

THE USE OF ACETOCHLOR FOR WEED CONTROL IN SUGARCANE

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Abstract

The herbicide Harness (acetochlor 960g/l; Mon 097) was evaluated alone and in combination with Gesapax or diuron for pre-emergence weed control and in combination with Actril DS, or diuron or Gesapax with Actril DS or Gramoxone for post-emergence weed control in plant and in burned ratoon sugarcane. Acetochlor gave excellent residual control of annual grasses and certain broadleaf weeds. The early post-emergence treatments of Harness with Gesapax or diuron and Actril DS or Gramoxone gave commercially acceptable control of weeds including *Cyperus esculentus*. The Harness combinations evaluated in the pre-emergence and post-emergence weed control programmes did not result in injury to NCo 376 sugarcane.

Introduction

The acetanilide, acetochlor, formulated as a 960g/l e.c. (Harness, Mon 097) is a selective herbicide with activity on most annual grasses, a wide range of broadleaf weeds and *Cyperus esculentus*. Crops which show tolerance to acetochlor are maize, cabbage, sugarcane, groundnuts, potatoes and rape with soyabeans, cotton and sunflower showing marginal tolerance. Acetochlor is a surface applied pre-emergence herbicide which is absorbed by the germinating grass shoots and by the roots of broadleaf plants. Rain, irrigation or a shallow incorporation is required to move acetochlor into the weed germinating zone (Anon¹, Anon², Anon³, Frost⁴).

The chemical characteristics and toxicology of acetochlor are described in the "Herbicide Handbook of the Weed Science Society of America. Fifth Edition 1983".

The data presented are those relevant to the various herbicide programmes based on acetochlor that can be used in South Africa.

Acetochlor was registered in South Africa in 1984 for use in maize at rates of 480 to 720g per hectare. Registration has been extended to groundnuts and plant and ratoon sugarcane in pre- and post-emergence situations.

Materials and Methods

All trials were sprayed using a carbon dioxide precision knapsack sprayer with a hand held lance and single flood jet nozzle, except in Experiment 4 where a 3,5 m hand held boom was used.

Phytotoxicity Trials

One pre-emergence and one post-emergence phytotoxicity trial on plant sugarcane were established to supplement the work being done by the South African Sugar Association Experiment Station. The trial design was a randomised complete block of 5 replicates with the plot size of 5 rows by 7 m, giving a sample plot of 4 rows by 5 m. The spray application was directed over the sugarcane row. Shoot counts were made by counting all the live shoots in one of the 4 rows of the sample plot. Stalk heights from ground level to

the top visible dewlap were made on 20 shoots taken at random in 2 of the 4 rows. NCo 376 was used in both trials since it is the most widely grown variety. (Turner⁵). The herbicide treatment combinations evaluated were applied at the 1× and 2× rates of the proposed commercial recommendation (Table 2). The sugarcane was at the 2 to 3 leaf stage in the post-emergence trial (Experiment 2). The sample plots in Experiment 2 were harvested and weighed using a tractor-mounted grab with a load cell.

Efficacy Trials

Eight weed control efficacy trials were conducted to evaluate Harness alone and in combination with other compounds (Tables 1 and 2). The trial design was a randomised complete block with 4 replicates. The plots were 5,0 or 7,0 m by 4 or 5 rows giving sample plots of 2 rows by 3,0 or 5,0 m. Unsprayed control strips of 2 interrows were left between the replicate blocks and standard herbicide treatments were included for comparison. Trials were conducted on plant sugarcane and on burned ratoon cane, pre-emergence and post-emergence to the weeds and the sugarcane. Trial details are given in Table 3. The spray was directed onto the interrow except in Trial 4 which was sprayed overall. Efficacy of the treatments was assessed by weed species as a visual

Table 1

Formulations used in the trial programme

Harness e.c.	: 960g acetochlor/l
Lasso e.c.	: 384g alachlor/l
Farmers Diuron s.c.	: 700g diuron/l
Gesapax s.c.	: 500g ametryn/l
Gramoxone solution	: 200g paraquat/l
Actril DS e.c.	: 600g 2,4-D (iso octylester) + 100g ioxynil/l
Atrazine s.c.	: 500g atrazine/l

