation may increase harvest losses.
Soybeans Mungbeans Cowpeas	glyphosate (Roundup Ultra Max) (Weedmaster ARGO) (Weedmaster DST)	645–1700mL 680–1800mL 780–2100mL	$5–$15	**SOYBEANS** Spray after pods have lost all green colour and 80–90% of leaves have dropped. Do not harvest within 7 days of application. **MUNGBEANS, COWPEAS** 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.

This list of herbicides for some fallow crops is not exhaustive. A range of publications dealing with the agronomy of chickpeas, mungbeans, peanuts, sogham, safflowers, soybeans and sunflowers are available from the Grains Research and Development Corporation (GRDC) https://grdc.com.au/resources-and-publications/grownotes/crop-agronomy

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 (900g/kg)	560–740g + 740–1100g	$10–$13 + $7–$10	Add atrazine for residual control.
	<50cm	2,4-D + picloram (Tordon 75-D*) + 2,4-D amine 625	700mL + 800mL	$12 + $6	Must be applied using coarse to very coarse droplets. Avoid use near sensitive crops. Only apply once per season.
	50–100cm		1000mL + 800mL	$16 + $6	
	>100cm		1500mL + 800mL	$25 + $6	
Milkweed	< 8 true leaves	dicamba (Cadence WG) + atrazine (900g/kg)	560g + 830g	$10 + $7	Boom or directed spray.
	Up to flowering	fluroxypyr (Comet 400) or fluroxypyr (Comet 400) + atrazine (900g/kg)	1500mL or 1150mL + 2200g	$74 or $57 + $20	Better control achieved with the atrazine mixture. Delay application until just before the cane reaches the "close-in" stage.

** Refer to label for plant back periods – legume crops*

Hard-to-kill vine control

CROP	WEED STAGE	TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)
Centro	<30cm	terbutryn + MCPA (Agtryne) + ametryn 500	3000–4000mL + 3000–3700mL (directed spray)	$59–$78 + $45–$88
	2–3 leaves until flowering	fluroxypyr (Comet 400)	650mL (ground applied) 750mL (aerial)	$32 $37
Calopo	<8 leaves	dicamba (Cadence WG)	400g	$8
	<100cm	terbutryn + MCPA (Agtryne MA)	2000–4000mL	$39–$78
Horned Cucumber Balsam pear	2–3 leaves until flowering	fluroxypyr (Comet 400)	650mL (ground applied) 750mL (aerial)	$32 $37

PROBLEM GRASS WEEDS AND SEDGES

Nutgrass control

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 15cm) remain dormant for extended periods
- Severe infestations can consume 25 to 45kg nitrogen/ha and at least 45kg potassium/ha
- Nutgrass can remove the equivalent of about 12mm rain from the cultivated layer in four to 8 days.

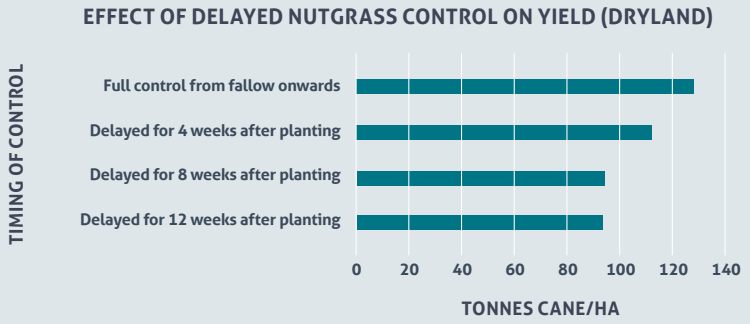
Poor nutgrass management may result in significant yield losses. Delayed control of nutgrass has resulted in cane yield losses of 18 and 25%, in irrigated and dryland crops, respectively in trials at Mackay *(Figures 5 and 6)*. Trials in Qld and NSW show completely unmanaged nutgrass may result in as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

Img. 18

Img. 19

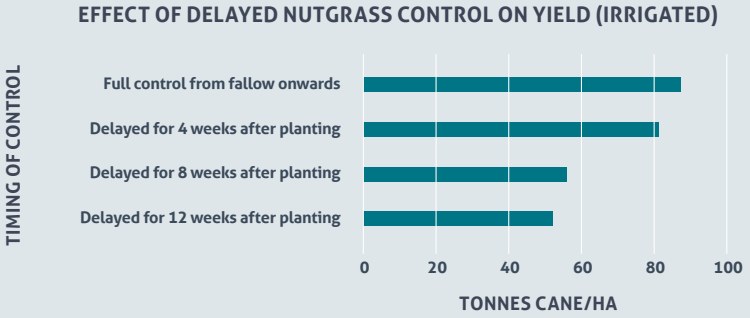
Image 18: *Connected chain of nutgrass tubers.*
Image 19: *Nutgrass at late seedling stage*

Figure 5: Productivity losses from nutgrass (dryland) (Fillols E. 2010).



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

Figure 6: Productivity losses from nutgrass (irrigated) (Fillols E. 2010).



In an irrigated system, delaying nutgrass control by four 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:

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. 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 to 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. Spark®) 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 30cm 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. Spark®) 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.

Ametryn plus trifloxysulfuron combinations (e.g. Krismat®) also reduces tuber viability but results are more variable.

Double knock treatments using 2,4-D or followed by Krismat® or 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 adequate reduction in tubers and tuber viability.

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

Nutgrass control

CROP	WEED STAGE	TREATMENT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
Soy fallow crop	2 to 4-leaf stage	imazethapyr (Spinnaker)	140g	$14	Add non-ionic surfactant at 200mL/100L or Hasten or Kwickin at 500mL/100L.
Peanut fallow crop	3 to 4-leaf stage	imazapic (Spark)	400mL	$11	Add Hasten or Supercharge at 1L/100L Apply before crop flowering and not more than once per season.
Bare fallow	At flowering	glyphosate 360	3000mL	$21	Two applications are needed to reduce tuber populations.
		glyphosate 450g/L (Gladiator)	2400mL	$15	
		glyphosate 540g/L – dual salt (Weedmaster ARGO)	2000mL	$17	
		glyphosate 540g/L – potassium salt (Glyphosate 540)	2000mL	$14	
		glyphosate 570g/L (Roundup Ultra Max)	1900mL	$16	
Cane (in-crop)	4 to 6-leaf stage	halosulfuron – methyl (Sempra)	65–130g	$28–$57	Always add Banjo or Supercharge Elite at 1L/100L. May be applied over sugarcane.
		trifloxysulfuron sodium + ametryn (Krismat)	1500–2000g	$63–$84	Can be applied 'over the top' until the 6-leaf stage or as a directed spray at all crop stages.
		glyphosate 540g/L – dual salt (Weedmaster ARGO)	1200–4700mL	$10–$40	Apply to inter-row only using spray shields/ hoods or DAF dual herbicide sprayer.
		glyphosate 540g/L – potassium salt (Glyphosate 540)	1200–5000mL	$9–$36	
		glyphosate 570g/L (Roundup Ultra Max)	1100–4700mL	$10–$42	

Perennial grass

GUINEA GRASS, SORGHUM, SETARIA, PASPALUM

TREATMENT	RATE	INDICATIVE COST/HA (GST INCLUSIVE)	COMMENTS
asulam (Asulox, Rattler)	8500mL/ha	$176	Safe to apply over sugarcane. Use high water volumes 200 to 400L/ha. Apply when weeds are actively growing, before flowering and before they exceed 200 to 250mm. For Guinea grass, apply to seedlings only – up to 10cm height.
asulam (Asulox, Rattler) + diuron (900g/kg)*	2000mL/100L + 500g/100L	$41/100L + $8/100L	Spot spray
hexazinone + diuron* (Bobcat Combi)	4000g/ha	$91	Directed spray
	1000g/100L	$19/100L	Spot spray
diuron (900g/kg)* + paraquat (250g/kg)	1900g/ha + 1600g/ha	$30 + $15	Directed spray
	1000g/100L + 500mL/100L	$15/100L + $5/100L	Spot spray
MSMA (Daconate)	6600mL/ha	$108	Directed spray
hexazinone + imazapic (Bobcat i-MAXX SG)	350g/100L	$40/100L	Spot spray when Guinea grass stools are at least 150mm high. Avoid contact with adjacent cane as crop injury will result.

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.*


Silvan
Silvan
50 YEARS

HERBICIDE SUITABILITY

HERBICIDE SUITABILITY

BROADLEAF KNOCKDOWN HERBICIDES		
ACTIVE INGREDIENT	**PRODUCT NAME EXAMPLES**	**PAGE NUMBER**
2,4-D	Amicide Advance 700, Amine 625, 2-4-D LV Ester	56
2,4-D + picloram	Tordon 75-D (registered for control of sicklepod only)	59
dicamba	Cadence WG, Kamba 750	70
flumioxazin	Valor 500 WG (as a "spike" for non-selective knockdown mixes)	75
fluroxypyr	Comet 400, Starane Advanced	78
glufosinate-ammonium	Basta	80
glyphosate	Roundup Ultra Max, Roundup CT, Weedmaster ARGO, Weedmaster DST, Weedmaster DUO	82
MCPA	Agritone 750, MCPA 750	92
paraquat + diquat	Spray.Seed 250, Revolver	98
terbutryne + MCPA	Agtryne MA	108

NUTGRASS KNOCKDOWN HERBICIDES		
ACTIVE INGREDIENT	**PRODUCT NAME EXAMPLES**	**PAGE NUMBER**
glyphosate	Roundup Ultra Max, Roundup CT, Weedmaster ARGO, Weedmaster DST, Weedmaster DUO	82
halosulfuron-methyl	Sempra	85

GRASS KNOCKDOWN HERBICIDES		
ACTIVE INGREDIENT	**PRODUCT NAME EXAMPLES**	**PAGE NUMBER**
asulam	Asulox, Rattler	67
MSMA	Daconate, Monopoly	95

BROAD-SPECTRUM KNOCK-DOWN HERBICIDES		
ACTIVE INGREDIENT	**PRODUCT NAME EXAMPLES**	**PAGE NUMBER**
ametryn + trifloxysulfuron	Krismat WG	63
glufosinate-ammonium	Basta	80
glyphosate	Roundup Ultra Max, Roundup CT, Weedmaster ARGO, Weedmaster DST, Weedmaster DUO	82
paraquat	Gramoxone 360 PRO, Paraquat, Spraytop	96
paraquat + diquat	Spray.Seed 250, Revolver	98

RESIDUAL (PRE-EMERGENT) HERBICIDES		
ACTIVE INGREDIENT	**PRODUCT NAME EXAMPLES**	**PAGE NUMBER**
ametryn	Ametryn 800 WG, Ametrex 800WG	61
amicarbazone	AmiTron 700WG	65
atrazine	Atrazine 900WG, Gesaprim Granules	68
diuron	Diuron 900WDG, Diurex WG	71
diuron + hexazinone	Bobcat Combi, Barrage	73
flumioxazin	Valor 500 WG	75
imazapic	Spark	86
imazapic + hexazinone	Bobcat i_MAXX SG	88
isoxaflutole	Balance	90
metribuzin	Mentor	93
pendimethalin	Stomp Xtra, Rifle 440	100
S-metolachlor	Dual Gold, Bouncer 960S	102
S-metolachlor + atrazine	Primextra Gold	104
terbuthylazine + isoxaflutole	Palmero TX	106
trifluralin	Trifluralin, TriflurX	109

How do cane varieties respond to herbicides?

Sugarcane varieties are known to have variable responses to herbicides with some being more impacted than others. As a result, data outlining susceptibility is critical to optimise productivity outcomes.

Since 2014, SRA has been conducting trials following a two-step process to obtain reliable data for the susceptibility of varieties to herbicides:

- a fully randomised replicated pot trial in year 1 to short-list the most susceptible combinations of varieties and herbicides.
- a fully randomised replicated field trial in year 2 to confirm that the short-listed combinations have an impact on yield.

In year 3, the two-step process starts again with new combinations of newly released varieties and herbicides.

In these trials, products are applied at their maximum label rate (and their minimum water label rate) when plant cane is at 4 to 6-leaf stage.

In the pot trials, weekly phytotoxicity ratings are conducted using the EWRC (European Weed Research Council) rating scale (*Table 1*) and the aerial plant dry biomass is measured 10 weeks after spraying.

In the field trials, plant cane yield is measured at harvest using a weigh truck.

In all trials, KQ228$^{\Phi}$ is assessed and used as a reference susceptible variety to compare to other tested varieties.

The phytotoxicity ratings obtained on KQ228$^{\Phi}$ in the pot trials are presented in Table 2. All varieties present identical symptoms but their severity may vary between varieties.

Table 3 summarises all phytotoxicity, biomass and yield results obtained in the pot and field trials from 2014 to 2020.

Tables 2 and 3 present the herbicide symptoms severity on the cane foliage on all tested varieties in a green to red scale (mild to severe symptoms due to the herbicide treatment compared to the untreated control).

These tables are updated yearly to include newly tested combinations of varieties by herbicides.

TABLE 1 PHYTO RATING USING THE EWRC SELECTIVITY RATING SCALE

NOTE	SYMPTOMS SEVERITY
1	No effect
2	Very slight effects. Some stunting and yellowing just visible
3	Slight effects. Stunting and yellowing obvious, effects reversible
4	Substantial chlorosis and or stunting, most effects probably reversible
5	Strong chlorosis/stunting, thinning of stand (50% loss)
6	Increasing severity of damage (70% loss)
7	Increasing severity of damage (85% loss)
8	Increasing severity of damage (90% loss) a few plants survive
9	Total loss of plants and yield

TABLE 2 SUMMARY OF PHYTOTOXICITY RATINGS AND SYMPTOMS OBTAINED ON THE REFERENCE SUSCEPTIBLE VARIETY KQ228$^{\Phi}$

	2,4-D	AMETRYN	AMETRYN+ TRIFLOXY SULFURON	AMI-CARBAZONE	ASULAM	DIURON	FLUMI-OXAZIN	METOLACHLOR/ S-METOLACHLOR	METRIBUZIN	MSMA
SYMPTOM DESCRIPTION	Small white spotty discolorations	Yellowing of the whole plant	Slight yellow blotching	Small white spotty discolorations	Bright yellow blotching	Slight yellowing of the whole plant	Large necrotic lesions	Small necrotic lesions	Slight yellowing of the whole plant	Large necrotic lesions
SYMPTOMS SEVERITY ON KQ228$^{\Phi}$	Mild	Medium to severe	Mild	Mild	Medium	Mild	Severe	Medium	Mild	Medium to severe
KQ228$^{\Phi}$ PHYTO RATING RANGE	1.2 to 1.9	1.8 to 3.2	1.3	1.3 to 1.5	1.1 to 2.6	1.8	3.9 to 4.1	1.1 to 2.8	1.2 to 1.8	1.7 to 3.5

MILD MEDIUM SEVERE

Table 3 also presents the cane dry biomass measured 10 weeks after spraying compared to the biomass of the untreated variety in a light to dark grey scale (slight to severe biomass reduction due to the herbicide treatment compared to the untreated control). Yield data from the field trials were also added to Table 3 and the combinations of varieties by herbicide that were tested in the field are marked with the symbols ☆ or △. Cells with ☆ indicate varieties whose yield was reduced by less than 10% compared to the untreated control. Cells with △ indicate varieties whose yield was reduced by more than 10% compared to the untreated control (no yield loss was statistically significantly different to the untreated control at P 0.05).

