Trifloxysulfuron-sodium: a new post-emergence herbicide for use in Australian cotton and sugarcane

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Summary Trifloxysulfuron-sodium (formerly CGA 362622), a new sulfonylurea herbicide, has been under evaluation in Australia since 1997 for use in cotton and as a readymix with ametryn in sugarcane. Key attributes of trifloxysulfuron-sodium include: 1) excellent activity on many of the 'most troublesome weeds' in these crops, 2) flexibility of use in both sugarcane and cotton, 3) ultra-low use rate, 4) short but effective residual activity, and 5) an excellent environmental and safety profile. Applied post-emergence it is effective against troublesome broadleaf weeds such as *Xanthium* spp. (Noogoora burr, Bathurst burr), *Ipomoea* spp. (peachvine, bellvine), sesbania pea (*Sesbania cannabina* (Retz.) Poir.) and nutgrass (*Cyperus rotundus* L.) at very low use rates ranging from 11.25 to 22.5 g a.i. ha^{-1}.

A number of other weeds were also controlled or suppressed. Trifloxysulfuron-sodium is a versatile tool for both sugarcane and cotton growers in combating weeds by offering the flexibility of 'over the top' application. It has a wide window of application allowing treatment of cotton up until row closure and in plant cane and ratoon cane from two leaves until the 'out of hand' stage. Such flexibility is not found amongst the current commercial standards.

Keywords Herbicide, trifloxysulfuron-sodium, cotton, sugarcane, sulfonylurea.

INTRODUCTION

Pyrithiobac-sodium and glyphosate (in Roundup Ready® cotton) are the only selective post-emergent broadleaf herbicides available to Australian cotton growers. Sugarcane growers have become reliant on older herbicides with very high use rates including triazines, hexazinone and diuron. Few modern, effective, selective post-emergent herbicides have been introduced in recent years. Noogoora burr (*Xanthium occidentale* Bertol.), nutgrass, peachvine (*Ipomoea lonchophylla* J.M.Black) and sesbania pea (*Sesbania* spp.) are amongst the most troublesome weeds of cotton (Charles 1991). Nutgrass is regarded as the world's economically most damaging weed due to its competitiveness.

In Australia, halosulfuron has been withdrawn from the market so there is no selective post-emergent herbicide available for use in conventional cotton and sugarcane. Trifloxysulfuron-sodium is effective against these key weed species. Soares *et al*. (2000) and Rawls *et al*. (2000) report good activity on *Cyperus* spp., including reduced viability of underground tubers.

Trifloxysulfuron-sodium is a new selective sulfonyurea herbicide discovered by Syngenta in the mid 1990s and field tested in Australia since 1997. It is rapidly absorbed by the shoots and roots and is systemic within the plant. Its mode of action is the inhibition of the acetolactate synthase (ALS) enzyme, a key enzyme in the biosythesis of branched chain amino acids, which subsequently inhibits cell division and plant growth. Selectivity is based on two mechanisms: 1. enhanced metabolism and 2. extremely low translocation out of the treated area in cotton and sugarcane plants compared to sensitive weeds. Six hours after application, only 50% of the non-metabolised active ingredient was found in cotton compared to 95% in *Xanthium canadense*. Trifloxysulfuron-sodium is degraded primarily by hydrolysis and only slightly affected by soil pH (Hudetz *et al*. 2000).

It is not expected to persist and accumulate in the ground water. In sterile water (pH 4–9) at 25°C it has a half-life of 3–21 days.

Trifloxysulfuron-sodium has a low acute toxicity (WHO Class III) and an acute oral LD_{50} >5000 mg kg^{-1} bw, it is non-irritant to skin or eye, and not sensitising to the skin (Hudetz *et al*. Jan 2000).

It is expected that trifloxysulfuron-sodium will be commercialised in Australia in the near future in cotton with the trade name ENVOKE™ (registration pending) and as a readymix with ametryn under the trade name KRISMAT™.

This paper summarises major findings in biological performance following field evaluation from 1997 until 2001.

MATERIALS AND METHODS

Field trials in Australia started in 1997 and over 65 experimental sites were established in the major cotton growing valleys of NSW, the Darling Downs and Central Highlands areas of Queensland covering at least 22 weed species. More than 20 trials were conducted in the major sugarcane producing areas of Queensland on 23 broadleaf and grass species. Trials were conducted under a wide range of meteorological conditions, covering several soil types and climatic regions.