Table 2

The herbicide combinations evaluated in the programme to study phytotoxicity (all combinations were tank mixes)

Combination	1× rate l/ha
Harness	4,0
Harness + diuron	4,0 + 3,0
Harness + ametryn	4,0 + 6,0
Harness + diuron + 2,4-D/ioxynil	4,0 + 3,0 + 1,25
Harness + ametryn + 2,4-D/ioxynil	4,0 + 3,0 + 1,25
Harness + diuron + paraquat	4,0 + 3,0 + 1,5
Harness + ametryn + paraquat	4,0 + 3,0 + 1,5
Alachlor + diuron	6,0 + 3,0
Alachlor + diuron + 2,4-D/ioxynil	6,0 + 3,0 + 1,25

Table 3
Details of experiments in the herbicide evaluation programme

Experiment No.	1	2	3	4	5	6	7	8	9	10
Locality	Shakas-kraal	Shakas-kraal	Park Rynie	Jollivet	Umkomaas	Upper Tongaat	Park Rynie	Shakas-kraal	Shakas-kraal	Park Rynie
Date sprayed	9 March 1984	5 March 1984	4 March 1983	26 Oct 1983	11 March 1983	30 Sept 1983	26 Sept 1984	28 Sept 1984	5 Oct 1984	28 Jan 1985
Cultivar	NCo 376	NCo 376	NCo 376	N12	N55/805	NCo 376	NCo 376	NCo 376	NCo 376	NCo 376
Crop	Plant	Plant	3rd ratoon	Plant	3rd ratoon	Ratoon	Ratoon	Ratoon	Ratoon	Ratoon
% Clay	12	8	22	8	6	14	33	38	35	30
pH	5,0	5,6	4,8	5,8	4,7	5,2	4,8	5,8	5,0	4,8
Spray volume (ℓ/ha)	245	245	300	257	300	309	220	220	215	245
Spray speed (k.p.h.)	3,6	3,6	4,2	4,2	4,2	3,6	3,6	3,6	3,6	3,6
Nozzle size	TK-3,0	TK-3,0	TK-5	TJ8003	TK-5	TK-4	TK-2,5	TK-2,5	TK-3,0	TK-3,0
Pressure (bar)	1,8	1,8	2,0	2,0	2,0	2,2	2,0	2,0	2,0	2,0
Weed stage	Pre	Early post	Pre	Pre	Early post	Early post	Early post	post	Early post	Early post
Crop stage	Pre	Early post	Pre	Pre	Early post	50 cm	50 cm	30 cm	60 cm	60 cm

Table 4

The average number of live shoots per 5 m row and shoot heights at 124 and 211 days after treatment (DAT) with pre-emergence herbicide treatments

(Experiment 1)

Treatment	ℓ/ha	No. live shoots per 5 m row		Shoot heights (cm)	
		DAT 124	DAT 211	DAT 124	DAT 211
Harness	4,0	156	128	23,1	60,1
Harness	8,0	129	132	20,9	55,8
Harness + Gesapax	4,0 + 3,0	123	122	21,2	52,6
Harness + Gesapax	8,0 + 6,0	145	132	22,7	58,3
Harness + Diuron	4,0 + 3,0	133	141	20,6	56,3
Harness + Diuron	8,0 + 6,0	132	137	20,3	55,5
Lasso + Atrazine	6,0 + 2,0	140	135	21,4	55,4
Lasso + Atrazine	12,0 + 4,0	143	137	22,5	55,5
Diuron	6,0	148	132	22,7	57,6
Control	-	140	137	22,6	59,8

percent control in the treated plot compared to the adjacent untreated area. The pre-emergence trials were assessed at about 30 day intervals until the sugarcane had developed a full canopy. The post-emergence trials were assessed within 20 days of spraying to evaluate the post-emergence activity of the combinations and to distinguish between weed regrowth and residual weed control over the life of the trial.

