

DESTUN, DUAL AND VELPAR - THREE NEW HERBICIDES FOR THE SUGAR INDUSTRY

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Abstract

Weed control efficacy of three herbicides recently registered for use in the South African Sugar Industry is discussed and the phytotoxic effects on sugarcane are presented. Destun, with or without atrazine, is a safe pre-emergence treatment which is useful for the control of *Cyperus esculentus*, grasses and broadleaf weeds, while some activity on *Cyperus rotundus* has also been recorded. Dual + atrazine is likewise a safe pre-emergence treatment, similar in effect to alachlor + atrazine for the control of grasses, broadleaf weeds and, under favourable conditions, *Cyperus esculentus*. Velpar alone or in combination with diuron, is a very effective herbicide for the pre- or post-emergence control of *Cyperus esculentus*, grasses and broadleaf weeds, having a long residual effect. It is more effective than the currently recommended herbicides for the post-emergence control of *Panicum maximum*. Velpar treatments may affect cane yields but are generally less severe than the standard post-emergence herbicide treatments.

Introduction

Over the years considerable attention has been given to evaluating chemical treatments as weed control measures in the South African sugar industry. Herbicides have now become the major and most important part of most weed control programmes. Few situations exist, however, where the currently available herbicides are able to be used exclusively and there are still situations where new chemicals, less phytotoxic to sugarcane, or with more specific weed control spectra, would be an advantage. For example, no herbicide is available for the adequate control of *Cyperus rotundus* at a pre-emergence stage. Similarly no chemical currently in use is entirely satisfactory for the control of tillering-to-mature grasses, without the likelihood of damage to the crop, unless the spray is well directed away from the cane foliage. Therefore, a continuing programme of testing new products and combinations of products for their weed control efficacy and crop phytotoxicity is necessary.

Until recently ten herbicides were registered for use in the South African sugar industry. Following the past four years' screening work, three more herbicides have been added to the list. These are: perfluidone (trade name Destun), metolachlor (trade name Dual) and Velpar, for which there is no common chemical name. These chemicals were initially tested as the coded compounds MBR8251, CGA24705 and DPX 3674 respectively, and their weed control efficacies have been reported by Richardson and Dean¹, Iggo² and Gentner³.

Having ascertained the weed control efficacies of these products it was necessary to test their effects on sugarcane. An initial phytotoxicity trial conducted on cane grown in trays, indicated that yield reductions could result following pre-emergence applications of all three products². Further trials were therefore conducted in the field, and in trays, to ascertain whether these effects would persist until harvest, and also to observe their effects when they were applied over the sugarcane foliage. Results of six trials are presented in this paper.

Experimental

Field phytotoxicity trials were conducted either at Pongola on a sandy clay loam soil of the Makatini series, or at Shakaskraal on a sandy loam soil of the Waldene series. A randomised blocks design was used with five or six replications per treatment. The net plot size ranged from 3 to 4 rows 6 m long and all except one

trial had guard rows on both sides of the plots. End effects were avoided by discarding 1 m at the ends of each row when harvesting. Height measurements were made on 20 random stalks per plot, and stalks were counted at regular intervals. For a few months after spraying, ratings of visual phytotoxic effects were made. Sugarcane variety NCo 376 was used in all the trials and they were harvested at about 13 months of age at Shakaskraal and about 11 months of age at Pongola. All trials were maintained free of weeds so that weed competition would not confound the treatment effects. Pre-emergence treatments were applied to the soil at, or soon after, planting and before any emergence of sugarcane; post-emergence treatments were sprayed directly over the cane rows when the cane was about 40-60 cm high. Pre- and post-emergence sprays were applied by means of a lever-operated knapsack sprayer fitted with a Spraying Systems TK5 floodjet delivering approximately 300 l/ha.

One trial was conducted on cane grown in trays 30 cm x 30 cm x 10 cm in size. These were filled with a heavy soil or a sand and the treatments were replicated six times. Treatments were applied directly over the sugarcane foliage by means of a gas-operated knapsack sprayer fitted with a Spraying Systems 8003-E fan jet delivering about 150 l/ha. Two passes were made per treatment to ensure adequate and even coverage.

The soil physical analyses, site location, crop growth stage at spraying, and ratoon stage of the crop in each trial are shown in Table 1.