TABLE 3 PHYTOTOXICITY RATING, BIOMASS AND YIELD DIFFERENCE COMPARED TO THE UNTREATED CONTROL OF THE SAME VARIETY

	2,4-D		AMETRYN		AMETRYN+ TRIFLOXY-SULFURON		AMI-CARBAZONE		ASULAM		DIURON		FLUMI-OXAZIN		METOLACHLOR/ S-METOLACHLOR		METRIBUZIN		MSMA	
VARIETY	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD	PHYTOTOXICITY	BIOMASS/YIELD
KQ228(f)																				
Q208(f)						☆														☆
Q232(f)						△														
Q238(f)																				
Q240(f)						☆														△
Q242(f)																				
Q249(f)						☆														☆
Q250(f)																				
Q252(f)																				
Q253(f)																				
SP801-816										☆										△
SRA1(f)										☆										△
SRA2(f)																				☆
SRA3(f)										☆										△
SRA4(f)										△										
SRA5(f)																				
SRA6(f)										△										△
SRA7(f)										☆										☆
SRA8																				
SRA9(f)										☆										
SRA10(f)																				
SRA11(f)								☆		☆										
SRA12(f)		△								☆										
SRA13(f)		☆																		
SRA14(f)				☆																
SRA15(f)				△																
SRA16(f)		☆		☆						☆										
WSRA17(f)		△		△																
SRA19(f)																				
SRA21(f)																				
SRA23(f)																				
WSRA24(f)																				
SRA26(f)																				

- NO SYMPTOMS TO MILD PHYTOTOXICITY SYMPTOMS ON FOLIAGE
- MILD PHYTOTOXICITY SYMPTOMS ON FOLIAGE
- MODERATE PHYTOTOXICITY SYMPTOMS ON FOLIAGE
- SEVERE PHYTOTOXICITY SYMPTOMS ON FOLIAGE
- COMBINATION OF HERBICIDE BY VARIETY NOT TESTED
- NO BIOMASS REDUCTION IN POT TRIAL COMPARED TO UNTREATED
- SLIGHT BIOMASS REDUCTION IN POT TRIAL COMPARED TO UNTREATED
- MODERATE BIOMASS REDUCTION IN POT TRIAL COMPARED TO UNTREATED
- SEVERE BIOMASS REDUCTION IN POT TRIAL COMPARED TO UNTREATED
- ☆ COMBINATION OF HERBICIDE BY VARIETY TESTED IN FIELD TRIALS < 10% YIELD LOSS COMPARED TO UNTREATED
- △ COMBINATION OF HERBICIDE BY VARIETY TESTED IN FIELD TRIALS > 10% YIELD LOSS COMPARED TO UNTREATED

HOW TO READ
chemical labels and safety data sheets

Australia has now fully implemented the *Globally Harmonized System of Classification and Labelling of Chemicals*, or GHS. The GHS is a United Nations initiative to internationally standardise chemical classification, labelling and Safety Data Sheets (SDS) in the workplace. The key changes for users of chemicals will be Safety Data Sheets (SDS) replacing Materials Safety Data Sheets (MSDS), the presence of pictograms classifying hazardous chemicals and new warning information on labels (ref: comcare).

The main changes to labelling under the GHS are:

SIGNAL HEADING

The current schedule will be replaced with the signal words **DANGER** or **WARNING.** This indicates the severity of the hazard. Warning is used for less severe hazards while Danger means severe hazards.

HAZARD STATEMENTS

Hazard statements will describe the nature and the degree of a hazard. 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.

Examples: ***Do not eat, drink or smoke when using this product***

If swallowed: immediately call a POISON CENTRE or doctor

Store locked up

PICTOGRAMS

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

SEVERE HEALTH HAZARDS – *ASPIRATORY OR RESPIRATORY HAZARD, CARCINOGENICITY, MUTAGENICITY*

HEALTH HAZARDS – *ACUTE TOXICITY, SKIN IRRITIATION, EYE IRRITATION, SKIN SENSITISERS*

ACUTE TOXICITY – *ORAL, DERMAL OR INHALATION*

EXPLOSIVE – *SELF-REACTIVE SUBSTANCES, ORGANIC PEROXIDES*

FLAMMABLE – *PYROPHORIC, SELF-HEATING SUBSTANCES; WATER REACTIVE*

OXIDISING SUBSTANCES, ORGANIC PEROXIDES

CORROSIVE – *SKIN DAMAGE, EYE DAMAGE*

GASES UNDER PRESSURE – *COMPRESSED, LIQUEFIED OR DISSOLVED GASES*

ENVIRONMENTAL – *HAZARDOUS TO THE ENVIRONMENT, AQUATIC TOXICITY (SEE REFERENCE TABLE OVER PAGE).*

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.*

HOW TO READ
the following pages

PRODUCT NAME **BROAD USE TYPE (e.g. broadleaf systemic, knockdown, residual)** EXAMPLE PRODUCT NAMES	Example product name – active ingredient(s) and concentration Summary of useage – e.g. selective/non selective, systemic, pre/post-emergent, weeds targeted

HERBICIDE SUITABILITY	
WEATHER CONDITIONS	
TARGET WEED CONDITIONS	
CROP STAGE	
VARIETY SUSCEPTIBILITY	
WITHHOLDING PERIOD	
RISK TO OTHER CROPS	
PLANT BACK PERIOD	Minimum interval required before planting a following crop. Minimum time periods and rainfall/irrigation amounts may be required to prevent subsequent crop damage. Always refer to the label, not all product rates and species types are listed. Minimum rainfall amounts may also be required before the minimum time period begins.
ENVIRONMENTAL RISK	Products may have a seperate table at the end of this section indicating buffer zones if required.
HERBICIDE RESISTANCE	

EXAMPLE PRODUCT NAME The following information refers only to this product. It is intended as a guide only. Always refer to the current chemical label and SDS information. Products with the same active ingredient(s) may not always have the same hazard information.	
SIGNAL HEADING	***Signal Heading (as stated on the chemical label):*** 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
PICTOGRAM	A pictogram is a symbol that is intended to quickly convey special information about the hazards of chemicals. It is a black symbol on a white background within a red diamond.
HAZARD STATEMENT	This brief and to-the-point message describes the nature of the hazard, such as 'Fatal if swallowed'.

EXAMPLE PRODUCT NAME(S) The following information may refer to all listed products, unless specified.	
FORMULATION	Examples: soluble liquid, water dispersible granule
WATER QUALITY	This relates to potential issues with the quality of water used to make up the spray volume. Characteristics such as spray water pH, hardness and turbidity may influence the performance of the herbicides used.
APPLICATION EQUIPMENT	

APPLICATION RATES				
PRODUCT	**ACTIVE CONCENTRATION**	**PRODUCT/ha & ADJUVANT RATE**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**

2,4-D

Broadleaf systemic knockdown herbicide

AMICIDE® ADVANCE 700,
AMINE 625,
2,4-D LV ESTER 680

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

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

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

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

HERBICIDE SUITABILITY	
WEATHER CONDITIONS	Rainfast after 6 hours. Do not use unless wind speed is more than 3km/h and less than 15km/h measured at boom height at the application site and during time of application. For best results Delta T should be below eight. Do not apply if there are surface temperature inversion conditions present at the application site during the time of application.
TARGET WEED CONDITIONS	Apply to actively growing weeds with good soil moisture – do not apply to weeds that are stressed due to dry or excessively moist conditions. Seedling weeds are easily controlled when small. Perennial weeds should be sprayed just prior to flowering. High rates may cause rapid leaf drop. Tank mix with atrazine or fluroxypyr (Comet, etc) to improve knockdown of large harder to kill weeds and vines. The addition of Activator surfactant can also improve results on larger harder to kill weeds.
VARIETY SUSCEPTIBILITY	Refer to QCANESelect™ for variety sensitivity information or consult the SRA regional variety guides.
WITHHOLDING PERIOD	Do not cut for stock food for 7 days.
RISK TO OTHER CROPS	**Avoid drift onto non-target areas/crops.** Check new buffer zone restrictions on page 58. 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.
PLANT BACK PERIOD	Soybeans: 14 to 21 days. Chickpeas: 7 to 21 days*. Rice: 7 to 14 days. *Planting must be delayed for at least 14 days following rainfall of at least 15mm.
ENVIRONMENTAL RISK	Short persistence in the soil. Low hazard to bees. Do not contaminate streams, rivers or waterways. Do not apply in a manner that may cause an unacceptable impact to native vegetation, agricultural crops, landscaped gardens and aquaculture production, or cause contamination of plant or livestock commodities, outside the application site from spray drift. Check new buffer zone restrictions on page 58.
HERBICIDE RESISTANCE	Moderate risk (Group I).

Continued over page

AMICIDE ADVANCE 700	
SIGNAL HEADING	**DANGER**
PICTOGRAM	
HAZARD STATEMENT	***H318*** Causes serious eye damage. ***H302*** Harmful if swallowed. ***H317*** May cause an allergic skin reaction.

AMICIDE ADVANCE 700, AMINE 625, 2,4-D LV ESTER 680	
FORMULATION	**Amicide Advance 700:** Soluble liquid. **Amine 625:** Soluble liquid. **2,4-D LV Ester:** Soluble liquid
WATER QUALITY	If mixing with glyphosate: Hard water/water high in bicarbonates–add Liase (add Liase to tank first) or crystalline ammonium sulfate (ensure product is fully disolved before adding 2,4-D). High pH : add Li700.
APPLICATION EQUIPMENT	Boom, aerial, handgun. Nozzles producing droplets no smaller than the VERY COARSE spray quality category are required for Amicide Advance 700 and COARSE to VERY COARSE for 2,4-D LV Ester and Amine 625 under new legislation.

APPLICATION RATES				
PRODUCT	**ACTIVE CONCENTRATION**	**PRODUCT/HA & ADJUVANT RATE**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**
AMICIDE ADVANCE 700	700g/L	1600–3100mL + Activator surfactant (60–120mL/100L water)	$12–$24	50–250L
AMINE 625	625g/L	1800–3500mL + Wetspray 600 surfactant (170mL/100L)	$13–$25	30–120L
2,4-D LV Ester 680	680g/L	1150–2400mL	$11–$23	30–100L

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BUFFER ZONES FOR COMMONLY APPLIED 2,4-D FORMULATIONS IN SUGARCANE*

GROUND APPLICATION

CONCENTRATION OF 2,4-D IN PRODUCT	PRODUCT RATE/HA	DOWNWIND MANDATORY NO SPRAY ZONE (M) - GROUND APPLIED OVER THE TOP OF CANE WITH BOOM SPRAYER#	
		AQUATIC	TERRESTRIAL
625g/L (e.g. Nufarm Amine 625, Nufarm Zephyr 625) (excludes DMA salt only formulation)	Up to 1700mL	20	20
	Up to 3500mL	35	35
680g/L (e.g. Nufarm Estercide Xtra 680)	Up to 2400mL	30	40
700g/L (e.g. Amicide Advance 700) (excludes sodium salt formulation)	Up to 1500mL	20	20
	Up to 3100mL	30	30

AERIAL APPLICATION - LOW APPLICATION RATES, 3 M ABOVE CANOPY AND LOWER APPLICATION HEIGHT

CONCENTRATION OF 2,4-D IN PRODUCT	PRODUCT RATE/HA	MINIMUM SPRAY DROPLET SIZE	DOWNWIND MANDATORY NO SPRAY ZONE (M)			
			FIXED WING		HELICOPTER	
			AQUATIC	TERRESTRIAL	AQUATIC	TERRESTRIAL
625g/L (e.g. Nufarm Amine 625, Nufarm Zephyr 625) (excludes DMA salt only formulation)	Up to 1700mL	VERY COARSE	95	90	90	85
		EXTREMELY COARSE	70	70	70	65
	Up to 2000mL	VERY COARSE	110	100	95	95
		EXTREMELY COARSE	80	75	75	70
700g/L (e.g. Amicide Advance 700) (excludes sodium salt formulation)	Up to 1500mL	VERY COARSE	95	90	90	85
		EXTREMELY COARSE	70	70	70	65
	Up to 1800mL	VERY COARSE	110	100	95	95
		EXTREMELY COARSE	80	75	75	70

AERIAL APPLICATION - HIGH APPLICATION RATES IRRESPECTIVE OF SPRAY DROPLET SIZE

CONCENTRATION OF 2,4-D IN PRODUCT	PRODUCT RATE/HA	APPLICATION HEIGHT ABOVE CANOPY (M)	DOWNWIND MANDATORY NO SPRAY ZONE (M)			
			FIXED WING		HELICOPTER	
			AQUATIC	TERRESTRIAL	AQUATIC	TERRESTRIAL
625g/L (e.g. Nufarm Amine 625, Nufarm Zephyr 625) (excludes DMA salt only formulation)	Up to 3500mL	≤3	180	170	150	140
		>3 to max 5	425	400	250	225
680g/L (e.g. Nufarm Estercide Xtra 680)	Up to 1150mL	≤3	75	110	70	100
		>3 to max 5	140	220	120	160
	Up to 2400mL	≤3	130	250	120	180
		>3 to max 5	300	550	190	300
700g/L (e.g. Amicide Advance 700) (excludes sodium salt formulation)	Up to 3100mL	≤3	170	160	150	140
		>3 to max 5	400	375	250	220

**Reference: APVMA Special Gazette, Thursday, 30 September 2020*

#Refer to page 23 for APVMA clarification that downwind mandatory buffer zones do not apply when applied with under-canopy directed spray systems. APVMA is due to confirm regional time of spraying constraints during 2021

2,4-D + PICLORAM

Broadleaf systemic knockdown herbicide

TORDON™ 75-D, TROOPER® 75-D

2,4-D – 300g/L, picloram – 75g/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 3km/hr and 15km/hr. Do not apply if rain is forecast within 4 hours (Trooper 75D) or within 6 hours (Tordon 75D).
TARGET WEED CONDITIONS	Apply to actively growing sicklepod.
CROP STAGE	Crop damage may occur when spraying over the top of actively growing cane.
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.
PLANT BACK PERIOD	Soybeans: 12 months. Peanuts: 12 months. Chickpeas: 12 months. Mungbeans: 12 months.
ENVIRONMENTAL RISK	Do not contaminate streams, rivers, or waterways.
HERBICIDE RESISTANCE	Moderate risk (Group I).

TORDON 75-D	
SIGNAL HEADING	**DANGER**
PICTOGRAM	
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H315*** Causes skin irritation. ***H317*** May cause an allergic skin reaction. ***H318*** Causes serious eye damage. ***H351*** Suspected of causing cancer. ***H335*** May cause respiratory irritation. ***H411*** Toxic to aquatic life with long-lasting effects.
FORMULATION	Soluble liquid.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Directed spray or handgun.

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APPLICATION RATES						
PRODUCT	**WEED TARGET**	**WEED SIZE**	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
TORDON 75-D **TROOPER 75-D**	Sicklepod	<50cm tall	700mL + 800mL 2.4-D amine (625g/L)	$12 + $6	Minimum 50L (aerial) Minimum 200L (ground boom)	Always add suitable spray oil OR suitable non-ionic surfactant following label recommendations. Apply only once per season.
		50–100cm tall	1000mL + 800mL 2,4-D amine (625g/L)	$16 + $6		
		>100cm tall	1500mL + 800mL 2,4-D amine (625g/L)	$25 + $6		

DOWNWIND MANDATORY NO SPRAY ZONE		
GROUND APPLIED WITH BOOM SPRAYER		
PRODUCT RATE	**DOWNWIND MANDATORY NO SPRAY ZONE (M) - GROUND APPLIED OVER THE TOP OF CANE WITH BOOM SPRAYER#**	
	AQUATIC	**TERRESTRIAL**
Up to 700mL + 1000mL 2,4-D Amine 500	10	10
Up to 1500mL + 1000mL 2,4-D Amine 500	15	15
Up to 2400mL	20	20

AERIAL APPLICATION					
RELEASE HEIGHT (M)	**PRODUCT RATE/HA**	**DOWNWIND MANDATORY NO SPRAY ZONE (M)**			
		FIXED WING		**HELICOPTER**	
		AQUATIC	**TERRESTRIAL**	**AQUATIC**	**TERRESTRIAL**
≤3	Up to 700mL + 1000mL 2,4-D Amine 500	70	70	70	65
	Up to 1500mL + 1000mL 2,4-D Amine 500	85	85	80	80
>3 to max 5	Up to 0.7L + 1L 2,4-D Amine 500	130	120	110	110
	Up to 1500mL + 1L 2,4D Amine 500	190	350	150	220

**Reference: APVMA Special Gazette, Thursday, 30 September 2020*
#Refer to page 23 for APVMA clarification that downwind mandatory buffer zones do not apply when applied with under-canopy directed spray systems.
APVMA is due to confirm regional time of spraying constraints during 2021

AMETRYN

Early post-emergent and residual herbicide

AMETREX® 800 WG

Ametryn – 800g/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/WEATHER CONDITIONS	Best applied to moist soil.
INCORPORATION	Within 10 days of application when mixed with atrazine.
TARGET WEED CONDITIONS	Emerged weeds and grasses should be no more than 3 to 4-leaf stage.
CROP STAGE	Minimise contact with sugarcane leaves if concerned about crop injury. Apply as a directed spray.
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 or consult the SRA regional variety guide. Known tolerant varieties may be sprayed over-the-top, otherwise avoid contact with leaves.
RISK TO OTHER CROPS	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.
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).