Results

Injury to plant sugarcane

- **Pre-emerge herbicide treatments; Experiment 1 (Table 4)**

Differences between the treatments for live shoot counts and shoot heights were not statistically significant ($P=0.05$) when assessed 124 and 211 days after treatment (DAT) indicating that, at the dosage rates evaluated, Harness alone or in combination with Gesapax or diuron does not detrimentally affect plant sugarcane.

(Yields were not obtained from this trial because it was accidentally burnt just prior to harvesting).

- **Post-emergence herbicide treatments; Experiment 2 (Table 5)**

Differences between the treatments for the number of live shoots per 5 m row and for shoot heights at 125 and 217 DAT and for yield in kg per plot at 491 DAT were not statistically significant ($P=0.05$). This indicates that Harness alone or in combination with Gesapax or diuron and Gramoxone or Actril DS was not detrimental when applied at the 2 leaf stage on plant sugarcane.

Table 5
Average number of live shoots per 5 m row and average shoot heights (cm) at 125 and 217 DAT and yield in kg cane per plot from Experiment 2

Treatment	l/ha	No. live shoots per 5 m row		mean shoot height (cm)		mean yield kg per plot
		DAT 125	DAT 217	DAT 125	DAT 217	
Harness	4,0	59	129	18,4	49,5	335,4
Harness	8,0	72	133	20,1	53,5	330,6
Harness + Gesapax + Agrowett	4,0 + 6,0	77	137	18,9	53,7	340,6
Harness + Gesapax + Agrowett	8,0 + 12,0	85	147	18,7	56,0	356,6
Harness + Gesapax + Gramoxone	4,0 + 3,0 + 1,5	75	131	18,8	54,8	349,0
Harness + Gesapax + Gramoxone	8,0 + 6,0 + 3,0	81	143	19,9	53,1	331,8
Harness + Gesapax + Actril DS	4,0 + 3,0 + 1,25	97	154	18,1	54,7	364,0
Harness + Gesapax + Actril DS	8,0 + 6,0 + 2,5	86	125	22,5	48,7	328,0
Harness + Diuron + Actril DS	4,0 + 3,0 + 1,25	68	156	18,1	55,6	334,8
Harness + Diuron + Gramoxone	4,0 + 3,0 + 1,5	69	165	20,3	53,8	337,2
Lasso + Gesapax + Gramoxone	12,0 + 6,0 + 3,0	81	150	17,0	55,0	376,6
Lasso + Diuron + Actril DS	12,0 + 6,0 + 2,5	84	136	19,8	52,0	333,2
Gesapax + Actril DS	6,0 + 2,5	70	135	19,2	52,4	326,8
Control	-	71	115	20	53,3	335,0

Table 6
The average percent pre-emergence weed control of *P. maximum* (Experiment 3)

Treatments	l/ha	% Weed Control <i>P. maximum</i>		
		DAT 38	DAT 60	DAT 80
Lasso + Gesapax	6,0 + 3,0	96	94	87
Lasso + Diuron	6,0 + 3,0	96	95	87
Lasso + Atrazine	6,0 + 3,0	93	93	70
Harness + Gesapax	1,0 + 3,0	98	97	86
Harness + Gesapax	2,0 + 3,0	99	99	89
Harness + Gesapax	3,0 + 3,0	99	99	92

Efficacy: Pre-emergence treatments

***Panicum maximum* control: Experiment 3** (Table 6): Harness was applied at 1,0, 2,0 and 3,0l/ha in combination with Gesapax at 3,0l/ha pre-emergence to weeds on burnt ratoon sugarcane. The old *P. maximum* stools were hoed out by hand and the trash windrowed and burnt. (The burn was incomplete due to damp conditions at the time).

Harness at 1,0 to 3,0l/ha in a tank mixed with Gesapax at 3,0l/ha gave better control of *P. maximum* than the stan-

dard Lasso plus atrazine tank mix (6,0 + 3,0l/ha) treatment. The weed control on the bare soil surface was superior in all the treatments to that in the burnt trash windrow.

There was only a relatively small increase in the control of *P. maximum* with increasing rates of Harness, indicating high unit activity and large residual activity. There were no visual symptoms of injury to the sugarcane in any of the treatments.