TABLE 1

Soil analyses, crop growth stage, site location and crop stage in respect of six phytotoxicity trials

Trial number	Site	Soil analysis			leaf height (cm) at time of spraying	Crop
		Clay %	Silt %	Sand %		
I	Pongola	40	13	45	(pre-emergence)	Plant cane
II	Shakaskraal	7	2	91	(pre-emergence)	Plant cane
III	Mt Edgecombe	41	12	46	40	Plant cane
III	Mt Edgecombe	-	-	100	40	Plant cane
IV	Pongola	46	12	42	40	5th ratoon
V	Shakaskraal	7	2	91	55	2nd ratoon
VI	Pongola	46	12	42	45	6th ratoon

Standard pre- and post-emergence herbicide treatments were included in the trials for comparison, as was an unsprayed control. Rates of herbicides used are indicated as a function of the registered rates, eg x1 or x2 etc of the registered rate. Registered rates of the standard treatments and the newly registered treatments are presented in Table 2.

Weed Control

Destun

Rates of Destun tested have ranged from 2,25 to 4,5 kg of active ingredient per hectare (kg ai/ha) alone and in combination with atrazine. Registration was subsequently approved at a rate of 2,5 kg ai/ha alone and at 2,5 kg + 1,0 kg ai/ha in combination with atrazine. The efficacy of these treatments will be discussed in relation to the three weed categories identified as *Cyperus* spp., grasses and broadleaf weeds.

a) *Cyperus esculentus* and *Cyperus rotundus*

Destun + atrazine has been consistently superior to alachlor + atrazine (1,92 kg + 1,0 kg ai/ha) for *Cyperus esculentus*

control and it has had a longer residual effect. *Cyperus rotundus*, although not susceptible to Destun to the same degree as is *Cyperus esculentus*, has nevertheless been adequately controlled at higher rates (3,0 kg ai/ha) and also at the registered rate in one recent trial⁴. Insufficient data are available, however, to confirm that consistent control can be achieved under local conditions at the registered rate.

b) *Grass weeds*

Very effective grass weed control, equal to that given by alachlor + atrazine², has been achieved, with the exception of one trial in which poor results were obtained under irrigated conditions on a soil containing 25% clay. *Rottboellia exaltata* was found to be resistant² and this confirms results reported by Richardson and Dean¹.

c) *Broadleaf weeds*

Destun on its own has shown good control of a limited spectrum of broadleaf weeds. Both Iggo² and Dean and Richardson¹ reported resistance of certain broadleaf weed species to Destun treatment. The addition of atrazine has considerably improved the broadleaf spectrum of control^{4,2}.

TABLE 2

Names of the standard and recently registered herbicides and the rates at which they are recommended.

Treatment	Rate in kg or ℓ ai or ae/ha	Acceptable soil clay content, %
<u>Standard pre-emergence</u>		
Alachlor + atrazine . . .	1,92 + 1,0	0 - 35
Alachlor + atrazine . .	1,92 + 1,5	> 35
<u>Standard post-emergence</u>		
Diuron + 2,4-D	2,0 + 1,44	all soils
<u>New treatments</u>		
Destun	2,5	0 - 35
Destun + atrazine	2,5 + 1,0	0 - 35
Dual + atrazine	2,0 + 1,0	all soils
Velpar	0,45	0 - 10
Velpar	0,675	11 - 35
Velpar + diuron	0,45 + 2,0	0 - 35
Velpar K5*	2,45	0 - 35

*Velpar K5 is a formulated mixture of Velpar + diuron containing 0,45 kg + 2,0 kg ai/ha respectively.

Dual

Dual has been evaluated at rates of 2,0 and 3,0 ℓ ai/ha in combination with atrazine at 1,0 and 1,5 kg ai/ha for pre-emergence weed control. Registration has been approved at the rate of 2,0 ℓ + 1,0 kg ai/ha.

a) *Cyperus esculentus* and *Cyperus rotundus*

Dual + atrazine has shown no activity on *Cyperus rotundus*, while its activity on *Cyperus esculentus* has been found to be equivalent to that of alachlor + atrazine⁴ under the same conditions.

b) *Grass weeds*

Excellent control of a wide spectrum of annual grasses has been achieved control again being comparable to that obtained with alachlor + atrazine^{2,4}.

c) *Broadleaf weeds*

Evaluation has been made only in combination with atrazine, due to the known limitations of Dual in regard to broadleaf weed control. Such treatments were as successful as treatment with alachlor + atrazine.