AMETREX 800 WG	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H410*** Very toxic to aquatic life with long-lasting effects.
FORMULATION	Water dispersible granule.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Broadcast, band, directed.

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APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
AMETREX 800 WG	2800g	$67	300–400L Pre-emergent	Always add non-ionic surfactant at early post-emergent stage for weeds and grasses. Do not apply more than 2800g/ha PRODUCT per year (23000g ai ametryn/ha/year).
AMETREX 800 WG **+** **ATRAZINE (900 g/kg)**	2500g + 3300g	$60 + $30		Apply as pre or early post-emergent. Apply as directed spray if cane has emerged. Atrazine – do not apply more than 3300g/ha PRODUCT per season (3000g ai atrazine/ha/year). Ametryn – do not apply more than 2800g/ha PRODUCT per year (2300g ai ametryn/ha/year).

Note: *Refer to Appendix 3 for additional Queensland legislative constraints for ametryn.*

AMETRYN + TRIFLOXYSULFURON SODIUM

Broadleaf, grass and nutgrass systemic knockdown herbicide

KRISMAT® WG

ametryn – 731.5g/kg, trifloxysulfuron sodium – 18.5g/kg

Post-emergent systemic herbicide for the control of certain broadleaf weeds and suppression of certain grasses, nutgrass and sour grass.

HERBICIDE SUITABILITY	
SOIL/WEATHER CONDITIONS	Best applied to moist soil when weeds are actively growing. Use the higher rates on heavy soils. Do not apply to waterlogged soils.
INCORPORATION	Apply to moist soil when follow-up rainfall is expected within 10 days. Performance is enhanced when good soil moisture is maintained in the top 10cm of soil for at least 10 days after application through the use of overhead irrigation or rainfall. Do not apply if heavy rainfall expected within the next 2 days.
CROP STAGE	Apply post-emergent as a broadcast spray over the top of sugarcane up to the 6-leaf stage, or as a directed spray for older sugarcane or cane varieties sensitive to ametryn. Do not apply to stressed crops. Do not apply more than 2 applications per year.
VARIETY SUSCEPTIBILITY	Contact of Krismat on the foliage of some sugarcane varieties sensitive to ametryn may cause short term yellowing. Apply as a partially directed spray to minimise contact of the spray with ametryn sensitive sugarcane varieties. Refer to QCANESelect™ for variety sensitivity information or consult regional variety guide.
WITHHOLDING PERIOD	Do not harvest for 4 weeks after application. Do not graze or cut for stock food for 4 weeks after application.
RISK TO OTHER CROPS	This product is very highly toxic to non-target plants including aquatic plants. Do not apply under weather conditions or from spraying equipment that may cause spray to drift over nearby susceptible plants or crops, cropping lands or pastures. All applications should be made in accordance with the Best Management Practices for sugarcane. Do not plant crops other than sugarcane within 24 months of an application of Krismat. Do not apply in final ratoon.
ENVIRONMENTAL RISK	PSII herbicide. Dangerous to fish. Do not apply within 20m of any waterway, waterbody or other aquatic area. Do not apply unless there is a 30m downwind buffer distance between the treated area and native vegetation. Do not apply if heavy rain is forecast within 48 hours. Do not irrigate within 48 hours; or within 6 days after application if run-off cannot be contained on farm. Do not use on slopes >5% if soil erosion measures are not in place.
HERBICIDE RESISTANCE	High – moderate (Group B and C).

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SIGNAL HEADING	**WARNING**
PICTOGRAM	 *Source: Gold SDS, Chemwatch*
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H317*** May cause an allergic skin reaction. ***H373*** may cause damage to organs through prolonged or repeated exposure. ***H402*** harmful to aquatic life. ***H410*** very toxic to aquatic life with long-lasting effects.
FORMULATION	Water dispersible granule.
WATER QUALITY	For best results use clean water. Once Krismat is mixed in the spray tank, it should be applied the same day.
APPLICATION EQUIPMENT	Ground application: apply in a minimum 150L of water/ha with fine – medium spray quality. Do not apply by aircraft.

APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
KRISMAT WG	1500–2000g + Agral at 250mL/100L	$63–$84	Minimum 150L	Good spray coverage of emerged weeds is essential. Spray when broadleaf weeds are at the 2 to 6-leaf stage and grasses are at the 3-leaf to early tillering stage. Use the higher rate when weeds are at the upper end of the specified growth stage range, on dense weed infestations or heavy soil types. Apply when weeds are actively growing. Nutgrass suppression only. No residual control of nutgrass.

Note: *Refer to Appendix 3 for additional Queensland legislative constraints for ametryn.*

AMICARBAZONE

Broad-spectrum early post-emergent and residual herbicide

AmiTron®

Amicarbazone – 700g/kg

Early post-emergent and residual control of grass, broadleaf weeds and some sedges.

HERBICIDE SUITABILITY		
SOIL/WEATHER CONDITIONS	***Lighter textured soils*** Use lower rates. Ensure at least 75mm soil cover over setts. Prevent slippage of treated soil into plant furrow.	***Very sandy soils (>90% sand)*** Do not use.
INCORPORATION	Amicarbazone is UV stable. Activated with minimal rainfall (2 to 5mm). Moves readily through trash. If possible apply a light initial irrigation to incorporate the herbicide (to avoid risk of losses in subsequent heavy irrigation or rainfall).	
TARGET WEED CONDITIONS	Emerged weeds should ideally be no more than 6-leaf stage.	
CROP STAGE	For plant cane, apply within 5 days of planting to avoid risk of crop injury or apply after cane is 30cm high using a directed spray. For ratoons, apply just after cane shoot emergence. Add paraquat if crop is 4 to 5-leaf stage or more. Alternatively, apply after cane is 30cm high with directed spray. For furrow irrigated situations, consider band spraying over the beds to minimize risk of movement into cane root zone.	
CULTIVATION AND IRRIGATION	Do not irrigate within 48 hours after application. Manage irrigation to avoid run-off. If possible apply a light initial irrigation to incorporate the herbicide. In furrow irrigated systems, consider early application to avoid later heavy water flows.	
VARIETY SUSCEPTIBILITY	Avoid contact with cane leaves – mild foliar uptake will show as slight yellowing of cane leaves. Cane usually grows out of symptoms after 1 to 3 weeks. Foliar effect is worsened if wetting agents are used. Uptake by cane roots will show more severe symptoms including stunting. Refer to Qcane select or consult regional variety guide	
RISK TO OTHER CROPS	Do not cut cane for stockfeed and do not graze stock for 21 weeks after application. Export slaughter Interval of 3 days is required for export stock.	
PLANT BACK PERIOD	Do not apply within 24 months of planting crops other than sugarcane.	
ENVIRONMENTAL RISK	PSII herbicide. No-spray time intervals apply to the Mackay/Whitsunday and Mary/Burnett regions: Do not apply during October, November or December (Refer to Appendix 2). Do not apply on slope steeper than 3% in the Mackay/Whitsunday region. Do not apply when wind speed is less than 3 or more than 20km per hour. Do not apply during surface temperature inversion conditions. Do not apply if there are sensitive vegetation, protected native vegetation or protected animal habitat within 10metres downwind. Do not apply if there are aquatic and wetland areas within 30metres downwind. Very toxic to aquatic life.	
HERBICIDE RESISTANCE	Moderate risk (Group C).	

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AmiTron	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	May form combustible dust concentrations in air ***H302+H332*** Harmful if swallowed or if inhaled. **H320** Causes eye irritation. ***H335*** May cause respiratory irritation. ***H400*** Very toxic to aquatic life.
FORMULATION	Water dispersible granule.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Broadcast when cane is spiking and up to the 4 to 5-leaf stage. Directed spray when cane is stooling (30cm plus). Banded spray over the row spike to 4 to 5-leaf stage. Do not apply by aircraft. Ensure spray droplet spectrum (Spray Quality) is at least MEDIUM.

APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
AmiTron 700 WG	500–1000g + 200mL/100L non-ionic surfactant (600 g/L) when used as early post-emergent (low rate)	$36–$72	200L minimum (ground application)	For early post-emergence weed control and pre-emergence residual control. Use higher rates for more advanced weeds (up to 6-leaf stage) and/or longer residual control (up to 10–14 weeks). Where shading of cane leaves prevents contact with the soil surface or small weeds, droppers with wide angle nozzle tips and/or leaf lifters should be used to provide complete soil coverage.

ASULAM

Grass systemic knockdown herbicide

ASULOX®, RATTLER®

asulam – 400g/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 100mm).

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 200–250mm in height.
CROP STAGE	Direct the spray to minimise coverage of the cane foliage.
VARIETY SUSCEPTIBILITY	Yellowing of sugarcane leaves may occur. Do not use crop oils as crop damage may result. Refer to QCANESelect™ for variety sensitivity information or consult regional variety guide.
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).

RATTLER 400	
SIGNAL HEADING	**WARNING**
PICTOGRAM	 *Source: Gold SDS, Chemwatch*
HAZARD STATEMENT	***H315*** Causes skin irritation. ***H319*** Causes serious eye irritation. ***H335*** May cause respiratory irritation.

ASULOX, RATTLER 400	
FORMULATION	Soluble liquid.
WATER QUALITY	Recommended water pH: greater than 6.
APPLICATION EQUIPMENT	Aerial. Broadcast, band or directed spray. Use flat fan nozzles.

APPLICATION RATES

PRODUCT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
ASULOX, RATTLER 400	8500mL	$174	200–400L (ground application)	Use high water rate to ensure thorough coverage on dense weed stands. Add non-ionic wetting agent.
ASULOX, RATTLER 400	2000mL/100L	$41/100L	Spot spraying	

ATRAZINE

Broadleaf residual herbicide

ATRAZINE 900 WG,
GESAPRIM®GRANULES

atrazine – 900g/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 passion vine.

HERBICIDE SUITABILITY	
SOIL CONDITIONS	Best applied to moist soil. Do not apply to waterlogged soil. Do not apply on light sandy soils. Do not apply to hot, dry soil.
INCORPORATION	Incorporate with 25mm 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 to 3cm if rainfall is not received within 10 days.
TARGET WEED CONDITIONS	Do not use on weeds taller than 40mm. Avoid spraying weeds under stress.
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	Avoid drift onto non-target areas/crops.
PLANT BACK PERIOD	Do not plant susceptible crops for 6 months for rates up to 1400g/ha and 18 months for rates up to 3300g/ha (refer to label).
WITHOLDING PERIOD	Do not graze or cut for stockfeed within 28 days of application.
ENVIRONMENTAL RISK	PSII herbicide. Do not contaminate streams, rivers or waterways with the chemical or used containers. This product is very highly toxic to algae and aquatic macrophytes. Do not apply within 60m of natural or impounded lakes or dams. Do not use in channels and drains. Do not apply under weather conditions or from equipment which could be expected to cause drift of this product or spray mix onto adjacent areas, particularly wetlands, waterbodies or watercourses Do not apply to any drainage line.
HERBICIDE RESISTANCE	Moderate risk (Group C).

ATRAZINE 900 WG	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H317*** May cause an allergic skin reaction. ***H373*** May cause damage to organs through prolonged or repeated exposure. ***H410*** Very toxic to aquatic life with long-lasting effects.

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ATRAZINE 900 WG, GESAPRIM GRANULES	
FORMULATION	Water dispersible granule.
WATER QUALITY	Avoid hard water or add ammonium sulphate.
APPLICATION EQUIPMENT	Broadcast, band or directed spray. Use flat fan nozzles.

APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
ATRAZINE 900 WG GESAPRIM GRANULES	2200–3300g	$20–$30	300–400L (ground application, pre-emergent)	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 3300g/ha PRODUCT per year (3000g ai atrazine/ha/year).
				Tank mix with 2,4-D amine for improved post-emergent broadleaf weed control.
ATRAZINE 900 WG GESAPRIM GRANULES **+** **AMETRYN (800 g/kg)**	3300g + 2500g	$30 + $60		Apply as a directed if cane has emerged. Emerged weeds and grasses should not exceed 3 to 4-leaf stage. Atrazine – do not apply more than 3300g/ha PRODUCT per season (3000g ai atrazine/ha/year). Ametryn – do not apply more than 2800g/ha PRODUCT per year (2300g ai ametryn/ha/year).

DICAMBA

Broadleaf systemic knockdown herbicide

KAMBA® 750,
CADENCE® WG

Kamba 750: dicamba – 750g/L, Cadence WG: dicamba – 700g/kg

Selective systemic herbicide for post-emergent control of certain broadleaf weeds, including amaranthus, bellvine, blackberry nightshade, calopo, caltrop, convolvolus, khaki weed, milkweed, prickly cucumber, sensitive plant and 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™ or regional variety guides for variety sensitivity information.
WITHOLDING 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.
PLANT BACK PERIOD	Soybeans: 21 days; Corn: 21 days; Mungbeans: 21 days.
ENVIRONMENTAL RISK	Do not contaminate streams, rivers or waterways.
HERBICIDE RESISTANCE	Moderate risk (Group I).

KAMBA 750	
SIGNAL HEADING	**DANGER**
PICTOGRAM	
HAZARD STATEMENT	***H318*** Causes serious eye damage ***H302*** Harmful if swallowed.

KAMBA 750, CADENCE WG	
FORMULATION	Kamba 750 – soluble liquid. Dicamba 700 WG, Cadence WG– water dispersible granule.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Boom. Aerial. Directed spray. Use only COARSE or larger spray nozzles.

APPLICATION RATES

PRODUCT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
KAMBA 750	375mL	$7–$13	100–250L (ground application)	Add atrazine: (900g/kg) at 560 to 1100g/ha for residual control and for improved control of certain weeds – refer to labels.
CADENCE WG	370–740g			

DIURON

Broad-spectrum residual herbicide

DIUREX® WG,
DIURON 900 WDG

Diuron – 900g/kg

Pre-emergent and early post-emergent herbicide for control of grass and broadleaf weeds. Controls summer grass, barnyard grasses, 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. Do not use in water-logged areas.
INCORPORATION	Incorporate with 25mm of rainfall or overhead irrigation within 10 days after application.
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. 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	Refer to QCANESelect™ or regional variety guides for variety sensitivity information.
RISK TO OTHER CROPS	Avoid drift onto non-target areas/crops.
PLANT BACK PERIOD	Do not replant treated area with any crop, apart from sugarcane and pineapples within 2 years unless otherwise stated. Treated areas can be replanted to pineapple or sugarcane 1 year after last spray.
ENVIRONMENTAL RISK	PSII herbicide. Relatively immobile in soil due to binding with clay and organic matter. Do not use in water-logged areas. Do not apply if greater than 50 mm rainfall is expected within 3 days of application. Do not irrigate within 3 days of application. Do not apply to fields where the slope exceeds 3%. Do not spot spray more than 5% of total farm areas. Do not apply more than once per calendar year. Do not apply when wind speed is less than 3 or more than 20 kilometres per hour as measured at the application site. Do not apply when there is non-target vegetation or aquatic and wetland areas downwind from the application area and within the mandatory no-spray zones shown in table next page.
HERBICIDE RESISTANCE	Moderate risk (Group C).

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DIURON 900 WDG	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H373*** May cause damage to organs through prolonged or repeated exposure. ***H410*** Very toxic to aquatic life with long-lasting effects. ***H351*** Suspected or causing cancer. ***H302*** Harmful if swallowed.

DIUREX WG, DIURON 900 WDG	
FORMULATION	Water dispersible granule.
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. Use nozzles that produce COARSE droplets.