Annual grass and broadleaf control: Experiment 4 (Table 7): Harness at 2,0 to 5,0l/ha was applied alone or tank mixed with Gesapax at 3,0l/ha pre-emergence to plant cane.

Harness alone gave excellent grass control (*Digitaria sanguinalis* and *Panicum schinzii*) as well as broadleaf control (*Amaranthus* spp and *Bidens pilosa*) at 2,0l/ha, as did the combinations with Gesapax and diuron. Harness alone gave poor control of *C. esculentus* as did the combinations with Gesapax or diuron. There were no visual symptoms of injury to the sugarcane in any of the treatments.

Efficacy: Post emergence treatments

Annual grass and broadleaf weeds and *C. esculentus*: Experiment 5 (Table 8): Post-emergence activity on pre tillering (2-4 leaf) *Eleusine indica* was excellent due to all treatments. *P. maximum* control was barely commercially acceptable, possibly due to the growth being beyond the 2-4 leaf stage.

The post emergence control of *C. esculentus* was good due to all treatments (89 to 99% control).

Table 7
Average percent pre-emergence weed control of some annual grass and broadleaf weeds
(Experiment 4)

Treatment	ℓ/ha	<i>Digitaria sanguinalis</i>		<i>Panicum schinzii</i>		<i>Amaranthus hybridus</i>		<i>Amaranthus deflexus</i>		<i>Bidens pilosa</i>		<i>Cyperus esculentus</i>	
		DAT 73	DAT 91	DAT 73	DAT 91	DAT 73	DAT 91	DAT 73	DAT 91	DAT 73	DAT 91	DAT 73	DAT 91
Harness	2,0	100	100	100	100	100	100	100	100	100	100	12,5	12,5
Harness	3,0	98,3	100	100	100	100	93,3	100	100	100	100	35,0	20,0
Harness + Gesapax	2,0 + 3,0	100	97,7	100	100	100	100	100	93,3	100	100	60,3	36,3
Harness + Gesapax	3,0 + 3,0	100	100	100	100	97	100	100	100	100	100	60,0	31,6
Harness + Gesapax	5,0 + 3,0	100	100	100	100	100	100	100	100	100	100	73,8	47,5
Harness + Gesapax	3,0 + 2,0	100	100	100	100	100	100	100	100	100	100	61,35	52,5
Harness + Diuron	3,0 + 3,0	100	100	100	100	100	100	100	100	100	100	56,7	45,0
Lasso + Diuron	6,0 + 3,0	100	100	100	100	100	100	100	100	100	100	77,7	62,5
Lasso + Gesapax	5,0 + 3,0	100	100	100	100	100	100	100	100	100	100	44,0	13,3

Table 8
Average percent weed control with post-emergence treatments of Harness + Gesapax + Actril DS combinations
(Experiment 5)

Treatments	ℓ/ha	<i>Eleusine indica</i>			<i>Panicum maximum</i>			<i>Cyperus esculentus</i>		Residual** control		<i>Eleusine indica</i>		
		DAT			DAT			DAT		DAT		DAT		
		*5	40	87	*5	40	87	*5	47	5	40	5	40	87
Lasso + Gesapax + Actril DS	6,0 + 3,0 + 1,25	97	99	99	-	-	-	87	96	100	100	100	100	100
Lasso + Gesapax + Actril DS	6,0 + 2,0 + 1,25	95	100	100	95	98	95	82	90	100	100	100	100	100
Harness + Gesapax + Actril DS	2,0 + 3,0 + 1,25	96	100	100	93	95	92	65	90	100	100	100	100	100
Harness + Gesapax + Actril DS	3,0 + 3,0 + 1,25	97	100	100	95	100	92	87	99	100	100	100	100	100
Harness + Gesapax + Actril DS	4,0 + 3,0 + 1,25	97	100	100	-	98	87	80	89	100	100	100	100	100

* 5 DAT observations on weed species: percent foliar kill 40 and 87 DAT is percent control relative to control

** Residual control of grass and broadleaf weeds

The rating of residual control was made to differentiate between true residual control and the post emergence control of the combinations on broadleaf and grass weeds. Residual control due to all treatments was excellent, 100% control of broadleaf and grass weeds being obtained.