Velpar

Early trials with Velpar were conducted using 2,0-3,0 kg ai/ha and at these rates Velpar gave exceptional control of *Cyperus esculentus*, grasses and broadleaf weeds². Indications of phytotoxicity to sugarcane at these rates led to a lowering of the rates. The lower rates have controlled weeds equally effectively and registration has been approved for Velpar alone at 0,45 to 0,68 kg ai/ha and in combination with diuron at rates of 0,45 kg + 2,0 kg ai/ha respectively. Evaluations have been made both pre- and post-emergence since this product is absorbed through both the leaves and the roots.

a) *Cyperus esculentus* and *Cyperus rotundus*

No control of *Cyperus rotundus* was achieved when Velpar was used post-emergence, but in one trial a slight suppression of growth occurred when it was applied pre-emergence². Activity on *Cyperus esculentus* is excellent and adequate control may be achieved when it is applied either pre- or post-emergence, although the latter treatment appears to be the more reliable. Activity is comparable with that of diuron + Sencor.

b) *Grass weeds*

Excellent control of grasses was achieved in the early evaluation trials² with pre-emergence applications at high rates. Subsequent trials have confirmed that even at the lower rates at which it is registered, good control is obtained of a broad spectrum of grasses including *Panicum maximum*. Post-emergence applications are less reliable as grass weeds are not always adequately controlled after tillering⁴. When applied either pre- or post-emergence Velpar, in combination with diuron, is superior to Velpar alone at the same rate. In a recent trial to test post-emergence treatments on a light soil, diuron + Velpar was superior to diuron + Sencor in the control of *Panicum maximum*, but the two treatments had similar effects on *Cyperus esculentus*, *Digitaria sanguinalis* and *Eleusine indica*. Good control of *Rottboellia exaltata* was achieved in one trial by high rates of Velpar when used alone (1,25 kg and 2,5 kg ai/ha).

c) *Broadleaf weeds*

Excellent long term control of broadleaf weeds has been achieved. The results obtained have been as good as those obtained with the standard diuron + Sencor treatment in terms of spectrum and duration of weed control. Both Velpar alone, and in combination with diuron showed similar results⁴.

Phytotoxicity

Results from six trials involving Destun, Dual and Velpar are presented below.

Table 3 contains the yield results of Trials I and II in terms of tons cane/ha expressed separately as percentages of the yields from the unsprayed control and the standard pre-emergence treatment plots.

Discussion

On a heavy soil Velpar (x4) induced chlorosis and necrosis in the leaves of sugarcane up to five months of age. The cane was stunted and the stalk populations were reduced. Destun had some retarding effect on cane growth at an early age (2-3 months) but no yield differences were evident at harvest when compared with the standard treatment. A slight non-significant (n.s.) reduction in yield compared with the unsprayed control was evident. Velpar reduced yields compared with the unsprayed control (P>0,01) and with the standard treatment (P>0,05). Dual + atrazine showed no effects on the cane and induced higher yields (n.s.) than obtained with the standard treatment. Rates of all three products were greater than x2 of their registered rates.

TABLE 3
Yields of plant cane treated with pre-emergence applications of Destun, Dual and Velpar, expressed as percentages of the yields from the unsprayed control and the standard pre-emergence treated plots.

Treatment	Rate (x registration rate)	Yield (tons cane/ha)			
		Heavy soil (Trial I)		Light soil (Trial II)	
		% Control	% Standard	% Control	% Standard
Alachlor + atrazine*	x2	90		96	
Destun	x2	93 **	103 **		
Destun + atrazine	x2			101	106
Dual + atrazine	x2	100 *	111 **	100	105
Velpar	x4	79	87		
Velpar + diuron	x1			92	96

* Standard treatment

**Rates actually applied higher than indicated

On a light soil no treatments reduced yields statistically significantly compared with the unsprayed control or the standard treatment, although the yields from the Velpar + diuron plots were slightly inferior to those of the other treatments. The registered rate of Velpar + diuron was used in this case.

Table 4 contains the results of the tray trial in terms of grams of foliage yielded per tray, expressed separately as percentages of the yields from the unsprayed control and the standard pre-emergence treatment trays.

Velpar alone and in combination with diuron produced necrosis of leaf blades and tips, chlorosis and also a rust colouration of the leaves. This was more severe on the clay soil than on the sand. Stunting was noticeable at the x2 rate alone and at the x1 rate in combination with diuron. The x0,5 rate of the combination produced only very slight phytotoxicity symptoms. Alone Velpar x2 severely depressed the mass of foliage harvested ($P>0,01$) compared with that from the unsprayed control and the standard treatment. The combination with diuron at the x1 rate depressed yields ($P>0,05$) compared with the unsprayed control and the standard treatments on a clay soil but not on the sand.

Dual + atrazine treatments caused a distinct purple discolouration to develop on the cane leaves three weeks after spraying. No statistically significant yield reduction occurred in either the sand or the clay soil due to the Dual + atrazine treatments.

Table 5 contains the yield results of trials IV, V and VI in terms of tons cane/ha expressed separately as percentages of the yields from both the unsprayed control and the standard post-emergence treatments.