Trifloxysulfuron-sodium was tested at 7.5 to 45 g a.i. ha^{-1} in cotton and at 18.5 to 55.5 g a.i. ha^{-1} in sugarcane. Herbicide treatments were applied over the top from two true leaves to early flowering stages or as a directed spray in cotton. In sugarcane, treatments were applied to 2–3 leaf stage of cane as an over the top treatment and as directed spray from 60–80 cm TVD to out of hand stage. Trials were established on the main commercial cotton and sugarcane cultivars. Herbicide treatments were applied using a small plot CO_2 or LPG gas sprayer. A non-ionic surfactant was added to all treatments at 0.2 or 0.25 % v/v. Plot size was 30–45 m^2, replicated 3–4 times and arranged as a randomised compete block design

Efficacy and crop safety assessments were made. Visual assessments were made using a 0–100 scale (0% = check and 100% = completely dead weeds) in comparison to an untreated check plot. Results are given as proportion (%) of the untreated control. Individual trials were analysed using standard statistical methods; the results presented in this paper are means only, due to the large volume of data generated.

RESULTS AND DISCUSSION

Cotton Trifloxysulfuron-sodium efficacy on nutgrass (9 trials) are presented in Tables 1 and 2.

The results demonstrate the need to control nutgrass in a planned program involving a range of weed control tactics as none of the products tested provided total control of nutgrass. Trifloxysulfuron-sodium provided good control of young actively growing nutgrass but failed to provide substantial effect on nutgrass germinating after application. Where continuous germinations of nutgrass occurred control was improved with split applications (data not shown).

Noogoora burr and peachvine have been identified as two important weeds of cotton. Results averaged over 11 trials are presented in Table 3.

Trifloxysulfuron-sodium provided excellent control of noogoora burr and is more flexible than existing post-emergent standards by providing control up to the eight leaf stage of burrs. Peachvine control was as good as existing standards. Control can be improved by using herbicides in mixture or as part of a control program.

Trifloxysulfuron-sodium when applied as a tankmix with glyphosate gave very good control of peachvine when compared to glyphosate alone (Table 4).

The rotation of glyphosate and trifloxysulfuron-sodium will be also beneficial as a resistance management tool by utilising two alternate modes of action herbicides.

Trifloxysulfuron-sodium provides control of a range of broadleaf weeds in cotton at very low use rates. With application rates at 11.25 g a.i. ha^{-1} this is up to nine times lower than pyrithiobac-sodium and up to 90 times less than glyphosate.

Other weeds susceptible to trifloxysulfuron-sodium are presented in Table 5. They include sesbania pea, Bathurst burr (*Xanthium spinosum* L.) budda pea (*Aescynomena indica* L.), burr medic (*Medicago polymorpha* L.), wild gooseberry (*Physalis minima* L.) and volunteer mungbeans (*Vigna mungo* (L.) Pepper).

Table 1. Biomass reduction (%) of nutgrass from trifloxysulfuron-sodium and halosulfuron at 43–57 days after treatment.

Cotton	trifloxysulfuron-sodium 22.5 g a.i. ha^{-1}	halosufuron 97.5 g a.i. ha^{-1}
3–6 leaf	77	84

Table 2. Biomass reduction (%) of nutgrass from trifloxysulfuron-sodium and glyphosate at 36–58 days after treatment.

Cotton	trifloxysulfuron-sodium 22.5 g a.i. ha^{-1}	glyphosate 1035 g a.i. ha^{-1}
3–6 leaf	68	66

Table 3. Biomass reduction (%) of noogoora burr and peachvine (2–8 leaf) from trifloxysulfuron-sodium at 21–45 days after treatment.

	trifloxysulfuron-sodium 11.25 g a.i. ha^{-1}	pyrithiobac-sodium 102 g a.i. ha^{-1}
Noogoora burr	90	60
Peachvine	79	81

Pyrithiobac-sodium: weeds up to 4-leaf stage only.

Table 4. Biomass reduction (%) of peachvine.

Peachvine	glyphosate 1035 g a.i. ha^{-1}	glyphosate + trifloxysulfuron-sodium (1035+11.25 g a.i. $ha^{-1)}$
2–4 leaf	79	99

Cotton – crop effect Cotton may show transient phytotoxicity symptoms following an application of trifloxysulfuron-sodium. Visual symptoms were most obvious in the first seven days after application and included interveinal yellowing and mottling, visible mainly on the top leaves. Reddening and height reduction was also observed in some cases.