Experiment 6 (Table 9): Harness alone at 3,0 and 4,0ℓ/ha had little if any post-emergence activity. Harness + Actril DS (3,0 + 1,25ℓ/ha) improved the knockdown of grasses, but the effects were not commercially acceptable even on the pre-tillered 0 to 4 leaf growth stage. The mixture gave commercially acceptable control of *A. deflexus*, *C. benghalensis* and *C. esculentus*.

The most effective tank mix treatments for control of grasses (*P. schinzii* and *D. sanguinalis*) and broadleaf weed knockdown were those containing Gramoxone, viz Harness + Gesapax + Gramoxone (3,0 + 3,0 + 1,5 ℓ/ha) and Harness + Diuron + Gramoxone (3,0 + 3,0 + 1,5). Also giving acceptable results was Harness + diuron + Actril DS (3,0 + 3,0 + 1,25ℓ/ha). Harness + Gesapax + Actril DS did not give acceptable grass control because the selected rate of Gesapax (3,0ℓ/ha) was too low for the size of weeds in the plots. Control of *A. deflexus*, *C. benghalensis* and *C. esculentus* was excellent in all the treatments.

Harness at 2,0ℓ/ha in the Gesapax + Actril DS and diuron + Actril DS combinations gave excellent residual control

Table 9
Average percent foliar kill and residual control of annual weeds with post-emergence herbicide treatments
(Experiment 6)

Treatments	ø/ha	<i>P. schinzii</i>						<i>D. sanguinalis</i>						% residual control +									% less scorch		
		DAT						DAT						Broadleaf weeds			<i>P. schinzii</i>			<i>Digitaria sanguinalis</i>			DAT		
		6	6	6	24	49	80	6	6	6	24	49	80	6	24	49	80	24	49	80	24	49	80	24	49
		*	**	***				*	**	***															
Harness	3,0	0	0	0	11	5	7	0	0	0	11	15	8	0	1	0	0	100	99	70	100	99	70	3	0
Harness	4,0	14	1	8	15	0	0	14	1	8	15	0	0	0	6	5	0	100	100	98	100	100	98	0	0
Harness + Actril DS	3,0 + 1,25	50	20	50	65	41	37	50	20	50	65	53	39	80	100	100	100	100	100	98	100	100	98	5	0
Harness + Gesapax + Gramoxone	3,0 + 3,0 + 1,5	99,0	97	97	98	98	97	99	97	99	98	99	98	90	100	100	100	100	100	98	100	100	98	55	30
Harness + Gesapax + Actril DS	3,0 + 3,0 + 1,25	97	95	95	91	78	78	97	95	95	97	90	74	94	100	100	100	100	100	96	100	100	96	13	0
Harness + Diuron + Actril DS	2,0 + 3,0 + 1,25	98	84	84	96	92	81	98	84	84	96	97	93	73	100	100	100	100	99	97	100	99	97	13	0
Harness + Diuron + Actril DS	3,0 + 3,0 + 1,25	98	90	90	99	97	91	98	90	90	98	97	91	90	100	100	100	100	100	96	100	100	96	13	0
Harness + Diuron + Actril DS	4,0 + 3,0 + 1,25	96	89	92	98	93	91	96	89	89	99	98	97	80	100	100	100	100	100	98	100	100	98	13	0
Harness + Diuron + Gramoxone	3,0 + 3,0 + 1,5	99	97	97	98	98	97	99	96	96	98	99	98	87	100	100	100	100	99	98	100	99	98	33	25

* 0-4 leaf stage
 ** 5 leaf to 3 tillers
 *** large tillered
 - 6 DAT assessment is percent foliar kill of weeds
 - 24, 49 and 80 is percent control relative to untreated control
 + residual grass control

Table 10
Average percent control of tillered *P. maximum* and residual control of weeds with post-emergence herbicides
(Experiment 7)