APPLICATION RATES					
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**SUGARCANE GROWING DISTRICT**	**NO-SPRAY PERIOD (DO NOT USE BETWEEN THESE DATES)**	**WATER RATE/COMMENTS**
DIUREX WG, DIURON 900 WGD	275–500g + 1200–1600 mL paraquat (250mL/L)	$4–$8 + $11–$15	All	can spray all year in all regions	250–400L Can be blanket sprayed.
	1900g or 500–1900g + 1200–1600 mL paraquat (250g/L)	$30 or $8–30 + $11–$15	Wet Tropics	Prohibited all year	250–350L Apply as a directed spray only over a maximum of 60% of crop area. If weeds are present, add 600g/L non ionic surfactant at 250ml/100L.
			Burdekin	1 January – 29 February	
			Mackay/ Whitsunday	1 December – 30 April	
			Burnett/ Mary	1 November – 29 February	
			NSW	1 November – 30 April	

Note: *Refer to Appendix 3 for additional Queensland legislative constraints for diuron*

BUFFER ZONES FOR DIURON IN SUGARCANE		
PRODUCT RATE (900G/KG FORMULATION)	**DOWNWIND BUFFER ZONE (M)**	
	AQUATIC	**TERRESTRIAL**
280–500 G/HA	25	50
2000 G/HA	100	200

DIURON + HEXAZINONE

Broad-spectrum residual herbicide

BOBCAT® COMBI WG, BARRAGE

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

Pre-emergent and knockdown herbicide for control of grasses and broadleaf weeds. Controls summer grass, barnyard grasses, green summer grass, Guinea grass, crowsfoot, thickhead, square weed, bell vine, convolvulus vines, star of Bethlehem, stinking passion vine, itch grass, centro and giant sensitive plant.

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 25–50mm of rainfall or overhead irrigation from 4 to 10 days after application.	
TARGET WEED CONDITIONS	Knockdown of annual grasses and broadleaf weeds up to 15cm. Best knockdown results are achieved under conditions of high humidity and temperatures higher than 21°C. If weeds are present, use 250-500mL/100L of nonionic surfactant (1000g ac/L).	
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.	
PLANT BACK PERIOD	Do not replant treated areas to any other crop within 2 years after last application. Treated areas may be replanted to sugarcane one year after last 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. Do not apply if greater than 50mm rainfall is expected within 3 days. Do not spot spray more than 5% of total farm areas. Do not irrigate within 3 days. Do not apply to slopes >3%. Do not apply more than once per calendar year. Do not apply when there is non-target vegetation or aquatic and wetland areas downwind from the application area and within the mandatory no-spray zones shown in table next page.	
HERBICIDE RESISTANCE	Moderate risk (Group C).	

Continued over page

BOBCAT COMBI WG	
SIGNAL HEADING	DANGER
PICTOGRAM	
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H320*** Causes eye irritation. ***H351*** Suspected of causing cancer. ***H373*** May cause damage to organs through prolonged or repeated exposure. ***H410*** Very toxic to aquatic life with long-lasting effects.

BOBCAT COMBI WG, BARRAGE	
FORMULATION	Water dispersible granule.
WATER QUALITY	Generally not affected 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	USE SITUATION	NO-SPRAY PERIOD (DO NOT USE BETWEEN THESE DATES)
BOBCAT COMBI WG	600–900g + 1200–1600mL paraquat (250g/L)	$14–$20 + $11–$15	400–600L	Plant and ratoon directed spray	Can use any time of year in all regions.
	3000–4000g	$69–$91		Ratoon (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
				Plant and ratoon (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 1000g/100L			To control Guinea grass	Can use any time of year in all regions.

Note: *Refer to Appendix 3 for additional Queensland legislative constraints for diuron*

BUFFER ZONES FOR DIURON + HEXAZINONE (E.G. BOBCAT COMBI) IN SUGARCANE		
USE TYPE	DOWNWIND BUFFER ZONE (M)	
	AQUATIC	TERRESTRIAL
USED ALONE	100	200
MIXED WITH PARAQUAT	25	50

FLUMIOXAZIN

Knockdown enhancer and/or broad-spectrum residual herbicide

VALOR® 500 WG

Flumioxazin – 500g/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, pink convolvulus, red convolvulus, morning glory, star of Bethlehem, summer grass, green summer grass, feather top Rhodes grass, barnyard grass, 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. Do not apply in sandy soils in areas where the slope exceeds 4%.
INCORPORATION	*For residual control of weeds:* Soil should be moist at time of application, either from summer rainfall or irrigation. Follow-up rainfall or irrigation (at least 15mm) 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.
WITHHOLDING PERIOD	Do not harvest sugarcane for 22 weeks after application. Do not graze or cut sugarcane for stockfeed for 22 weeks after application.
PLANT BACK PERIOD	Peanuts: 5 months. Soybeans: 5 months. Mungbeans: 8 months (rotation crop planted after soil has been thoroughly cultivated).
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 1 application per year. Do not apply when wind speed is less than 3km/h or more than 20km/h. Do not apply during surface temperature inversions. Do not apply if there are aquatic and wetland areas within 5m downwind from the application site. Do not apply if there are sensitive crops, gardens, landscaping or protected native vegetation or protected animal habitat within 120m downwind of the application site.
HERBICIDE RESISTANCE	Moderate risk (Group G).

VALOR 500 WG	
SIGNAL HEADING	DANGER
PICTOGRAM	
HAZARD STATEMENT	***H360D CLP only*** – May damage the unborn child. ***H400 + H410*** Very toxic to aquatic life with long-lasting effects.
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 500 WG **+** **PARAQUAT 250** **or** **SPRAY.SEED 250/ REVOLVER**	90–120g + 1200–1600mL or 1200–2400 mL	$15–$19 + $11–$15 or $13–$27	250L 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 500 WG **+** **ATRAZINE**	90–120g + 2200– 3300g	$15–$19 + $20–$30		When calopo or sicklepod are present the addition of atrazine may improve knockdown. Do not apply more than 3300g/ha atrazine PRODUCT per year (3000g ai atrazine/ha/year).

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

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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 500 WG**	350–560g	$56–$90	200L minimum	For residual control, Valor 500 WG should be applied to moist soil with follow-up rain or irrigation of at least 15mm within 3 weeks, particularly on trash. Apply after fill-in in plant cane. If existing weeds are present at the 2 to 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 (275–500g/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)		560–700g	$90–$113		

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 passion flower, centro and blackberry nightshade.

HERBICIDE SUITABILITY	
WEATHER CONDITIONS	Rainfast after 1 hour. Do not apply with aircraft when temperature is above 30°C.
TARGET WEED CONDITIONS	Apply to actively growing weeds with good soil moisture. Generally, apply from 2 to 3-leaf until flowering.
CROP STAGE	Safe from early tillering to maturity.
VARIETY SUSCEPTIBILITY	No known susceptible varieties.
WITHHOLDING PERIOD	Do not cut for stock food for 7 days.
RISK TO OTHER CROPS	Do not allow spray drift onto non-target areas/crops.
PLANT BACK PERIOD	Soybeans: 7 to 14 days. Chickpeas: 7 days. Corn: 7 days.
ENVIRONMENTAL RISK	Short persistence in the soil. Do not contaminate streams, rivers or waterways.
HERBICIDE RESISTANCE	Moderate risk (Group I).

COMET 400	
SIGNAL HEADING	**DANGER**
PICTOGRAM	 *Source: Gold SDS, Chemwatch*
HAZARD STATEMENT	***H360*** May damage fertility or the unborn child. ***H315*** Causes skin irritation. ***H319*** Causes serious eye irritation. ***H336*** May cause drowsiness or dizziness. ***H304*** May be fatal if swallowed and enters airways. ***H410*** Very toxic to aquatic life with long-lasting effects.

COMET 400, STARANE ADVANCED	
FORMULATION	Emulsifiable concentrate.
WATER QUALITY	Always use good quality water. Avoid using hard water when mixing with atrazine or add appropriate water conditionner. AGITATION IS VERY IMPORTANT WHEN MIXING STARANE® ADVANCED AND ATRAZINE.
APPLICATION EQUIPMENT	Boom, aerial, handgun. Aerial application: use coarse quality spray. Boom application: use medium quality spray.

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APPLICATION RATES					
PRODUCT	**ACTIVE CONCENTRATION**	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
COMET 400	400g/L	650–1500mL + Collide700	$30–$74	100–400L (ground application)	Add Amine 625 at 800mL/ha for bell vine, morning glory, red or pink convolvulus, star of Bethlehem. Milkweed: best control is with the atrazine mixture. Check label recommendations when mixing with atrazine. Do not add spraying oil when mixing with atrazine.
STARANE ADVANCED	333g/L	780–1800mL + Uptake Spraying oil Refer to appropriate labels			

GLUFOSINATE – AMMONIUM

Broadleaf spectrum knockdown herbicide

BASTA®

Glufosinate – ammonium – 200g/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. 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 run-off 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 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. Do not apply where slope exceeds 4%.
HERBICIDE RESISTANCE	Moderate risk (Group N).

BASTA®	
SIGNAL HEADING	**DANGER**
PICTOGRAM	
HAZARD STATEMENT	***H319*** Causes serious eye irritation. ***H373*** May cause damage to organs through prolonged or repeated exposure. ***H360F + H361D*** May damage fertility. May damage the unborn child. ***H302 + H312*** Harmful if swallowed or in contact with skin.
FORMULATION	Aqueous solution.
WATER QUALITY	Always use clean water.
APPLICATION EQUIPMENT	Directed application. Irvin spray boom. Shield or hood application. Use nozzles that produce coarse to very coarse droplets. Do not apply by aircraft.

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APPLICATION RATES					
PRODUCT	**ACTIVE CONCENTRATION**	**PRODUCT AND RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
BASTA	200g/L	1000–3000mL (directed application) 1000–5000mL (shielded/hooded application)	$16–$49 $16–$81	300–500L	**DIRECTED APPLICATION.** *Plant cane* Do not apply earlier than just prior to out-of-hand stage. *Ratoon cane* Do not apply until cane reaches 100cm height to top of plants or 20cm 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.**

Note: *Basta does have limited translocation within plants, therefore it is important to ensure crop safety by avoiding contact with the crop's growing tips and green plant material.*

GLYPHOSATE

Broadleaf spectrum systemic knockdown herbicide

ROUNDUP ULTRA® MAX, WEEDMASTER® ARGO®, WEEDMASTER® DST®, WEEDMASTER® DUO

Roundup Ultra Max: 570g/L glyphosate present as the potassium salt; Weedmaster ARGO: 540g/L glyphosate present as the potassium and isopropylamine salts; Weedmaster DST: 470g/L glyphosate present as the potassium and mono-ammonium salts; Weedmaster DUO: 360g/L glyphosate 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 and Weedmaster Argo are rainfast after 1 hour. 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 eight.
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 60–120cm high. Nutgrass should be at least 6 to 8-leaf stage but preferably when at least 20% have reached the head stage. Do not disturb weeds by cultivation for 6 hours of daylight following treatment of annual weeds and 7 days for perennial weeds.
VARIETY SUSCEPTIBILITY	All varieties are susceptible. Do not allow spray drift to contact any part of the crop.
WITHHOLDING PERIOD	Not required when used as directed.
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. Do not apply when wind speed is less than 3 or more than 20km/h. Plantback period – nil.
ENVIRONMENTAL RISK	Immobile in soil. Do not contaminate aquatic areas and susceptible plants. Roundup Biactive and Weedmaster DUO are registered formulations for spraying weeds in, on and over water.
HERBICIDE RESISTANCE	Moderate risk (Group M).

WEEDMASTER ARGO	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H319*** Causes serious eye irritation. ***H315*** Causes skin irritation.

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ROUNDUP ULTRA MAX, WEEDMASTER ARGO, WEEDMASTER DST, WEEDMASTER DUO	
FORMULATION	Soluble liquid.
WATER QUALITY	Avoid water with high levels of bicarbonates ions (i.e. hard water) or add Liase to tank first. 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. Do not use galvanized or unlined steel spray tanks.

APPLICATION RATES

PRODUCT	ACTIVE CONCENTRATION	PRODUCT AND RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
ROUNDUP ULTRA MAX	570g/L	1100–4700mL	$10–$42	80L or less	In-crop inter-row application – use a shielded/hooded sprayer or correctly set-up non-shielded sprayer (see note below). Do not apply more than 3 applications or more than 11,400mL/ha per crop.
		425–1900mL	$4–$17		In fallow.
		3800–5700mL	$34–$51		Ratoon spray-out.
Weedmaster ARGO	540g/L	1200–5000mL	$10–$43		In-crop inter-row application – use a shielded sprayer or correctly set-up non-shielded sprayer (see note below). Do not apply more than 3 applications or more than 12,000mL/ha per crop.
		340–2000mL	$3–$17		In fallow.
		4000–6000mL	$34–$52		Ratoon spray-out.
WEEDMASTER DST	470g/L	380–2300mL	$3–$17		In fallow.
		4600–6900mL	$33–$50		Ratoon spray-out.
Weedmaster DUO	360g/L	500–9000mL	$4–$78	75–100L	For fallow.
		6000–9000mL	$52–$78	75–200L	Ratoon spray-out.

Do not mix with atrazine for control of barnyard grass or liverseed grass. Adding Liase to tank mix with atrazine may enhance knockdown weed control.

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NUTGRASS APPLICATION RATES						
PRODUCT	**ACTIVE CONCENTRATION**	**RATE/HA**	**CROP SITUATION**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
ROUNDUP ULTRA MAX	570g/L	1900mL followed by 1900mL	fallow	$17 x 2	80L	Allow for maximum re-emergence before retreating. Follow label recommendations for surfactants. Use a spray shield/hood for inter-row spraying. or correctly set-up non-shielded sprayer (see note below).
Weedmaster ARGO	540g/L	2000mL followed by 2000mL		$17 x 2		
Weedmaster DST	470g/L	2300mL followed by 2300mL		$17 x 2	80L	
Weedmaster DUO	360g/L	3000mL followed by 3000mL		$26 x 2	75–200L	
ROUNDUP ULTRA MAX	570g/L	1100–4700mL	in-crop inter-row	$10–$42	80L or less	
Weedmaster ARGO	540g/L	1200–5000mL				

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

HALOSULFURON-METHYL

Nutgrass knockdown herbicide

SEMPRA®

Halosulfuron – methyl 750g/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 to 6-leaf stage and new leaf growth is a minimum of 5cm high. Yellowing of nutgrass will occur in 7 to 10 days, but complete kill may take 4 to 6 weeks to occur. Do not cultivate for at least 2 days following treatment.
CROP STAGE	Safe at any crop stage.
VARIETY SUSCEPTIBILITY	Safe on all varieties.
WITHHOLDING PERIOD	Not required when used as directed.
RISK TO OTHER CROPS	Avoid drift onto non-target areas/crops.
PLANT BACK PERIOD	Sugarcane: 2 months. Corn/maize, sorghum: 2 months. Pasture: 3 months. Cotton: 4 months. Other crops: 24 months.
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	**NON-HAZARDOUS SUBSTANCE**
FORMULATION	Dry flowable granule.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Broadcast, banded or directed spray. Do not apply by aircraft.

APPLICATION RATES

PRODUCT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
SEMPRA	65–130g + Banjo or Supercharge Elite at 1L/100L	$28–$57	Minimum 80L	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 200g/ha per season.
	1.3g/100m^2		10 L/100m^2	Spot spray. Add 100mL Banjo or Supercharge Elite/10L.

IMAZAPIC

Broad-spectrum residual herbicide

SPARK®

Imazapic – 240g/L

Pre-emergent herbicide for control of certain annual grasses and broadleaf weeds. Controls summer grass, barnyard grasses, green summer grass, urochloa, 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 5cm 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 5cm. Under dry conditions, mechanical incorporation can improve weed control, however care must be taken to minimise exposure of untreated soil. Apply at early spike stage with paraquat 1L/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	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.	
WITHHOLDING PERIOD/ RISK TO OTHER CROPS	Avoid drift onto non-target areas/crops. Do not graze or cut for stockfeed for 6 weeks after application.	
PLANT BACK PERIOD	Chickpeas: 4 months. Corn: 10 months. Peanuts, Mungbeans, Soybeans: 0 months. Other crops: up to 36 months.	
ENVIRONMENTAL RISK	Do not contaminate streams, river or waterways. Do not spray within 50m of wetlands or waterways.	
HERBICIDE RESISTANCE	High risk (Group B).	

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SPARK	
SIGNAL HEADING	**NOT CLASSIFIED AS HAZARDOUS**
PICTOGRAM	N/A
HAZARD STATEMENT	N/A If medical advice is needed, have product container or label at hand.

SPARK	
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. Select nozzles to produce a medium to coarse spray pattern for pre-emergence applications or medium spray pattern for post-emergence applications.