On heavy soils leaf scorch symptoms were evident on cane sprayed with Velpar, Velpar + diuron and the standard diuron + 2,4-D treatment. The effects of the standard treatments were less severe than those of the Velpar treatments. Destun + atrazine resulted in higher yields ($P>0,01$) compared with the standard treatment. Velpar alone at greater than x2 rate was similar to diuron + 2,4-D (x2) in its effect. Both treatments depressed cane yields ($P>0,01$). Velpar + diuron (x2) depressed yields to a lesser extent ($P>0,05$).

In a second trial on heavy soils, Velpar K5 and the standard diuron + 2,4-D treatment caused stunting of growth forty days after the spray application. There were, however, no statistically significant differences in yield between the treatments at harvest.

On a light soil visual symptoms of leaf scorch were evident in all treatments two months after spraying. The symptoms caused by the Velpar treatments were more severe than those caused by diuron + 2,4-D and an increase in severity occurred with increasing rates. Stunting of growth was worse in the diuron + 2,4-D treated plots. No treatments caused statistically significant reductions in yield although Velpar alone at the x2 rate and diuron + 2,4-D treatments resulted in lower yields than those produced by the other treatments.

Conclusion

Destun is an effective herbicide for the pre-emergence control of *Cyperus esculentus*, grasses, and, when in combination with atrazine, broadleaf weeds as well; a measure of control of *Cyperus rotundus* may also be achieved. Tray trials have indicated that Destun may have a depressing effect on early cane growth², but field trials, on both light and heavy soils, have

TABLE 4
The yields of plant cane grown in trays and treated with post-emergence applications of Dual and Velpar, expressed as percentages of the fresh mass of material from the unsprayed control and the standard pre-emergence treated trays.

Treatment	Rate (x registration rate)	Yield			
		Heavy soil (Trial III)		Sand (Trial III)	
		% Control	% Standard	% Control	% Standard
Alachlor + Atrazine*	x2	95		106	
Velpar	x1	82	86	84	79
Velpar	x2	51	54	74	70
Velpar + diuron	x0,5	95	100	98	92
Velpar + diuron	x1	76	79	85	80
Dual + atrazine	x1	93	98	103	97
Dual + atrazine	x2	96	101	93	88

* Standard treatment

TABLE 5
 The yields of ratoon cane treated with post-emergence applications of Destun and Velpar, expressed as percentages of the yields from unsprayed control and the standard post-emergence treated plots.

Treatment	Rate (x registration rate)	Yield (tons cane/ha)			
		Heavy soil (Trial IV)		Light soil (Trial V)	
		% Control	% Standard	% Control	% Standard
Diuron + 2,4-D*	x2	87		88	
Velpar	x1			102	110
Velpar	x2	87**	99**	94	107
Velpar + diuron	x2	92	109		
Destun + atrazine	x2	100**	115**		
		TRIAL VI		TRIAL V	
Diuron + 2,4-D	x2	92			
Velpar K5	x1	101	110	107	116
Velpar K5	x2	101	110	101	114

* Standard treatments

** Rates actually applied higher than indicated

shown no yield reduction in comparison with the control treatment due to Destun applied at double the recommended rate either onto the soil at planting, or over the cane foliage.

Dual + atrazine is effective for pre-emergence grass and broadleaf weed control and it controls *Cyperus esculentus* under suitable conditions. A traysite phytotoxicity trial indicated that, like Destun, early cane growth may be retarded, but field trials have shown no yield reduction in comparison with control plots due to Dual when it was applied at double the registered rates on both light and heavy soils. In a further traysite trial leaf scorch symptoms were noticeable when Dual + atrazine was applied at double rates over the cane foliage; no reduction in yield was observed however.

Velpar and Velpar in combination with diuron, provides excellent long term control of *Cyperus esculentus*, grasses and broadleaf weeds, the effect being similar to that of diuron + Sencor, but superior to it for *Panicum maximum* control when it is sprayed post-emergence. Post-emergence control of *Cyperus esculentus* is superior to pre-emergence control. Phytotoxicity trials have shown Velpar to have severe effects when applied at high rates either pre- or post-emergence of sugarcane. Visual symptoms of necrosis and chlorosis are produced by both pre- or post-emergence applications. Pre-emergence applications on plant cane have reduced cane yields when used at very high

rates and had a slight effect when used at the registered rate. Double rates applied pre-emergence have not been evaluated and hence the safety of the product on plant cane has not been fully assessed. Post-emergence applications of both Velpar alone and in combination with diuron at the x2 rates, have reduced yields but have been no more severe than the standard post-emergence treatment; it is therefore considered acceptable for use in ratoon cane.

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