Treatments	ø/ha	% foliar kill			% Control residual								
		<i>P. maximum</i> tillered			<i>P. maximum</i>			<i>A. deflexus</i>			<i>C. esculentus</i>		
		DAT			DAT			DAT			DAT		
		28	52	106	28	52	106	28	52	106	28	52	106
Harness + Gesapax + Actril DS	2,0 + 5,0 + 1,25	96	92	73	100	100	85	100	100	100	100	99	95
Harness + Gesapax + Actril DS	3,0 + 5,0 + 1,25	86	84	45	100	100	95	100	100	100	100	100	95
Harness + Gesapax + Actril DS	4,0 + 5,0 + 1,25	95	99	87	100	100	98	100	100	100	100	100	98
Harness + Diuron + Actril DS	2,0 + 3,0 + 1,25	94	96	70	100	100	98	100	100	100	100	93	90
Harness + Diuron + Actril DS	3,0 + 3,0 + 1,25	82	83	53	100	100	90	100	100	100	100	98	90
Harness + Diuron + Actril DS	4,0 + 3,0 + 1,25	94	95	57	100	100	96	100	100	100	100	95	94
Lasso + Diuron + Actril DS	6,0 + 3,0 + 1,25	93	97	60	100	100	95	100	100	100	100	100	90

Table 11
Average percent foliar kill and residual control of annual grass and broadleaf weeds with post emergence herbicides (Experiment 8)

Treatment	Weed species ℓ/ha	% Foliar kill 22 DAT						% Control 60 DAT				
		<i>D. sanguinalis</i>		<i>P. schinzii</i>		<i>P. maximum</i>		Broadleaf weeds	<i>D. sanguinalis</i>	<i>P. schinzii</i>	<i>P. maximum</i>	Broadleaf weeds
		*	**	*	**	*	**					
Harness + Gesapax + Actril DS	2,0 + 5,0 + 1,25	100	100	70	100	58	100	100	97	88	88	100
Harness + Gesapax + Actril DS	3,0 + 5,0 + 1,25	-	100	97	100	67	100	100	88	77	75	100
Harness + Gesapax + Actril DS	3,0 + 4,0 + 1,00	60	100	73	100	50	100	100	79	79	79	100
Harness + Diuron + Actril DS	2,0 + 3,0 + 1,25	-	100	95	100	67	100	100	97	88	89	100
Harness + Diuron + Actril DS	3,0 + 3,0 + 1,25	-	100	89	100	70	100	100	97	89	89	100
Harness + Diuron + Actril DS	3,0 + 3,0 + 1,0	96	100	90	100	85	100	100	97	97	98	100
Harness + Diuron + Actril DS	3,0 + 2,5 + 1,25	60	100	76	100	72	100	100	93	93	85	100
Lasso + Diuron + Actril DS	6,0 + 3,0 + 1,25	95	100	88	100	82	100	100	90	84	89	100

* tillered
** 4 to 6 leaf

of *P. schinzii* and *D. sanguinalis* up to 80 DAT (the last evaluation).

Leaf scorch was still severe in the treatments with Gramoxone at 49 DAT but had disappeared completely by the 80 DAT assessment.

Experiment 7 (Table 10): All combinations gave unacceptable long term control of tillered *P. maximum*. However, good residual control of *P. maximum* was achieved by Harness + Gesapax + Actril DS (3,0 + 5,0 + 1,25ℓ/ha) and by Harness + diuron + Actril DS (2,0 + 3,0 + 1,25ℓ/ha). All combinations controlled *A. deflexus* and gave acceptable control of *C. esculentus*.

No foliar scorch or any other injury to the sugarcane was observed in any of the treatments.

Experiment 8 (Table 11): All treatments gave excellent control of pre-tillered (0 to 4 leaf) *D. sanguinalis*, *P. maximum* and *P. schinzii*. All treatments failed to give satisfactory control of the tillered grasses and the trial was abandoned at 60 DAT.

All treatments gave excellent post-emergence and residual control of broadleaf weeds which included *C. esculentus*, *A. deflexus* and *C. benghalensis*. Slight leaf scorch was visible at 22 DAT but the sugarcane had completely recovered by 60 DAT.

Experiment 9 (Table 12): All the treatments evaluated gave excellent post-emergence control of *D. sanguinalis* and *P. schinzii* at the 0 to 4 leaf stage. *C. esculentus* and *Ricardia scabra* were also controlled by all treatments. All the treatments gave at least 100 days residual weed control.