APPLICATION RATES

PRODUCT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
SPARK	300–400mL	$8–$11	200L minimum	Add paraquat (250g/L) at 1200–1600mL/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. Do not apply more than once a year to the same crop.
SPARK **+** **STOMP XTRA**	400mL + 2200mL	$11 + $36		Use mixture when crowsfoot grass present (imazapic alone will not control crowsfoot grass).

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

IMAZAPIC + HEXAZINONE

Residual herbicide

BOBCAT® I-MAXX SG

Imazapic – 150g/kg, hexazinone – 750g/kg

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 should be as clod-free as possible. Application to weed-free, moist soil within 3 to 4 days of incorporation provides best results. Lower rates are effective on lighter soils while higher rates may be necessary for effective control on heavier soils. Do not apply on light sandy soils. 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 5cm of soil. Avoid application if heavy rainfall is forecast within 24–48 hours of application.
INCORPORATION	Incorporate by rainfall or irrigation from 3 to 4 days after application (12–25mm on moist soils; 25–50mm on dry soils), to wet soil to a minimum depth of 5cm before weed emergence. Under dry conditions, mechanical incorporation can improve weed control, however, care must be taken to minimise exposure of untreated soil.
TARGET 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.
PLANT BACK PERIOD	Mungbeans: 24 months. Peanuts: 24 months. Soybeans: 24 months. Corn: 24 months. Chickpeas: 24 months. Other crops: up to 36 months.
ENVIRONMENTAL RISK	PSII herbicide Do not allow spray drift onto non-target areas/crops. Do not contaminate streams, rivers or waterways. Do not spot spray more than 5% of the total farm area. Do not apply when slope exceeds 5%.
HERBICIDE RESISTANCE	High (Group B), Moderate (Group C).

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BOBCAT I-MAXX SG	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H319*** Causes serious eye irritation. ***H410*** Very toxic to aquatic life with long-lasting effects.
FORMULATION	Soluble liquid.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Boom, banded, hand gun or directed spray. Use nozzles that produce medium to coarse droplet size. Do not apply by aircraft.

APPLICATION RATES					
CROP STAGE	**PRODUCT**	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
Plant cane (after weed emergence)	**Bobcat i-MAXX SG** **+** **PARAQUAT (250 g/L)**	500–630g + 1600mL	$58–$73 + $15	400–600L	**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 630g/ha/year.
Ratoon cane (before cane and weed emergence)	**Bobcat i-MAXX SG**	500–630g	$58–$73		Apply with paraquat if cane is emerged. Do not apply more than 630g/ha/year.
Ratoon cane (after cane and weed emergence)	**Bobcat i-MAXX SG** **+** **PARAQUAT (250 g/L)**	500–630g + 1600mL	$58–$73 + $15		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 630g/ha/year.
Plant and ratoon cane	**Bobcat i-MAXX SG**	350g/100L Spot spray	$41/100L spray volume	n/a	Spot spray for Guinea grass. Spray when Guinea grass stools are at least 15cm high. Apply to point of run-off. Crop injury to cane will occur.

ISOXAFLUTOLE

Residual herbicide

BALANCE® 750 WG

Isoxaflutole – 750g/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 at any rate to soils of cation exchange capacity (C.E.C.) less than 3meq/100 g or with clay content less than 10%, or with organic carbon content of less than 0.8%. These soils have low binding potential for Balance which increase the risk of herbicide movement and adverse crop effect. Do not apply at rates of 125g/ha or higher to soils with organic carbon content of less than 1.0%, unless the cation exchange capacity (C.E.C.) is above 9.5meq/100g. Do not apply at rates of 125g/ha or higher to soils of cation exchange capacity (C.E.C) less than 4.5meq/100g. 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 60mm) to reduce the risk of treated soil contacting the sett. Ratoon cane – boomed or band sprayed over the top of ratoon cane up to the 2-leaf stage. • Apply in a tank mix with a knockdown herbicide if weeds have germinated. • 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 0.75m in height. • Apply to a consolidated soil profile to prevent soil movement resulting in weed escapes.

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BALANCE 750 WG	
IRRIGATION	Do not apply Balance in the cutaway situation if irrigating by flood.
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 to 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.
WITHHOLDING PERIOD/RISK TO OTHER CROPS	Avoid drift onto non-target areas/crops. Do not harvest for 19 weeks after application. Do not graze animals on treated crops.
PLANT BACK PERIOD	Corn: 10 weeks. Mungbeans: 7 months. Soybeans: 7 months. *rainfall dependent.
ENVIRONMENTAL RISK	Do not contaminate streams, rivers or waterways.
HERBICIDE RESISTANCE	Moderate (Group H).

BALANCE 750 WG	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H361*** Suspected of damaging fertility or the unborn child. ***H410*** Very toxic to aquatic life with long-lasting effects.
FORMULATION	Water dispersible granule.
WATER QUALITY	Use clean water. Do not allow to the spray mixture to stand overnight.
APPLICATION EQUIPMENT	Broadcast or banded spray depending on crop stage. Do not apply by aircraft. Select nozzles to produce medium to coarse droplet pattern at selected operating pressure.

APPLICATION RATES

PRODUCT	SOIL CATEGORY	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
BALANCE	Light: clay content <15%	100–125g	$18–$22	Minimum 250L	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%	100–150g	$18–$26		
	Heavy: clay content >33 %	100–200g	$18–$35		

MCPA

Broadleaf systemic knockdown herbicide

AGRITONE® 750, MCPA 750

MCPA – 750g/L

Selective systemic herbicide for post-emergent control of broadleaf including ipomea vines, convolvulus vines, bluetop, gambia pea, rattle pod and merremia vines.

HERBICIDE SUITABILITY	
SOIL CONDITIONS	Rainfast after 6 hours. Do not use unless wind speed is more than 3km/h and less than 15km/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 or waterlogging.
CROP STAGE	Safe at any crop stage.
VARIETY SUSCEPTIBILITY	Refer to QCANESelect™ or the regional variety guides 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	
SIGNAL HEADING	**DANGER**
PICTOGRAM	 *Source: Gold label, Chemwatch*
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H312*** Harmful in contact with skin. ***H410*** Very toxic to aquatic life with long-lasting effects. ***H315*** Causes skin irritation. ***H318*** Causes serious eye damage. ***H351*** Suspected of causing cancer. ***H335*** May cause respiratory irritation. ***H373*** May cause damage to organs through prolonged or repeated exposure.

AGRITONE® 750, MCPA 750	
FORMULATION	Soluble liquid.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Directed inter-row spray.

APPLICATION RATES

PRODUCT	ACTIVE CONCENTRATION	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA
AGRITONE 750 MCPA 750	750g/L	930–1450mL	$13–$21	30–120L

METRIBUZIN

Broad-spectrum knockdown and residual herbicide

MENTOR®

Metribuzin – 750g/kg

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 – bell vine, convolvulus, star of Bethlehem.

HERBICIDE SUITABILITY	
SOIL CONDITIONS	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. 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-emergenent control. Do not apply to plant cane up to 3-leaf stage on very light sandy soil.
INCORPORATION	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 12.5mm) will provide sufficient incorporation. Do not disturb treated surface after application.
TARGET 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). Two sunny days before spraying enhances crop tolerance. Apply as a directed spray where sugarcane exceeds the 3-leaf stage.
CULTIVATION & 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™ or the regional variety guides for variety sensitivity information.
WITHHOLDING PERIOD	Do not harvest for 21 weeks after application.
RISK TO OTHER CROPS	Avoid drift onto non-target areas/crops.
PLANT BACK PERIOD	Do not plant susceptible crops such as brassicas, capsicums, cotton, cucurbits, lettuce or sunflowers within 12 months of application.
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. Do not irrigate crop to the point of run-off unless it can be retained on-farm. Do not apply within 30m of a downwind waterway for all ground spray applications without droppers. Do not apply within 75m of downwind non-target vegetation for all ground spray applications without droppers.
HERBICIDE RESISTANCE	Moderate risk (Group C).

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MENTOR	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H320*** Causes eye irritation. ***H410*** Very toxic to aquatic life with long-lasting effects.

MENTOR	
FORMULATION	Water dispersible granule.
WATER QUALITY	Use clean water. Do not allow spray mix to stand overnight.
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**
MENTOR	Plant cane to 3-leaf stage 640–2000g	$31–$97	250L minimum	Provides residual weed control for 4 to 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. Do not apply more than 2kg/ha per season.
	Plant cane final hilling until "out of hand". Ratoon cane after harvest until "out of hand". 800–2000g	$39–$97		
	Plant and ratoon cane after canopy closure. 640–1000g	$31–$49		

MSMA

Grass knockdown herbicide

DACONATE 720®, MONOPOLY®

MSMA – 720g/L

Contact herbicide for post-emergent control of hard-to-kill grass. Controls summer grass, barnyard grasses, green summer grass, vasey grass, itch grass, *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 50–80cm 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™ and the regional variety guides 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®	
SIGNAL HEADING	**WARNING**
PICTOGRAM	 *Source: Gold label, Chemwatch*
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H332*** Harmful if inhaled. ***H351*** Suspected of causing cancer. ***H373*** May cause damage to organs through prolonged or repeated exposure. ***H410*** Very toxic to aquatic life with long-lasting effects.

DACONATE 720®, MONOPOLY®	
FORMULATION	Soluble concentrate.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Directed or spot spray where sugarcane has emerged. Do not apply by aircraft.

APPLICATION RATES

PRODUCT	WEED	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
DACONATE 720, MONOPOLY	Small annual grass	6600mL	$108	300L minimum	Ensure thorough coverage of weeds. Add non-ionic wetting agent. Spray when cane is 50–80cm high.
	Perennial grass	1100mL/100L	$18/100L	Spot spraying	

PARAQUAT

Broad-spectrum contact knockdown herbicide

GRAMOXONE® 360 PRO, SPRAYTOP® 250

Shirquat 250, Paraquat 250, Spraytop 250: paraquat -250g/L Gramoxone 360 PRO -360g/L

Contact herbicide for post-emergent control of grasses and some 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 5cm 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 to 4-leaf stage of plant cane. Directed spray on ratoon cane over 10cm in height. Avoid broadcast application over sugarcane in Southern Qld/NSW during winter months.
VARIETY SUSCEPTIBILI	All varieties are sensitive. All green plant material is scorched. Actively growing sugarcane sprayed at the 3 to 4-leaf stage will recover within 7 to 10 days.
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, blackberry nightshade and crowsfoot grass (Southern Queensland).

GRAMOXONE 360 PRO	
SIGNAL HEADING	**DANGER**
PICTOGRAM	
HAZARD STATEMENT	***H290*** May be corrosive to metals. ***H302*** Harmful if swallowed. ***H311*** Toxic in contact with skin. ***H315*** Causes skin irritation. ***H318*** Causes serious eye damage. ***H330*** Fatal if inhaled. ***H335*** May cause respiratory irritation. ***H372*** Causes damage to organs through prolonged or repeated exposure.

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GRAMOXONE 360 PRO, SPRAYTOP 250	
FORMULATION	Soluble concentrate.
WATER QUALITY	Avoid water containing clay, silt and algae. Hard or saline water may be used.
APPLICATION EQUIPMENT	Directed spray where plant cane is greater than 3 to 4-leaf stage, or ratoons are greater than 10cm. Do not apply by aircraft.

APPLICATION RATES					
PRODUCT	**WEED SIZE**	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
GRAMOXONE 250 **SPRAYTOP 250**	Up to 10cm	1200–1600mL	$11–$15	250–350L	Apply paraquat alone as broadcast spray over-the-top in plant cane up to the 3 to 4-leaf stage, or up to 10cm high in ratoon cane, otherwise use a directed inter-row spray. Diuron may be added to enhance activity. Add 275–500g/ha diuron (900g/kg) or 1000g/ha diuron (900g/kg) for weeds up to 5cm or 10cm high, respectively. Ensure diuron applied as per district-specific spray conditions as per label. Only add diuron if seeking enhanced efficacy. Always add an adjuvant as per label.
GRAMOXONE 360 PRO	Up to 10cm	835–1100mL	$7–9	Minimum 250L	

PARAQUAT + DIQUAT

Broad-spectrum contact knockdown herbicide

SPRAY.SEED® 250, REVOLVER®

Paraquat – 135g/L, diquat – 115g/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 or humid 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 5cm high. Ensure good coverage. Do not spray if weeds are covered with dust or heavy dew. Do not spray plants which are waterlogged or under stress. Key weeds include sicklepod, bluetop, 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 cane sprayed up to the 3 to 4-leaf stage (or ratoons up to 10cm) will recover in 7 to 10 days. Directed spray where the sugarcane exceeds the 3 to 4-leaf stage, or ratoons are greater than 10cm.
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. Do not contaminate streams, rivers or waterways.
HERBICIDE RESISTANCE	Moderate risk (Group L).

SPRAY.SEED 250	
SIGNAL HEADING	**DANGER**
PICTOGRAM	
HAZARD STATEMENT	***H290*** May be corrosive to metals. ***H302*** Harmful if swallowed. ***H311*** Toxic in contact with skin. ***H315*** Causes skin irritation. ***H317*** May cause an allergic skin reaction. ***H318*** Causes serious eye damage. ***H330*** Fatal if inhaled. ***H335*** May cause respiratory irritation. ***H372*** Causes damage to organs through prolonged or repeated exposure.

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SPRAY.SEED 250, REVOLVER	
FORMULATION	Soluble concentrate.
WATER QUALITY	Use clean water. Avoid muddy water.
APPLICATION EQUIPMENT	Directed spray where the sugarcane is at 3 to 4-leaf stage or more, or ratoons are greater than 10cm. Ground application only. Good spray coverage is critical. For boom spray, use 110 degrees flat fan nozzles adjusted to give at least a double overlap at the top of the weeds being sprayed. Recommended spray pressure: 2.4–2.8 bars. Recommended speed of travel: 6 to 10km/h.

APPLICATION RATES						
PRODUCT	**WEED**	**WEED SIZE**	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
SPRAY.SEED 250, REVOLVER	Grass and Broadleaf	Dependent on weed species and size (refer to label)	1200–3200mL (fallow) 1200–2000mL (crop)	$13–$36	250–400L	Add 2,4-D at 1000mL/ha to enhance vine control in fallow. Add 500–1000g/ha diuron (900g/kg) to enhance grass knockdown (apply as a directed spray where sugarcane has emerged). A split application 10 to 12 days apart will improve control of tall dense weeds. Add suitable non-ionic wetter.

PENDIMETHALIN

Grass residual herbicide

STOMP® XTRA, RIFLE® 440

Stomp XTRA: pendimethalin – 455g/L
Rifle 440: pendimethalin – 440g/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. Soil containing high organic matter will result in poor control. Do not apply if OM >6%.
INCORPORATION	Incorporation by 12–25mm 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. Subsequent tillage operations should not exceed incorporation depth.
CROP STAGE	Safe at any crop stage. Apply before weed emergence. 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.
WITHHOLDING PERIOD	Not required when used as directed.
RISK TO OTHER CROPS	Avoid drift onto non-target areas/crops.
PLANT BACK PERIOD	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	
SIGNAL HEADING	**WARNING**
PICTOGRAM	 *Source: Gold label, Chemwatch*
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H317*** May cause an allergic skin reaction. ***H373*** May cause damage to organs through prolonged or repeated exposure. ***H410*** Very toxic to aquatic life with long-lasting effects.

STOMP XTRA, RIFLE 440	
FORMULATION	Capsule suspension concentrate (Stomp XTRA), Emulsifiable concentrate (Rifle 440).
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Broadcast or directed spray. Atrazine or diuron tank mixtures should have nozzle screens greater than 50 mesh. Do not apply by aircraft.

