POST-EMERGENCE CONTROL OF CYPERUS SPP. WITH HALOSULFURON

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Abstract

Halosulfuron (methyl 3-chloro-5-(4,6-dimethoxypirimidin-2-ylcarbamoylsulfamoyl)-1-methyl-pyrasole-4-carboxylate) was evaluated in 30 field experiments in sugarcane, maize and grain sorghum to determine herbicidal efficacy and crop tolerance. Post-emergence applications of 36 g ai/ha made from the four leaf stage to just prior to flowering afforded 85-95% control of both *Cyperus esculentus et rotundus* depending on climatic conditions. Growth ceases two to three days after application but the full effect is only visible three to five weeks later. The use of an oil-based adjuvant is imperative. Post-emergence applications of up to 72 g ai/ha proved to be selective in sugarcane.

Keywords: halosulfuron, *Cyperus* spp., sugarcane, post-emergence.

Introduction

Halosulfuron (NC-319) is a new herbicide being developed by Ciba-Geigy Ltd. It belongs to the sulfonylurea group of herbicides and has the tradename Servian (Figure 1).

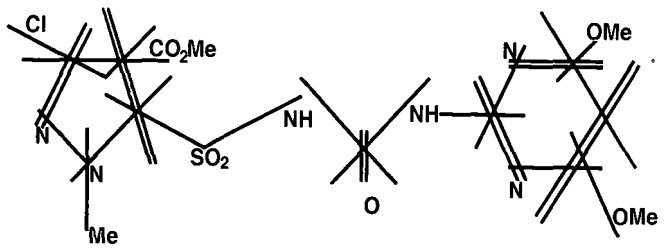

FIGURE 1: Methyl 3-chloro-5-(4,6-dimethoxypirimidin-2-ylcarbamoylsulfamoyl)-1-methylpyrazole-4-carboxylate.

The product is safe to handle with an acute oral LD_{50} (rats) of 8 865 mg/kg, acute dermal LD_{50} (rabbit) of >2 080 mg/kg with no skin irritation (rabbit) and only slight eye irritation (rabbit). It is also practically non-toxic to fish, *Daphnia*, birds and honey bees.

The sulfonylurea herbicides are rapidly absorbed by the foliage as well as by the roots of plants (Amrein and Gerber, 1985; Anon., 1983). It is readily translocated throughout the plant and inhibits cell division. Decomposition of the sulfonylureas in the soil takes place by both hydrolytic and microbial processes. The rate of degradation is enhanced by increased temperatures, soil moisture content and low soil pH. Its adsorption to clay or soil colloids is relatively low.

Cyperus esculentus et rotundus (yellow and purple nutsedge) are very common weeds in sugarcane fields in Natal, Swaziland and the Transvaal Lowveld. Good solutions are presently available for the control of *C. esculentus* but not for *C. rotundus*. The latter is considered the world's worst weed and yield decreases in sugarcane of 75% in Argentina and 38% in Australia have been reported (Holm *et. al.*, 1977). Turner (1984) stated that plant cane may suffer severely from the effects of competition and suggested some control methods.

The purpose of this study was to determine the efficacy of halosulfuron against *Cyperus* spp. and the tolerance of sugarcane to this herbicide.

Materials and methods

The first experiments in the development of halosulfuron in South Africa were sprayed in Natal in the summer of 1992-93. By the end of 1995 a total of 30 experiments had been carried out under a wide variety of soil and climatic conditions in Natal, Transvaal and Orange Free State. Efficacy and yield experiments were designed as randomised complete blocks with four replications for efficacy and six for yield purposes. The experiments were laid out in such a manner that each plot could be compared with an adjacent control strip. Plot size varied from 20-25 m^2. The yield experiments in sugarcane were carried out in weed-free fields or in fields with very low weed infestations. The cane was approximately 30 cm tall at the time of herbicide application. Herbicides were applied post-emergence over the cane by means of specially designed small plot sprayers delivering 200-400 L/ha spray mixture over a swath width of four metres at constant speed and pressure. The halosulfuron formulation was a 750 g ai/kg dispersible granule with the trade name Servian. Weed control and crop tolerance were assessed visually by comparing treated plots with untreated control strips. Percentage weed control was determined two to three and five to seven weeks after application.

The following aspects were investigated:

- A rate response on *C. esculentus et rotundus* using 9, 18, 27, 36 and 54 g ai/ha.
- The effect of adjuvants on halosulfuron weed control efficiency.
- The timing of application with respect to growth stage of *C. esculentus et rotundus*.
- Yield experiments to determine selectivity in plant and ratoon cane.

For the statistical analyses of the efficacy data, all observations per treatment per series of similar experiments were considered replications. For instance, where six similar experiments each with four replications were done at different locations, data was analysed as a single experiment with 24 replications by using non-parametric statistics (Krushal-Wallis test). Highly significant treatment effects were observed. Standard analysis of variance and other procedures were used to carry out these analyses as well as that of the yield data (Steel and Torrie, 1980).

Results and discussion

Rate response with halosulfuron

Halosulfuron had a very flat dose response curve on both *Cyperus* species (Table 1).

There was no significant increase in control at five to seven weeks when the application rate was increased from 18 to 54 g ai/ha. Although 90% control was occasionally reached on *C. esculentus* with less than 36 g ai/ha, there was a lack in consistency with lower application rates. The actual figures per experiment for the average of 91% control at 27 g ai/ha were 89, 87, 80, 95, 100 and 98, and for 93% at 36 g ai/ha were 91, 90, 84, 96, 100 and 98. No rain occurred 10 days before and 14 days after application where 36 g ai/ha afforded only 84% control. An application rate of 36 g ai/ha would therefore be appropriate for the control of *C. esculentus*. For *C. rotundus* 36 g ai/ha is the minimum that should be applied, since 90% control was not reached at lower application rates. Speed of herbicide activity was closely related to weather conditions before and after spraying. Under good growing conditions the full effect of halosulfuron is realised earlier. Normally the full effect of the herbicide is visible three to five weeks after application. However, observations revealed that growth stops two to three days after application.