Crop recovery was rapid and symptoms were generally not evident after 21–28 days from application. No negative yield effect has been recorded. Cotton

Table 5. Mean biomass reduction (%) of weeds* sensitive to trifloxysulfuron-sodium (21–45 days after treatment).

	trifloxysulfuron-sodium 11.25 g a.i. ha^{-1}	pyrithiobac-sodium 102 g a.i. ha^{-1}
Sesbania pea	92	99
Budda pea	85	70
Burr medic	100	81
Bathurst burr	80	35
Wild gooseberry	94	69
Mung beans	95	76

*Up to 6–8 leaves.

sprayed under cooler, wet and overcast conditions tended to be more susceptible to injury.

Sugarcane The development of trifloxysulfuron-sodium in sugarcane is not as advanced as in cotton. Registration is not expected for several years. Trifloxysulfuron-sodium is being developed as a ready-mix with ametryn under the trade name KRISMAT™. Use rates for KRISMAT are expected to be between 1500 and 2500 g ha^{-1} product. The complimentary spectrums of trifloxysulfuron-sodium and ametryn make the combination excellent for broad spectrum grass, sedge and broadleaf weed control.

Initial results with KRISMAT have demonstrated excellent broadleaf weed and nutgrass control can be achieved in sugarcane. (Table 6).

KRISMAT as a formulated product gave excellent control of seedling summer grass (*Digitaria ciliaris* (Retz.) Koeler.), barnyard grass (*Echinochloa crus-galli* (L.) Beauv.) and good control of green summer grass (*Brachiaria subquadripara*) and crowsfoot (*Eleusine indica* (L.) Gareth.).

The use rates required are much below the commercial standards such as ametryn + atrazine with 3000–4000 g a.i. ha^{-1}. General weed control by KRISMAT over 11 common species was comparable in most situations to Velpar K4™ at 3000 g ha^{-1} (Table 7).

At the proposed use rates KRISMAT was well tolerated by both plant and ratoon cane as an 'over the top' application. Some slight yellowing to sugarcane leaves has been experienced (<10% injury) and is well within the limits of commercial acceptability.

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Table 6. Biomass reduction (% knockdown) of major broad leaved weeds and nutgrass in sugarcane at 14–28 days after treatment.

	Krismat 1500 g ha^{-1}	Krismat 2000 g ha^{-1}
Bellvine	94	97
Calopo[1]	93	100
Hairy indigo[2]	100	100
Knobweed[3]	93	100
Rattlepod[4]	100	100
Red convolvulus[5]	65	70
Sensitive weed[6]	90	93
Nutgrass	85	86
Common sida[7]	74	96
Small square weed[8]	83	91
Bluetop[9]	80	85

[1] *Calapagonium mucunoides* Desv. [2] *Indigofera hirsute* L. [3] *Hyptis capitata* Jacq. [4] *Crotolaria* spp. [5] *Ipomoea hederifolia* L. [6] *Mimosa pudica* L. [7] *Sida rhombifolia* L. [8] *Mitracarpus hirtus* [9] *Ageratum* spp.

Table 7. Mean biomass reduction (%) of 11 grass and broadleaf weeds in sugarcane at an average 49 days after treatment (20 sites).

	KRISMAT 2000 g ha^{-1}	Velpar K4 3000 g ha^{-1}
general situation (4 grass + 7 broadleaf spp.)	81	84

REFERENCES

Charles, G. (1991). The cost of unwanted weeds to the cotton industry. *The Australian Cotton Grower* May–June, 37-40.

Hudetz, M., Foery, W., Wells, J. and Soares, J.E. (2000). CGA 362622, a new low rate Novartis post-emergent herbicide for cotton and sugarcane. Proceedings SWSS Conference, Tulsa, USA.

Hudetz, M., Kreuz, K., Steinemann, A., Boutsalis, P., Reugg, W., Wells, J. and Soares, J.E. (2000). CGA 362622, uptake, translocation, and metabolism in cotton and sugarcane. Proceedings of the Third International Weed Science Congress, Foz du Iguazu, Brazil, p. 262.

Rawls, J., Wells, W., Hudetz, M., Jain, R. and Ulloa, M.F. (2000). CGA 362622: a new herbicide for weed control in sugarcane. Proceedings SWSS Conference, Tulsa, USA.

Soares, E.J., Filho, L.Z. and Hudetz, M. (2000). CGA 362622, uptake, translocation, and metabolism in cotton and sugarcane. Proceedings of the Third International Weed Science Congress, Foz du Iguazu, Brazil.