Continued over page

APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
STOMP XTRA	2200–3300mL	$36–$54	200L	Use high rate where: – Longer weed control is required. – Incorporation is delayed longer than 5 days. – High grass pressure exists (eg ground previously sown to pasture). Use the lower rate plus atrazine or diuron at 1500g ai/ha where broadleaf weed control is required. Alternatively use the lower rate plus 400mL/ha Spark (imazapic) where broadleaf weeds are present. Do not use on heavy clay soils when mixed with atrazine.
RIFLE 440	2250–3400mL			

S – METOLACHLOR

Grass residual herbicide

DUAL GOLD®, BOUNCER® 960S

S-metolachlor – 960g/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 (15mm) or a shallow cultivation (2.5cm) 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 SUSCEPTIBILITV	Safe on all varieties.
WITHHOLDING PERIOD	Do not graze or cut for stock food for 13 weeks after application.
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.
PLANT BACK PERIOD	Do not plant susceptible crops for 6 months after an application. Corn, peanuts and soybeans can be planted prior to 6 months.
ENVIRONMENTAL RISK	Toxic to fish. Do not contaminate streams, rivers or waterways. 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	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H319*** Causes serious eye irritation. ***H317*** May cause an allergic skin reaction. ***H332*** Harmful if inhaled.

DUAL GOLD	
FORMULATION	Emulsifiable concentrate.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Do not apply by aircraft. Thoroughly flush spray equipment with water after use.

Continued over page

APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
DUAL GOLD BOUNCER 960S SOUTHERN QLD	1100–1450mL + 1500–2000g Gesaprim Granules	$16–$20 + $14–$18	>60L	Apply once per year only. Use rates toward the higher end of the range on heavy soils where a high grass population is expected. 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 to 4-true-leaf stage, knockdown herbicides such as ametryn, diuron or paraquat applied as a post-directed spray can be added. Where broadleaf weeds only have emerged, and are at the 2 to 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.
DUAL GOLD BOUNCER 960S NORTH QLD	1450–1800mL + 2000–2500g Gesaprim Granules	$20–$25 + $18–$23		

S – METOLACHLOR + ATRAZINE

Broad-spectrum early post-emergent and residual herbicide

PRIMEXTRA GOLD®

S-metolachlor – 290g/L, atrazine – 370g/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, bellvine, blue top, blackberry nightshade, Mexican clover, passionfruit vines, pigweed, square weed, Star of Bethlehem, wild rose.

HERBICIDE SUITABILITY	
SOIL CONDITIONS	Apply to moist soil. Do not apply to waterlogged soil.
INCORPORATION	If conditions remain dry for 10 days after application, irrigation or a shallow cultivation (2.5cm) may improve results.
TARGET WEED CONDITIONS	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 run-off for at least 2 days after application.
VARIETY SUSCEPTIBILITY	Refer to QCANESelect™ or the regional variety guides 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.
PLANT BACK PERIOD	For rates up to 3200mL/ha, do not plant susceptible crops for 6 months (see label). For rates above 3200mL/ha do not plant susceptible crops for 18 months after application (see label).
ENVIRONMENTAL RISK	PSII herbicide. Do not apply if heavy rains or storms that are likely to cause runoff are forecast within 48h of application. Do not mix, load or apply within 20m of any well, sink hole, or waterway. Do not apply within 60m 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	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H319*** Causes serious eye irritation. ***H373*** May cause damage to organs through prolonged or repeated exposure.
FORMULATION	Suspension concentrate.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Boom, directed spray. Do not apply by aircraft.

Continued over page

APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
PRIMEXTRA GOLD	3600–4800mL (Southern Queensland, NSW) 4800–6000mL (North Queensland)	$70–$117	200–400L	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 3000g ai atrazine/ha per year.

TERBUTHYLAZINE + ISOXAFLUTOLE

Broad-spectrum early post-emergent and residual herbicide

PALMERO® TX

Terbuthylazine – 750g/kg, isoxaflutole – 75g/kg

Pre-emergent control of grass and broadleaf weeds.

HERBICIDE SUITABILITY	
SOIL CONDITIONS	Terbuthylazine component is more active in alkaline soils (pH>8) resulting in crop injury. Do not apply at any rate to soils of cation exchange capacity (C.E.C.) less than 3meq/100g or with clay content less than 10%, or with organic carbon content of less than 0.8%. Do not apply at rates higher than 1000g/ha to soils with organic carbon content of less than 1.0%, unless the cation exchange capacity (C.E.C.) is above 9.5meq/100g. Do not apply at rates of 1250g/ha or higher to soils of cation exchange capacity (C.E.C) less than 4.5meq/100g. Apply at the highest rate on heavy trash blanket. Do not apply to recently burnt stubble/trash. After burning, rainfall or cultivation is required to allow PALMERO TX to reach the soil and not be irreversibly bound by ash. Do not apply on newly limed soil. Do not apply to poorly drained soils, sodic soils or compacted soils. Do not apply where slope exceeds 3%.
INCORPORATION	Sufficient rainfall, or overhead irrigation (20–30mm), is required within 2 to 3 weeks of application and prior to weed emergence to wet soil to a minimum depth of 5cm.
TARGET WEED CONDITIONS	Before weeds emerge. Emerged weeds must be controlled by prior cultivation, or application of an appropriate herbicide.
CROP STAGE	As a directed spray in plant or ratoon cane just prior to canopy closure in a tank mix with Spraytop. As a broadcast or banded spray in ratoons after harvest and up to the two-leaf crop stage. Do not apply in fallow prior to planting sugarcane. Do not apply after the out-of-hand stage. Do not apply in the planting furrow in plant cane. Do not apply to crops with poor root development or to crops under stress. Do not apply to blocks that are to be replanted soon after harvest.
CULTIVATION AND IRRIGATION	Avoid soil disturbance e.g. stool splitting, after application. If applying as a band treatment, avoid throwing excessive untreated soil onto the treated band when inter-row cultivating.
VARIETY SUSCEPTIBILITY	All varieties likely to be susceptible to root and foliar uptake. Contact with sugarcane foliage may cause temporary crop damage such as chlorosis and/or a reduction in crop biomass or crop height
WITHHOLDIN PERIOD/RISK TO OTHER CROPS	Avoid drift to non-target areas. Do not apply unless wind speed is between 3 and 20km/h. No withholding period when used as directed. Do not graze or cut for stock food for 8 weeks after application.
PLANT BACK PERIOD	Maize: 6 months. Soybeans: 7 months *rainfall dependent. Up to 21 months and 500mm required for some other crops.

Continued over page

<table>
<tr><th colspan="2">HERBICIDE SUITABILITY (CONTINUED)</th></tr>
<tr><td rowspan="6">ENVIRONMENTAL RISK</td><td colspan="4">Mandatory downwind buffer zones when applied with boom sprayers</td></tr>
<tr><td>Application rate</td><td>Boom height above target canopy</td><td>Natural aquatic areas</td><td>Vegetation areas</td></tr>
<tr><td rowspan="2">1000 g/ha or lower</td><td>0.5m or lower</td><td>30m</td><td>30m</td></tr>
<tr><td>Over 0.5m</td><td>80m</td><td>75m</td></tr>
<tr><td rowspan="2">Up to maximum label rate</td><td>0.5m or lower</td><td>45m</td><td>45m</td></tr>
<tr><td>Over 0.5m</td><td>140m</td><td>130m</td></tr>
<tr><td colspan="4">Do not apply as a broadcast spray in the Fitzroy region.
Do not contaminate wetlands or watercourses.
Do not apply at the highest rate as a broadcast spray in ratoon cane after harvest and up to the 2-leaf stage unless green cane harvested with retention of trash blanket.</td></tr>
<tr><td>HERBICIDE RESISTANCE</td><td colspan="4">Moderate risk (Groups C and H).</td></tr>
</table>

PALMERO TX	
SIGNAL HEADING	**WARNING**
PICTOGRAM	
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H373*** May cause damage to organs through prolonged or repeated exposure. ***H361*** Suspected of damaging fertility or the unborn child. ***H410*** Very toxic to aquatic life with long-lasting effects.
FORMULATION	Water dispersible granule.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Do not apply by aircraft. Do not apply by boom spray equipment using an open cab tractor. Ensure spray droplet spectrum (Spray Quality) is COARSE. Directed spray (just prior to canopy closure). Broadcast or banded spray (in ratoons up to two-leaf crop stage).

APPLICATION RATES				
PRODUCT	**RATE/HA**	**INDICATIVE COST/HA (GST INCLUSIVE)**	**WATER RATE L/HA**	**COMMENTS**
Palmero TX	1000–2000g	$42–$84	>250L/ha	Soil CEC restrictions. See statements under Soil Conditions. Do not apply more than once in a 12-month period. Do not apply more than 2000g per year. Do not add adjuvants. Always apply in a tank mixture with paraquat when cane crop has emerged and/or weeds have germinated.
Palmero TX **+** **paraquat (250g/L)**	1000–2000g + 1200–1600mL	$42–$84 + $11–$15		

TERBUTRYN + MCPA

Broadleaf systemic knockdown herbicide

AGTRYNE® MA

Terbutryn – 275g/L, MCPA 160g/L

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

HERBICIDE SUITABILITY	
WEATHER CONDITIONS	Reduced control may occur when temperatures <22°C. Rainfast in 6 hours.
TARGET WEED CONDITIONS	Apply to weeds up to 8-leaf stage or 30cm diameter, vines to 1m. Apply to actively growing weeds. Do not spray if weeds are wilted by dry or cold weather.
CROP STAGE	Agtryne MA only: can be applied over the top of cane. Initial leaf yellowing and scorch may occur but cane normally recovers within 4 weeks.
VARIETY SUSCEPTIBILITY	Some sugar cane varieties may show yellowing and some leaf scorch immediately after spraying but plants normally recover within 4 weeks.
WITHHOLDING PERIOD	When Agtryne MA is used alone, no WHP is required when used as directed. 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	**DANGER**
PICTOGRAM	 *Source: Gold label, Chemwatch*
HAZARD STATEMENT	***H302*** Harmful if swallowed. ***H318*** Causes serious eye damage. ***H325*** Causes skin irritation. ***H351*** Suspected of causing cancer. ***H353*** May cause damage to organs through prolonged or repeated exposure. ***H410*** Very toxic to aquatic life with long-lasting effects.
FORMULATION	Suspension Concentrate.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Boom; directed spray when mixed with ametryn. Can be applied by aircraft (Agtryne MA only).

APPLICATION RATES

PRODUCT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
AGTRYNE MA	2000–4000mL	$39–$78	200–400L	Use lower rate on weeds < 4-leaf stage and higher rate on larger weeds. Will only suppress bluetop – use a minimum of 3000mL/ha on weeds <10cm. For common sensitive plant use a minimum of 3000mL/ha. Always add non-ionic wetter.
AGTRYNE + AMETRYN (800g/Kg)	3000–4000mL + 1900–2300g	$39–$78 + $43–$55		If grasses are present apply before 20cm height (15cm 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, TRIFLUR X®

Trifluralin – 480g/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, excess clods, free of crop and trash residues. Risk of root damage from excessive rainfall concentrating herbicide into the furrow. High organic matter levels may reduce control.
INCORPORATION	Generally, must be incorporated within 4 hours by mechanical cultivation. Thoroughly incorporate to a depth of 7.5–13cm. Several passes may be required for complete incorporation. Under hot conditions incorporate into the soil immediately after spraying.
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.
WITHHOLDIN PERIOD/RISK TO OTHER CROPS	Avoid drift onto non-target areas/crops. WHP not required when used as directed.
PLANT BACK PERIOD	Do not plant sensitive grasses for 12 months.
ENVIRONMENTAL RISK	Short persistence on soil, rapidly broken down by sunlight. Do not contaminate streams, rivers or waterways.
HERBICIDE RESISTANCE	Moderate risk (Group D).

TRIFLUR X	
SIGNAL HEADING	**DANGER**
PICTOGRAM	
HAZARD STATEMENT	***H351*** Suspected of causing cancer. ***H317*** May cause an allergic skin reaction. ***H304*** May be fatal if swallowed and enters airways. ***H336*** May cause drowsiness or dizziness. ***AUH066*** Repeated exposure may cause skin dryness or cracking. ***H410*** Very toxic to aquatic life with long-lasting effects.

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TRIFLURALIN, TRIFLUR X	
FORMULATION	Emulsifiable concentrate.
WATER QUALITY	Use clean water.
APPLICATION EQUIPMENT	Broadcast or banded spray.

APPLICATION RATES

PRODUCT	RATE/HA	INDICATIVE COST/HA (GST INCLUSIVE)	WATER RATE L/HA	COMMENTS
TRIFLURALIN 480 **TRIFLUR X**	2300–3000mL	$21–$27	300–400L	Apply to cane 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. Apply to ratoon cane immediately after harvest.

HERBICIDE APPLICATION

Nozzle Selection Guide

APPLICATION SYSTEM	NOZZLE TYPE (EXAMPLES)	COVERAGE	DROPLET SIZE	DRIFT RISK
BROADCAST SPRAYING 	Pre-orifice tapered flat fan 	Very good	Medium to coarse droplets (DG nozzle)	Low
	Air-inducted low pressure (Low drift) 	Very good (air mixed with droplets)	Medium to coarse droplets	Low
	Air-inducted (extra low drift) 	Good (air mixed with droplets)	Extra coarse	Very low
	Twin air-inducted (low drift) 	Good (air mixed with droplets)	Coarse to very coarse droplets	Low
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 droplets	Low
	Air induction even flat fan	Good	Coarse to Extra Coarse	Low
DIRECTED SPRAYING 	As for band spraying			
	Floodjet 	Poor	Variable droplet size	Low
OCTOPUS BAR 	Pre-orifice or air-inducted low pressure even flat fan (low drift)	See above		
DUAL-SPRAY BAR 	**Centre nozzle:** Air-inducted 95 to 110 degree angle even fan	Very good	Extra coarse to very course	Very low
	Wing nozzles: 80 to 95 degree angle even fan Air-inducted nozzles can be used		Very coarse to coarse	Low

HERBICIDE SUITABILITY			COMMENTS
POST-EMERGENT		SOIL RESIDUAL	
CONTACT	SYSTEMIC		
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.
Good	Excellent	Very good	**Example:** Agrotop Airmix® Recommended operating pressure range 3–5 bar. Essential when applying Group I products (eg 2,4-D, Starane, Tordon). Use in drift sensitive situations. Up to 90% drift reduction.
Not recommended	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.
Good	Excellent	Excellent	**Example:** Air Induction Turbo TwinJet (AITTJ60) Recommended operating pressure range 2–7 bar. Essential when applying Group I products (eg 2,4-D, Starane, Tordon). Use in drift-sensitive situations. Increase target coverage.
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..
Good	Excellent	Very good	**Example:** AI TeeJet® Recommended operating pressure range 2–7 bar.
Good	Not recommended	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.
Good	Very good	Not recommended	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 DAF dual herbicide sprayer is available from DAF. The User Manual includes design drawings and nozzle recommendations.
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 80L/ha
- Travel speed 8km/h
- operating pressure 2.5 bar
- nozzle spacing 50cm

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):
  - corresponds to nozzle spacing on a boom, if nozzles are 50cm apart
  - is the width (m) of a band from a single nozzle at the target (banded spraying)
  - 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

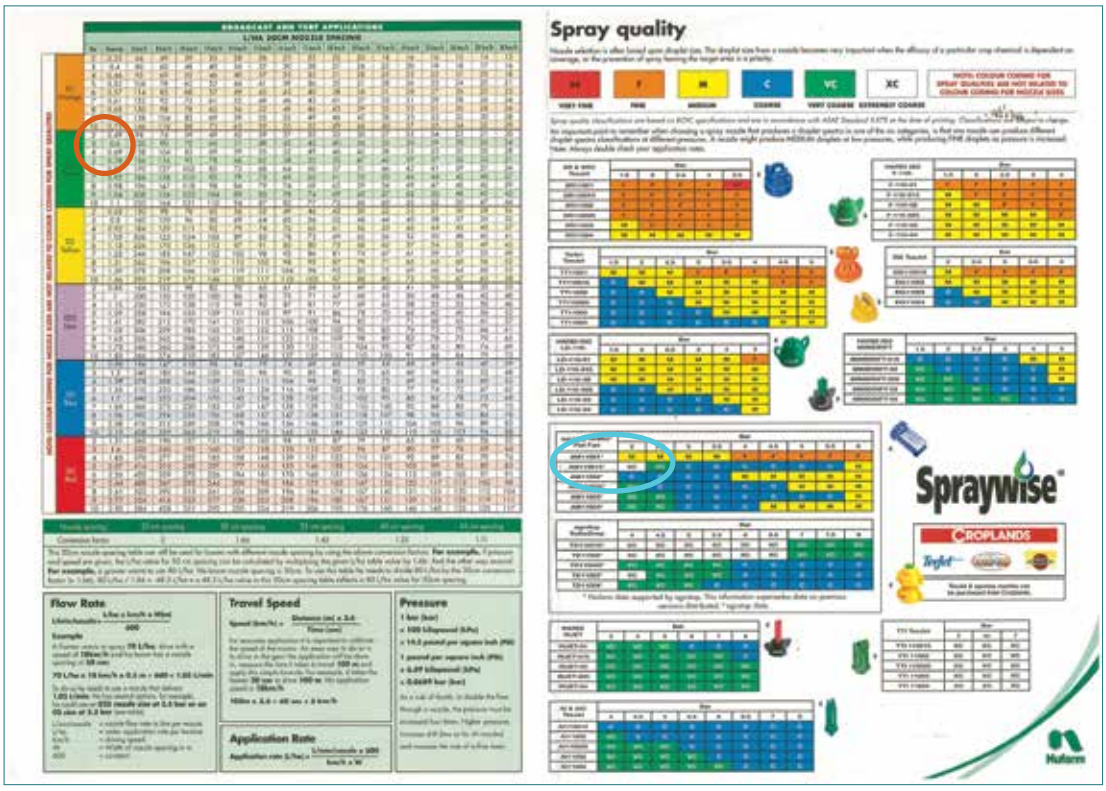
= 0.53000mL/minute/nozzle

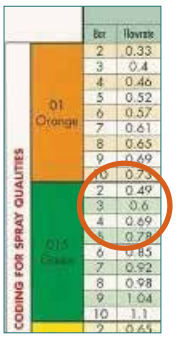
Go to the nozzle chart and choose a nozzle size that produces closest output at your desired operating pressure.