Table 1

Average percentage control of *Cyperus esculentus et rotundus* with halosulfuron and the adjuvant Penetrex at 1,0 L/ha

Treatment		*Cyperus esculentus*		*Cyperus rotundus*	
Herbicide	g ai/ha	DAA 11-20	DAA 34-44	DAA 14-21	DAA 35-49
Halosulfuron	9	72	79	66	74
Halosulfuron	18	74	90	76	87
Halosulfuron	27	77	91	77	88
Halosulfuron	36	78	93	79	90
Halosulfuron	54	78	95	82	92
Bendioxide	2 400	85	74	60	24
	F-value	–	10,1**	–	71,5
	LSD (P=0,05	–	7,6	–	8,7
Number of experiments		6		5	

DAA – days after application
** = highly significant (P=0,01)

Adjuvants

Results have shown that the addition of an oil-based adjuvant is imperative for good weed control with halosulfuron (Table 2).

Table 2

Average percentage control of *Cyperus esculentus et rotundus* with halosulfuron at 18 g ai/ha and various adjuvants 34-42 days after application

Treatment	g ai/ha + L/ha	*Cyperus esculentus*	*Cyperus rotundus*
Herbicide and adjuvant			
Halosulfuron	18	75	78
Halosulfuron and Penetrex	18 + 1,0	85	88
Halosulfuron and Penetrex	18 + 2,0	90	89
Halosulfuron and Tronic	18 + 0,5	85	85
Halosulfuron and Complement	18 + 0,5	91	88
Halosulfuron and Complement	18 + 1,0	85	89
F-value		2,38*	2,81*
LSD (P=0,05)		10,6	7,9
Number of experiments		3	3

* = significant (P=0,05)

The control of both the *Cyperus* species was improved by at least 10% with addition of the oil-based adjuvants Penetrex and Complement. There are only small differences between the adjuvants, although Tronic appears to be less effective. Complement at 0,5 L/ha seems to be optimal since no further improvement resulted from the addition of 1,0 L/ha.

Timing of application

It is important that the timing of a post-emergence application is optimal. Results of some timing experiments are given in Table 3.

Table 3

Average percentage control of *Cyperus esculentus et rotundus* with halosulfuron and Complement (0,5 L/ha) applied at the 3-4 and 6-8 leaf stage

Treatment		*Cyperus esculentus*		*Cyperus rotundus*	
Herbicide and adjuvant	g ai/ha	DAA 29-45	DAA 37-42	DAA 42-56	DAA 33-41
Halosufuron	18	81	84 NS	66	66 NS
+	27	85	86 NS	76	77 NS
Complement	36	89	89 NS	91	84*
(0,05 L/ha)	45	89	89 NS	90	84 NS
Application timing		3-4	6-8	3-4	6-8
Number of experiments		5		5	

DAA = days after application
NS = non-significant
* = significant (P=0,05)

Application timing did not effect the control of *C. esculentus*. Some indication of inferior control of *C. rotundus* was observed with application at the six to eight leaf stage. Experience has shown that early post-emergence applications (three to four leaf stage) can be very effective provided all the *Cyperus* has emerged. Plants that have not emerged will not be controlled. Late applications (six to eight leaf stage) can also be successful provided treatment takes place before flowering. Post-flowering applications usually give poor results. However, some competition between *Cyperus* and the crop could already have taken place when applications are delayed.

Yield experiments

Two experiments were carried out on ratoon cane and one on plant cane (Table 4).

Table 4

Treatment effects on stalk heights (cm to top visible dewlap) and cane yield (tons/ha)

Treatment		Experiment 1 Ratoon cane (N16)		Experiment 2 Plant cane (N16)		Experiment 3 Ratoon cane (N12)	
Herbicide	g ai/ha	Height (cm)	Yield (t/ha)	Height (cm)	Yield (t/ha)	Height (cm)	Yield (t/ha)
Untreated		103,8	73,8	50,4	86,2	38,3	77,2
Halosulfuron	36	104,1	75,0	51,8	95,3	39,2	88,8
Halosulfuron	72	102,2	74,8	51,1	79,6	41,8	84,7
Diuron + hexazinone	3200+1100	97,3	63,5	–	–	39,6	85,0
Diuron + metribuzin	3200+2800	–	–	46,2	99,3	–	–
F-value		NS	NS	NS	NS	NS	NS
% CV		8,5	13,9	13,1	15,6	6,7	13,0

NS = non-significant

Stalk heights were measured three to six weeks after application and yields were obtained. No phytotoxicity was observed in any of the experiments using halosulfuron at 72 g ai/ha, which is double the proposed recommended rate.

Conclusions

C. esculentus et rotundus can be effectively controlled by post-emergence applications of halosulfuron at 36 g ai/ha. *C. esculentus* is somewhat better controlled than *C. rotundus*. Applications from the four leaf stage to just prior to flowering can give control of 85-90%. Application should preferably take place after all the *Cyperus* has germinated but before it competes with the crop. The use of an oil-based adjuvant is imperative. Although growth stops soon after application, the full effect is only realised three to five weeks later.

Halosulfuron is safe for use in sugarcane, even at double the proposed recommended rate of 36 g ai/ha.

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