The treatments with Gramoxone showed the most foliar scorch but by 100 DAT the injury was no longer visible.

Experiment 10 (Table 13): Harness in combination with Gesapax and Actril DS or diuron and Actril DS was evaluated for early post emergence and residual weed control of *P. maximum*. Harness at 2.0ℓ/ha in combination with Gesapax at 4.0ℓ/ha or Diuron at 3.0ℓ/ha with 1.0ℓ Actril DS/ha gave excellent *P. maximum* control, as did all the other treatments.

Discussion

Phytotoxicity

Pre-emergence herbicide applications, plant sugarcane: Live shoot counts and stalk measurements from Experiment 1 indicate that Harness and Harness combinations with diuron or Gesapax are not detrimental treatments when applied pre-emergence on plant sugarcane. No injury to the sugarcane was observed in the efficacy trials evaluating these treatments.

Post-emergence herbicide applications, plant sugarcane: Live shoot counts, stalk measurements and yield data from Experiment 2 indicate that the Harness combinations with post-emergence herbicides which were evaluated are not detrimental when applied post-emergence to plant sugarcane at the 2 to 3 leaf stage.

The Harness combinations containing Gramoxone caused the most severe damage to the sugarcane, in the form of leaf scorch but did not affect the final yield. Severe scorch was also noted in the treatments containing Gramoxone in the efficacy trials, but these effects had completely disappeared by 50 DAT. These observations are consistent with those made by other workers (Turner⁵).

Table 13
Average percent control of *P. maximum* with post-emergence herbicides
(Experiment 10)

		<i>Panicum maximum</i>		
		DAT		
		37	98	208
Treatments	ℓ/ha			
Harness + Gesapax + Actril DS	2,0 + 4,0 + 1,0	99	95	97
Harness + Gesapax + Actril DS	3,0 + 4,0 + 1,0	98	96	97
Harness + Gesapax + Agrowett	3,0 + 6,0	99	99	98
Harness + Diuron + Actril DS	2,0 + 3,0 + 1,0	98	99	99
Harness + Diuron + Actril DS	3,0 + 3,0 + 1,0	98	97	98
Lasso + Diuron + Actril DS	6,0 + 3,0 + 1,25	99	98	99

Post-emergence herbicide applications, burnt ratoon: Visual observations in the efficacy trials indicate that the Harness combinations with Gesapax or Diuron and Actril DS were not detrimental and did not cause excessive foliar scorch.

The phytotoxicity of Harness and Harness combinations has been described elsewhere (Turner⁷).

Efficacy

Trial results show that Harness alone has little or no post-emergence activity. Harness must be used in pre-emergence situations or in combination with post-emergence herbicides when applied to established weeds.

Pre-emergence applications: Results indicate that Harness may be used alone, or in combination with Gesapax or diuron in true pre-emergence applications on plant sugarcane giving excellent control of grasses such as *D. sanguinalis*, *P. maximum*, *P. schinzii* and *E. indica* and broadleaf weeds such as *Amaranthus* spp., *B. pilosa* and *P. oleracea* for 10 to 12 weeks. The weakness of the pre-emergence application is that *C. esculentus* control breaks at 4 to 6 weeks after spraying (Experiment 4) requiring a further post emergence spray such as diuron + Actril DS to control the flush of *C. esculentus* (Wise⁸). Pre-emergence applications of Harness in combination with other chemicals are not recommended for use on burnt ratoon sugarcane where windrows on the soil surface may reduce their efficacy.

Post-emergence applications: The spectrum of annual grasses and broadleaf weeds controlled by Harness and its long residual action can be enhanced if it is combined with suitable post-emergence herbicides, and if the application is delayed until the first flush of weeds has germinated in both plant sugarcane and in burnt ratoons. This approach, described by Wise,⁸ gives greater flexibility of timing and the residual action of the mixtures is extended by the period of the delay.