STEP 2

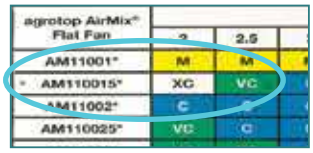
From the spray quality section of a nozzle chart, select a 015 nozzle that produces a coarse to very coarse droplet spectrum at 2.5 bar.

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.





(Nufarm nozzle chart)



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 produce agent or via the internet.

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, for 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% variation either side of the manufacturer's stated output is enough to replace the nozzle. This general figure should also take in to account and make allowances for the following:

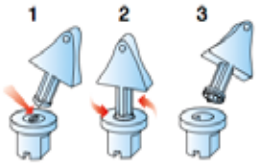
- Ensure the pressure gauge in in the usable range for the sprayer. Use a gauge that has a 0 to 5 or 0 to 10 bar range when using herbicides. Do not use a 0 to 25 bar gauge.
- There will be some pressure drop from the pump and pressure gauge to the nozzle. Expect a range from almost nothing to 0.5 bar 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 close feeder lines. In anything this will only be around 0.1 bar.
- Always record the outputs of each new nozzle and use this as a standard.

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.

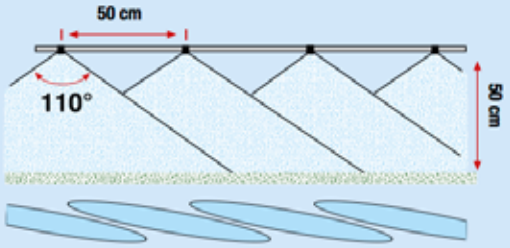
- ISO – Flow, colour and outer dimensions
- Working pressure – 1.5 to 5 bar
- Restrictor designed for minimum chemical residues
- SYNTAL – precision moulded thermoplastic
- CERAMIC – extremely high durability
- COLOR TIPS – for safe and easy handling

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		l/ha at km/h 6	7	8	10	12	15	20	25
01-Orange	1.5	0.28	M	57	48	42	34	28	23	17	14
	2.0	0.33	M	65	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	80	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-CT 371837 (12 pcs. 755708) SYNTAL-S 371817 (12 pcs. 755698) CERAMIC-CT 371842 (12 pcs. 755713) CERAMIC-S 371822 (12 pcs. 755703)										
015-Green	1.5	0.42	M	85	73	64	51	42	34	25	20
	2.0	0.49	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-CT 371838 (12 pcs. 755709) SYNTAL-S 371818 (12 pcs. 755699) CERAMIC-CT 371843 (12 pcs. 755714) CERAMIC-S 371823 (12 pcs. 755704)										
02-Yellow	1.5	0.57	M	113	97	85	68	57	45	34	27
	2.0	0.65	M	131	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	185	158	139	111	92	74	55	44
	5.0	1.03	M	207	177	155	124	103	83	62	50
	SYNTAL-CT 371839 (12 pcs. 755710) SYNTAL-S 371819 (12 pcs. 755700) CERAMIC-CT 371844 (12 pcs. 755715) CERAMIC-S 371824 (12 pcs. 755705)										
025-Lilac	1.5	0.71	C	141	121	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	171	150	120	100	80	60	48
	4.0	1.15	M	231	198	173	139	115	92	69	55
	5.0	1.29	M	258	221	194	155	129	103	77	62
	SYNTAL-CT 371958 (12 pcs. 750630) SYNTAL-S 371957 (12 pcs. 750632)										

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

	bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
03-Blue	1.5	0.85	C	170	145	127	102	85	68	51	41
	2.0	0.98	C	196	168	147	118	98	78	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-CT 371840 (12 pcs. 755711) SYNTAL-S 371820 (12 pcs. 755701) CERAMIC-CT 371845 (12 pcs. 755716) CERAMIC-S 371825 (12 pcs. 755706)										
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	165	124	99
	SYNTAL-CT 371841 (12 pcs. 755712) SYNTAL-S 371821 (12 pcs. 755702) CERAMIC-CT 371846 (12 pcs. 755717) CERAMIC-S 371826 (12 pcs. 755707)										
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-CT 371894 (12 pcs. 755815) SYNTAL-S 371893 (12 pcs. 755817) CERAMIC-CT 371897 (12 pcs. 755818) CERAMIC-S 371896 (12 pcs. 755818)										

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®

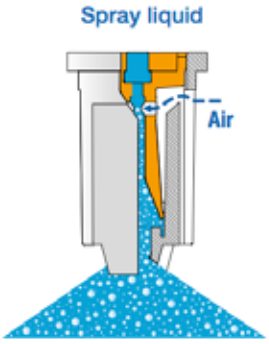
HARDI ISO MINIDRIFT air inclusion nozzles

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)
- SYNTAL – 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 leaves.
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.

015-Green

bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
1.5	0.42	C	85	73	64	51	42	34	25	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	55	42	33
5.0	0.77	M	155	133	116	93	77	62	46	37
6.0	0.85	M	170	145	127	102	85	68	51	41

SYNTAL-CT 372121 (12 pcs. 75083100) SYNTAL-S 372111 (12 pcs. 75082100)

02-Yellow

bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
1.5	0.57	VC	113	97	85	68	57	45	34	27
2.0	0.65	C	131	112	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	226	194	170	136	113	91	68	54

SYNTAL-CT 372122 12 pcs. 75083200) SYNTAL-S 372112 (12 pcs. 75082200)

025-Lilac

bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
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

SYNTAL-CT 372123 (12 pcs. 75083300) SYNTAL-S 372113 (12 pcs. 75082300)

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

03-Blue

bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
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	266	232	186	155	124	93	74
6.0	1.70	M	339	291	255	204	170	136	102	81

SYNTAL-CT 372124 (12 pcs. 75083400) SYNTAL-S 372114 (12 pcs. 75082400)

04-Red

bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
1.0	0.92	VC	185	158	139	111	90	74	55	44
1.5	1.13	VC	226	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

SYNTAL-CT 372125 (12 pcs. 75083500) SYNTAL-S 372115 (12 pcs. 75082500)

05-Brown

bar	l/min		l/ha at km/h 6	7	8	10	12	15	20	25
1.0	1.15	VC	231	148	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	155	124
6.0	2,83	C	566	485	424	339	283	226	170	136

SYNTAL-CT 372126 (12 pcs. 75083600) SYNTAL-S 372116 (12 pcs. 75082600)

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

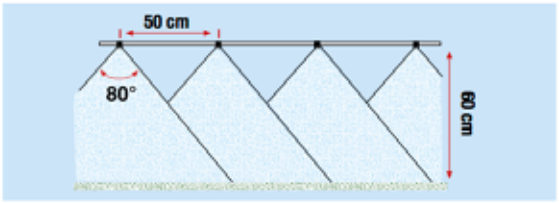
HARDI ISO F-80 – Flat fan nozzles

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	–	57	48	42	34	28	23	17	14
	2.0	0.33	–	65	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 371931 (12 pcs. 750640)										

	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	45	34	27
	2.0	0.65	–	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	55	44
	5.0	1.03	–	207	177	155	124	103	83	62	50
	SYNTAL-S 371933 (12 pcs. 750642) CERAMIC-CT 371921 (12 pcs. 750603) CERAMIC-S 371907 (12 pcs. 750610)										

	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	–	98	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	–	139	119	104	83	69	55	42	33
	5.0	0.77	–	155	133	116	93	77	62	46	37
	SYNTAL-S 371932 (12 pcs. 750641) CERAMIC-CT 371920 (12 pcs. 750602) CERAMIC-S 371906 (12 pcs. 750609)										

	bar	l/min	l/ha at km/h 6	7	8	10	12	15	20	25
03-Blue	1.5	0.85	–	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 371934 (12 pcs. 750643) CERAMIC-CT 371922 (12 pcs. 750604) CERAMIC-S 371908 (12 pcs. 750611)										

= 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.

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Acknowledgement: Hardi®

ISO Nozzle Application Rate Chart (l/ha)

ISO Standard Colour & Size	ID	IDK	IDKT	AD	LU	kpa	50 Spacing (cm) l/min	Speed (km/hr) 6	8	10	12	14	16	18	20	22	25	30	35	40
.03					M	100	0.68	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
Blue		VC	C	C	F	250	1.10	220	165	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	195	156	130	111	98	87	78	71	62	52	45	39
	VC	C	M	M	F	400	1.39	278	209	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	135	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		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	148	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	89	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	129	107	92	80
	VC					1000	2.83	566	425	340	283	243	212	189	170	154	136	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		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
Brown	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	136	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	3.36	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	278	247	223	202	178	148	127	111
						1200	3.88	776	582	466	388	333	291	259	233	212	186	155	133	116
.06	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	306	262	230	204	184	167	147	122	105	92
	VC				M	600	3.35	670	503	402	335	287	251	223	201	183	161	134	115	101
Grey	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	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
White	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					800	5.16	1032	774	619	516	442	387	344	310	281	248	206	177	155
	VC					900		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

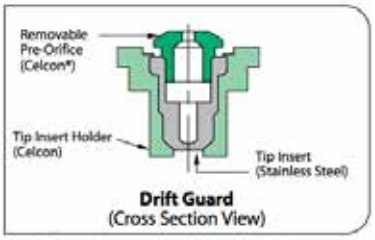
Nozzles

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	IS-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	OC-XX	02-16	90	Brass	OC-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

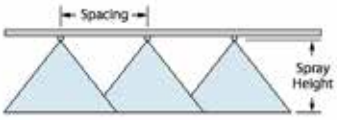


Drift Guard
(Cross Section View)

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 80°	DROP SIZE 110°	CAPACITY ONE NOZZLE IN l/min	l/ha 50 cm: 4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	16 km/h	18 km/h	20 km/h	25 km/h	30 km/h	35 km/h
DG80015† DG110015 (100)	2.0	M	M	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
	2.5	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
	4.0	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
DG8002† DG11002 (50)	2.0	C	M	0.65	195	156	130	111	97.5	78.0	65.0	48.8	43.3	39.0	31.2	26.0	22.3
	2.5	M	M	0.72	216	173	144	123	108	86.4	72.0	54.0	48.0	43.2	34.6	28.8	24.7
	3.0	M	M	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	M	M	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	M	1.02	306	245	204	175	153	122	102	76.5	68.0	61.2	49.0	40.8	35.0
DG8003† DG11003 (50)	2.0	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	M	1.08	324	259	216	185	162	130	108	81.0	72.0	64.8	51.8	43.2	37.0
	3.0	M	M	1.18	354	283	236	202	177	142	118	88.5	78.7	70.8	56.6	47.2	40.5
	4.0	M	M	1.36	408	326	272	233	204	163	136	102	90.7	81.6	65.3	54.4	46.6
	5.0	M	M	1.52	456	365	304	261	228	182	152	114	101	91.2	73.0	60.8	52.1
DG8004† DG11004 (50)	2.0	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	173	144	108	96.0	86.4	69.1	57.6	49.4
	3.0	M	M	1.58	474	379	316	271	237	190	158	119	105	94.8	75.8	63.2	54.2
	4.0	M	M	1.82	546	437	364	312	273	218	182	137	121	109	87.4	72.8	62.4
	5.0	M	M	2.04	612	490	408	350	306	245	204	153	136	122	97.9	81.6	69.9
DG8005† DG11005 (50)	2.0	C	C	1.61	483	386	322	276	242	193	161	121	107	96.6	77.3	64.4	55.2
	2.5	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
	4.0	M	M	2.27	681	545	454	389	341	272	227	170	151	136	109	90.8	77.8
	5.0	M	M	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 124–140 for drop size classification, useful formulas and other information.

†Available in VisiFlo stainless steel only.

Optimum Spray Height

	50 cm
80°	75 cm
110°	50 cm

How to order:

Specify tip number.

Examples:

DG8002VS – Stainless Steel with VisiFlo® color-coding

DG11002-VP – Polymer with VisiFlo color-coding

Acknowledgement: TeeJet® Technologies

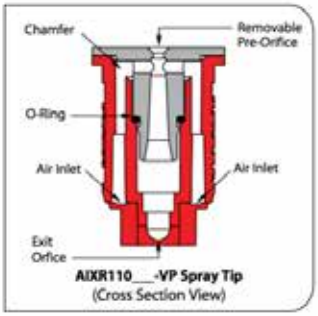
AIXR TeeJet® Air Induction XR Flat Spray Tips

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. UHMPE 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-*-NYR Quick TeeJet® cap and gasket. Reference page 57 for more information.

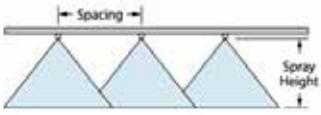


AIXR110___-VP Spray Tip
(Cross Section View)

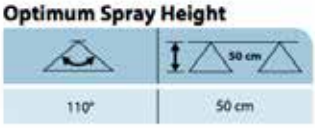
bar	DROP SIZE	CAPACITY ONE NOZZLE IN L/min	L/ha 50cm: 4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	10 km/h	12 km/h	16 km/h	18 km/h	20 km/h	25 km/h	30 km/h	35 km/h
AIXR110015 (100)															
1.0	XC	0.34	102	81.6	68.0	58.3	51.0	40.8	34.0	25.5	22.7	20.4	16.3	13.6	11.7
2.0	VC	0.48	144	115	96.0	82.3	72.0	57.6	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	99.6	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
AIXR110025 (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	0.91	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	184	147	122	105
6.0	C	3.35	1005	804	670	574	503	402	335	251	223	201	161	134	115

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.

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 CP25600-*-NYR Quick TeeJet® cap and gasket for automatic alignment. Reference page 57 for more information.

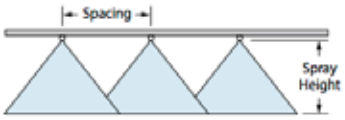
QCT Cam Lever Coupling Adapter

- Provides easy changeover from high capacity to lower capacity nozzles.
- Adapter fits standard ¼" 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 ONE NOZZLE IN l/min	l/ha 75 cm								l/ha 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	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-†2 (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	1.29	258	172	129	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	VC	1.58	316	211	158	126	105	79.0	63.2	50.6	237	158	119	94.8	79.0	59.3	47.4	37.9
TF-†2.5 (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-†3 (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-†4 (50)	1.0	UC	1.82	364	243	182	146	121	91.0	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-†5 (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-†7.5 (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	629	419	314	251	210	157	126	101
	2.0	UC	4.84	968	645	484	387	323	242	194	155	726	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	968	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

TeeJet® Even Flat Spray Tips

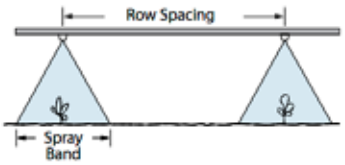
Typical Applications:

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 VisiFlo® color-coding in stainless steel or all stainless steel, hardened stainless steel and brass.

	bar	CAPACITY ONE NOZZLE IN l/min	l/ha 50cm Field Hectares						l/ha 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	0.32	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	0.36	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	0.39	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	0.45	135	90.0	67.5	54.0	36.0	27.0	90.0	60.0	45.0	36.0	24.0	18.0
TP40015E† TP65015E†	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
TP80015E TP95015E (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	146	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	296	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† TP11008E†	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† TP11010E† (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† TP11015E†	2.0	4.83	1449	966	725	580	386	290	966	644	483	386	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



						l/ha 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 l/ha rate on band widths, multiply the tabulated l/ha for ROW SPACING by conversion factors.

How to order:

Specify tip number.

Examples:

TP8002EVS	–	Stainless Steel with VisiFlo color-coding
TP8002E-HSS	–	Hardened Stainless Steel
TP8002E-SS	–	Stainless Steel
TP8002E	–	Brass

Acknowledgement: TeeJet® Technologies

Quick calibrations

BROADCAST SPRAYING

1

Drive tractor in field conditions for 100 meters

0 m — 100 m

2

Measure time (seconds)

3

Collect output (L) for same time from one nozzle

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

4

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

5

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

6

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

BAND SPRAYING

7

Drive tractor in field conditions for 100 meters

0 m — 100 m

8

Measure time (seconds)

9

Collect output (L) for same time from one nozzle

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

10

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

11

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

12

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

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

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 5.

TARGET	WATER RATE (L/HA)	COMMENTS
SMALL EMERGED WEEDS  	50–100L	Low water rates are effective on small grass (2 to 3-leaf stage) and broadleaf weeds (less than 4 leaves)
ESTABLISHED SEEDLINGS  	100–200L	Increase the water rate for grass which has tillered and mature broadleaf weeds
LARGE GRASS  	200–300L	High water rates are required to ensure good coverage on all leaves
NUTGRASS IN FALLOW (GLYPHOSATE)  	25–200L	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  	75–200L	
RESIDUAL APPLICATION TO SOIL  	200–400L	High water rates are required to give adequate coverage of the soil surface to maximise the length of residual control

Spray water 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® and Krismat® WG; which work better in alkaline water. Do not add acidifiers to these herbicides.

Spray water pH can be measured with simple test strips (Image 20), a pH meter, or as part of a full water analysis.

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 21) or as part of a full water analysis.

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.

Img. 20

Img. 21

Image 20: ph test strip kit
Image 21: Total hardness test strip kit

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]	Krismat WG, Balance, Diuron 900WG, Mentor
5	Suspension Concentrates	
6	Wetter if using ECs[2]	
7	Emulsifiable Concentrate (EC) Including capsule suspension (CS)	Triflur X, Dual Gold, Starane Advanced
8	Soluble Liquids (SL)[3] Includes aqueous solutions	Paraquat, Spark, 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*

RESOURCES AND APPENDICES

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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**			
diuron rate/ha	Up to 450g diuron active/ ha (mixed with paraquat)	More than 450g up to 1.8kg diuron active/ha	Up to 450g diuron active/ ha (mixed with paraquat)	1.4 to 1.8kg diuron active/ha		1kg product/100L spot spray for Guinea grass Maximum 5% of total farm area
situation	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**			
diuron rate/ha	Up to 450g diuron active/ ha (mixed with paraquat)	More than 450g up to 1.8kg diuron active/ha	Up to 450g diuron active/ ha (mixed with paraquat)	1.4 to 1.8kg diuron active/ha		1kg product/100L spot spray for Guinea grass Maximum 5% of total farm area
situation	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	Spray	No-spray	Spray	No-spray	No-spray	Spray
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**			
diuron rate/ha	Up to 450g diuron active/ ha (mixed with paraquat)	More than 450g up to 1.8kg diuron active/ha	Up to 450g diuron active/ha (mixed with paraquat)	1.4 to 1.8kg diuron active/ha		1kg product/100L spot spray for Guinea grass Maximum 5% of total farm area
situation	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**			
diuron rate/ha	Up to 450g diuron active/ ha (mixed with paraquat)	More than 450g up to 1.8kg diuron active/ha	Up to 450g diuron active/ha (mixed with paraquat)	1.4 to 1.8kg diuron active/ha		1kg product/100L spot spray for Guinea grass Maximum 5% of total farm area
situation	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	No-spray	Spray	No-spray	No-spray	Spray
DECEMBER 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**			
diuron rate/ha	Up to 450g diuron active/ ha (mixed with paraquat)	More than 450g up to 1.8kg diuron active/ha	Up to 450g diuron active/ha (mixed with paraquat)	1.4 to 1.8kg diuron active/ha		1kg product/100L spot spray for Guinea grass Maximum 5% of total farm area
situation	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 Bobcat Combi, Barrage.

Appendix 2

Regional time-of-spraying constraints for herbicides containing amicarbazone
Note: currently AmiTron is the only registered product containing amicarbazone.

REGION	DO NOT APPLY DURING THESE MONTHS
Wet Tropics	No restrictions
Burdekin	No restrictions
Mackay Whitsunday	1 October to 31 December
Mary Burnett	1 October to 31 December
Northern NSW	No restrictions

Appendix 3

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/Whitsundays** 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:
  - RTC3401A (superseded), AHCPMG301A (superseded) **or** AHCPMG301 (current) - Control Weeds
  - RTC3704A (superseded), AHCCHM303A (superseded), AHCCHM303 (superceded) **or** AHCCHM307 (current) - Prepare and apply chemicals to control pest, weeds and diseases
  - RTC3705A (superseded), AHCCHM304A (superseded) **or** AHCCHM304 (current) - Transport and store chemicals

  Or

  - 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 2.3kg
- Atrazine – the maximum rate of active ingredient per hectare per calendar year is 3kg (and is now noted on labels).
- Diuron – the maximum rate of active ingredient per hectare per calendar year is 1.8kg (and is now noted on labels).
- Additional constraints for products containing ametryn that may not appear on labels:
  - Do not prepare or apply:
    - At a place susceptible to run-off
    - Within 20m of a waterbody
    - Within 20m of a sinkhole or well.
  - Do not apply within 20m of all down-slope water bodies, or at the time of spraying, have a 5m 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.
  - Do not apply on waterlogged soils.
  - Do not apply within 30m of a water body unless:
    - Using a shielded sprayer
    - Applying below the canopy level, or
    - The water body is upwind of the application site.
  - 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 600mm 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.
  - Do not apply in wind speeds:
    - greater than 20km/h; and
    - less than 3km/h unless using a shielded sprayer or spraying below the canopy.
  - Do not irrigate to the point of run-off within 48 hours
  - Do not use if moderate to heavy rain is forecast during the 48 hours after use
  - Do not use if Bureau of Meteorology (BOM) forecasts moderate to heavy rain within a 50km radius, within two hours of the intended spray time.

Note: These additional constraints DO NOT apply to products containing both ametryn and trifloxysulfuron sodium at active ingredient concentrations of 731.5g and 18.5g per kilogram of product, respectively (e.g. Krismat WG)

See also **Record Keeping** on page 23.

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

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 sprayed.

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

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 two to three 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.

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

__Image 22:__ GCA-1050 4 row shielded sprayer; __Image 23-24:__ Combination venturi injector and spray tip commonly used with GCA-1050 shielded sprayers (left) and exploded view (right). __Image 25:__ The nozzle angle must be adjusted to ensure the spray does not hit against the shield side curtains

Img. 22

Img. 23

Img. 24

Img. 25

Side nozzles (two per shield)
Standard side nozzle configuration is:
Agrotop TurboDrop® TD01 injector;
fitted with 02 800 TeeJet even fan nozzle.

Img. 26

Img. 27

Img. 28

Image 26-27: *01 injector fitted with 02 800 flat fan nozzle (left) and fitted on sprayer to spray into cane (right);* ***Image 28:*** *Side nozzles mounted on an arm off the support leg. Nozzles are sometimes mounted straight on the shield top surface*

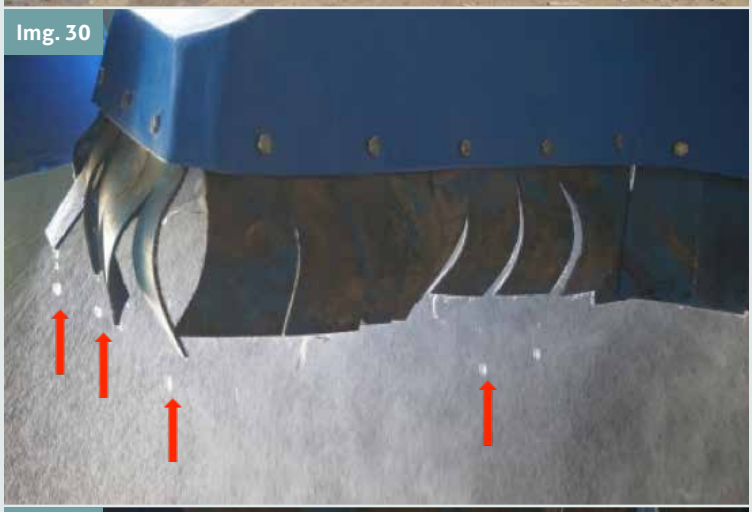
Boomerang spray hoods

Boomerang spray hoods are generally supplied with three flat fan 110 degree 02 (yellow) XR TeeJet® nozzles, operating at two 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 02000 mLow drift fans (e.g. Teejet Driftguard®) and operate at two to three bar pressure.

Img. 29

Img. 30



Img. 31

Image 29: *Boomerang spray hoods (Acknowledgements: Allan Blair, Jack Robertson. DAF);* ***Image 30:*** *Standard setup of sprayer showing droplets coalescing on skirt. Note also smaller droplets and potential for drift (XE type fan nozzle at 2.0 bar pressure;* ***Image 31:*** *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

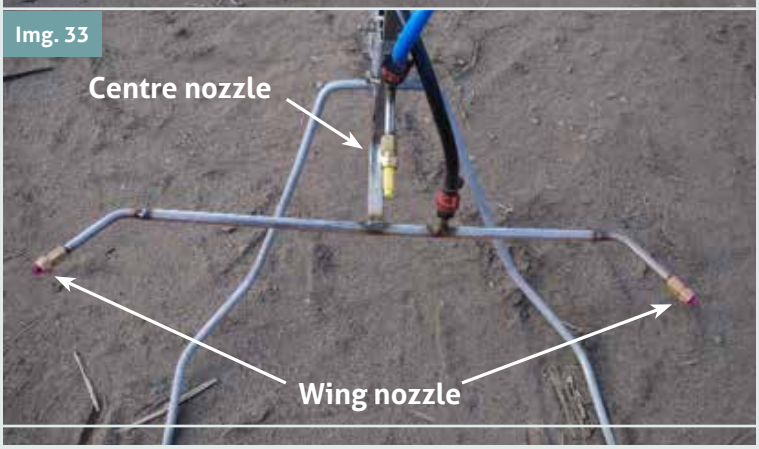
This sprayer uses two spray circuits, one to deliver a spray mixture (usually glyphosate) to the inter-row and a second circuit for a different spray mix to the rows. As the glyphosate is delivered without a spray shield or hood, specific nozzles must be used and the nozzle angle must be adjusted to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

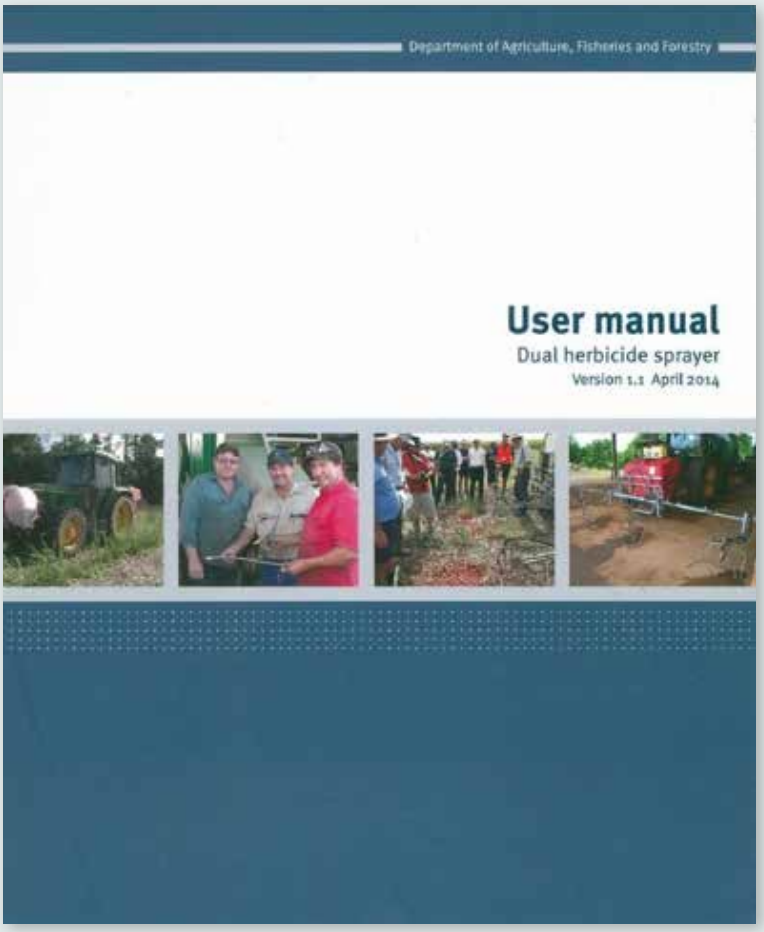
The centre nozzle should be a air-inducted 95–110° even fan nozzle.

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

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.

Image 32: *Non-shielded dual herbicide sprayer;* ***Image 33:*** *Spray arm of the dual sprayer*





Appendix 5
Common adjuvants used in sugarcane

An adjuvant is defined as any material that when added to a spray solution enhances or modifies the action of a pesticide. Adjuvants can be included in the formulations of various products to enhance the stability and functionality of the active ingredient(s) in a spray solution. Adjuvants can be surfactants, oils, acidifiers and buffers, fertiliser adjuvants and can have a variety of functions such as improving chemical compatibility and behaviour, spreading, wetting and modifying droplet forumation and behaviour.

Company	Product	Category	Rate	Rate/100 L	Tank properties						In field properties					
					Water conditioner	Acidifiant	pH buffer	Reduce chemical hydrolysis	Improve chemical compatibility	Anti foam	Spreader	Herbicide penetrant	Sticker	Drift retardant	Rain fastness	Droplet bounce reduction
Nufarm	Liase	ammonium sulphate	2%	2000mL	y				y							
Nufarm	Activator	non-ionic surfactant	0.06–0.12%	60–120mL						y	y	y		y		
Nufarm	LI 700	non-ionic surfactant and other	0.25–0.5%	250–500mL	y	y					y	y				
Victorian Chemicals	Hasten	oil and non-ionic	0.5–1%	0.5–1L							y	y				
Dow	Uptake	oil and non-ionic	0.5–1%	0.5–1L							y	y				
Nufarm	Supercharge Elite	oil and non-ionic	0.5–1%	0.5–1L							y	y				
Loveland/ Nutrien Ag Solutions	Choice Weather Master	aqueous mixture of salts	0.25–0.5%	250–500mL	y				y							
Victorian Chemicals	Hot-Up	ammonium sulphate, mineral oil and non-ionic surfactant	0.25–1%	0.25–1L	y				y		y	y				
Growth Agriculture	Steadfast	ester	0.03–0.12%	30–120mL		y			y		y					
Syngenta	Adigor	ester of vegetable oil	0.05–1%	0.5–1L							y					
Victorian Chemicals	Ad-Here	mineral oil	0.01%	10mL							y					
Imtrade	Pronto	esterified oil and non-ionic	0.5–1%	0.5–1L							y	y	y	y		
Growth Agriculture	Broadspred	organic-silicone	0.05–0.2%	50–200mL							y	y				
Socoa	Cropshield	petroleum oil	0.15–2%	0.15–2000mL							y	y				
OCP	Synertrol oil	vegetable oil	0.25–1L/ha	n/a							y	y	y	y	y	y
Vivtorian Chemicals	Envoy	vegetable oil and other	0.2–0.5%	200–500mL			y				y		y			

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