Table 12
Average percent weed control with post-emergence herbicides
(Experiment 9)

		<i>D. sanguinalis</i>			<i>P. schinzii</i>			<i>C. esculentus</i>			<i>Ricardia scabia</i>			% scorch or cane		
		DAT			DAT			DAT			DAT			DAT		
		14	55	100	14	55	100	14	55	100	14	55	100	14	55	100
Treatment	ℓ/ha															
Harness + Gesapax + Actril DS	2,0 + 4,0 + 1,25	100	100	91	95	99	96	91	83	89	100	100	99	5	1	0
Harness + Gesapax + Actril DS	3,0 + 4,0 + 1,25	100	100	100	100	100	99	96	100	96	100	100	100	10	0	0
Harness + Gesapax + Agrowett	2,0 + 6,0 + 0,07	100	100	94	100	100	98	90	99	87	100	100	100	6	0	0
Harness + Diuron + Gramoxone	2,0 + 3,0 + 1,5	100	100	99	100	100	99	100	100	94	100	100	100	24	7	0
Harness + Diuron + Gramoxone	3,0 + 3,0 + 1,5	100	100	100	100	100	100	100	100	95	100	100	100	21	4	0
Harness + Diuron	3,0 + 3,0	100	100	97	99	98	97	84	98	94	100	100	100	5	0	0
Harness + Diuron + Actril DS	3,0 + 3,0 + 1,25	100	100	99	100	100	99	99	100	90	100	100	98	10	2	0
Lasso + Diuron + Gramoxone	6,0 + 3,0 + 1,5	100	100	99	100	100	99	98	94	94	100	100	99	29	5	0
Lasso + Gesapax + Agrowett	5,0 + 6,0 + 0,07	100	100	94	100	100	94	98	89	88	100	98	99	26	3	0

Trial results show that the post-emergence treatments with Harness have been effective in controlling *C. esculentus*, but in certain circumstances a second weed control operation using diuron + Actril DS may be required to control a second flush of this weed 4 to 6 weeks after spraying (Wise⁸).

Timing of the post-emergence applications is critical to achieve success and should be determined by the size of the grass weeds, i.e. the largest grass weeds should be at the 4 to 6 leaf stage or pre-tillering. Applications to tillered grass weeds may result in poor grass control. If the first flush of *C. esculentus* has not completely emerged at the time of application, control can be expected to be lost 4 to 6 weeks after application, necessitating a follow up treatment of diuron + Actril DS as discussed by Wise.⁸

Table 14 summarises the use of Harness for weed control programmes in sugarcane.

Table 14

Recommendations for the use of Harness combinations with other herbicides for pre- and post-emergence weed control in plant and ratoon sugarcane

1. Combinations with Harness to be applied in pre-emergence weed control situations.

Crop situation	Timing	Combinations
Plant cane	Pre-emergence of sugarcane and weeds	Harness + diuron Harness + Gesapax

2. Combinations with Harness to be applied in post-emergence weed control situations.

Crop situation	Application timing		Combinations
	Sugarcane	Annual grass weeds	
Plant cane	2 to 3 leaf	pre tillering	Harness + diuron + Actril DS Harness + Gesapax + Actril DS Harness + diuron + Gramoxone Harness + Gesapax + Gramoxone
		2 to 3 leaf	Harness + Gesapax Harness + diuron
Burnt ratoon	2 to 3 leaf	pre tillering	Harness + diuron + Actril DS Harness + Gesapax + Actril DS Harness + Gesapax

Conclusion

Harness can be used effectively in a pre-emergence weed control programme and in integrated post-emergence weed control programmes as described by Wise.⁸

Harness can be used as a pre-emergence treatment in combination with Gesapax or diuron on plant sugarcane for residual grass and broadleaf weed control without injury to the crop. A follow up post-emergence weed control application of diuron + Actril DS may be required if *Cyperus esculentus* regrowth occurs.

Residual weed control can be extended and a wider weed control spectrum achieved if the Harness application is delayed and it is sprayed in combination with certain foliar-active herbicides in early post-emergence weed control situations.

The wide spectrum of broadleaf weeds controlled by Harness alone could be used to reduce dependency on other broadleaf herbicides when sugarcane varieties such as N8, N14 and J59/3 are involved, since they are reported to be sensitive to some of these herbicides (Turner⁶).

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