SOME RESULTS OF HERBICIDE TRIALS CONDUCTED IN THE RHODESIAN SUGARCANE INDUSTRY

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Abstract

Some results of herbicide trials are presented, and the rôle of the more important herbicides in the local industry are discussed.

The most successful herbicide is ametryne which can be used at sufficiently low levels to virtually eliminate phytotoxicity; but which controls a broad range of weeds if applied at an early post-emergence stage. Ametryne is usually applied in conjunction with atrazine or cyanazine.

In early spring, on virgin lands and on basalt soils, asulam combinations with ioxynil + 2,4-D or ametryne are recommended if other ametryne mixtures cannot be sprayed at a very early post-emergence stage. This is the only form in which 2,4-D is recommended, as severe phytotoxicity results from other types of application.

Of the pre-emergent treatments atrazine and metribuzin are best, but atrazine must be mixed with other herbicides if grasses (in particular *Brachiaria deflexa*) are present.

Introduction

The relatively new sugarcane industry in Rhodesia has, until recently, had adequate labour for weed control. In recent years, however, the supply of labour has become short and heavy infestations of *Portulaca oleracea* have substantially reduced labour output. Herbicides are consequently becoming increasingly important.

Since 1970, when interest in herbicides began to increase, experiments have been conducted to find herbicides suitable for the local industry, and to investigate how herbicide applications could be used to best advantage in the existing system. This paper summarises the more important results of these trials.

Experimental methods and materials

Three types of trials were conducted:—

(1) Herbicide screening trials in which plots of 3 sprayed rows and 1 unsprayed row, all 13m long, were replicated 4 times;

(2) Large scale trials in which hand weeders were timed in different treatments on unreplicated $\frac{1}{2}$-hectare plots; and

(3) Phytotoxicity trials which were statistically analysed to study the effect of herbicide applications on the yield of cane.

Trials were conducted in commercial cane and land preparation was dependent on the type of irrigation (Table 1)

TABLE 1

Details of trials

Trial number	Type*	Nett Plot Size (m^2)	Soil type	Irrigation	Applied	Spray Volume ℓ/ha	Major weeds
1 . .	1	39	PE1	Furrow	Band	450	*Portulaca oleracea, Amarantus hybridus, A. spinosus.*
2 . .	1	39	PE1	Furrow	Band	110	*Commelina benghalensis, Portulaca oleracea, Ipomoea sinensis, Brachiaria* spp.
3 . .	1	39	Basalt	Furrow	Band	110	*Brachiaria deflexa, Tragus berteronianus, Commelina benghalensis.*
4 . .	1	39	PE1	Furrow	Band	110	*Portulaca oleracea, Commelina diffusa, Ipomoea spp., Amarantus* spp., *Tragus.*
5 . .	1	39	PE1	Furrow	Band	220	*Brachiaria deflexa, Tragus berteronianus, Euphorbia hirta, Commelina benghalensis.*
6 . .	1	39	PE1	Furrow	Band	110	*Panicum maximum Brachiaria deflexa.*
7 . .	1	39	PE1	Furrow	Band	247	*Amarantus* spp.
8 . .	1	39	PE1	Furrow	Band	247	*Brachiaria deflexa, Eragrastis pilosa.*
9 . .	1	39	PE1	Furrow	Band	450	*Portulaca oleracea.*
10 . .	1	39	PE1	Furrow	Band	450	*Portulaca oleracea, Brachiaria deflexa.*
11 . .	1	39	Basalt	Furrow	Band	110	*Aristida* spp., *Chloris pycnothrix, Brachiaria deflexa.*
12 . .	2	5 000	PE1	Furrow	Band	100	*Amarantus* spp., *Boerhavia diffusa, Portulaca oelracea.*
13 . .	2	5 000	PE1	Furrow	Treat	Treat	*Amarantus* spp.
14 . .	2	5 000	PE1	Furrow	Treat	Treat	*Portulaca oleracea, Amarantus spinosus, Erigrostis aethiopica.*
15 . .	1	39	Basalt	Furrow	Band	110	*Brachiaria deflexa, Setaria phanerococca, Brachiaria eruciformis.*
16 . .	3	60	PE1	Furrow	Band	247	Kept weed free.
17 . .	3	60	PE1	Furrow	Band	110	Kept weed free.

*Type 1—Screening trials, 2—Large scale trials, 3—Yield trials.

Herbicides were applied in bands or full cover using a gas or lever operated knapsack sprayer and either floodjets or teejets. The volume of water and other details are given in Table 1.

Details of the two main soil types are given in Table 2.

TABLE 2
Description of soils

Type	pH range	Clay content range %	% O.M.	Comments
Triangle PE1	6,5-7,5	17-35	1-2	—
Chis. Basalt	7,0-8,0	35-55	2-3	Swelling clay which develops large cracks.

Weed control by herbicide treatments was either visually rated, using a scale of 1(= complete weed control) to 9 (= no weed control), or by timing the rate of hand weeding. Phytotoxicity was either visually rated using a scale of 1(= no damage) to 9 (= death of cane) or the yield of cane was determined.

Experimental results and discussion

Pre-emergence applications

Atrazine was probably the best pre-emergence herbicide for broad leafed weeds (Table 3), and is recommended at a rate of 2 kg of 80% WP product per hectare. This herbicide was, however, weak on grasses, in particular *Brachiaria deflexa* (Table 4). For this reason much of the early work was concentrated on combinations of atrazine with other herbicides.

TABLE 3
Pre-emergence trial 1, weed control ratings

Product/s	Rate prod/ha	Ratings after:		
		50 days	82 days	117 days
Atrazine 80 W.P.	1,4 kg	2	3	3
Atrazine 80 W.P.	2,8 kg	2	2	3
Ametryne 80 W.P.	1,4 kg	2	3	3
2,4-D amine	1,5 ℓ	3	3	4
Diuron 80 W.P.	2,1 kg	3	5	5
Cyanazine (Bladex)	3,3 kg	2	3	4
Alachlor (Lasso E.C.)	3,5 ℓ	4	5	5
Alachlor + 2,4-D	3,1 ℓ	2	2	3

The combination of atrazine and alachlor (Lasso) produced variable results (Tables 4, 5, & 7) and it was considered that certain germinated grass seeds were surviving soil disturbance during planting, and were consequently not susceptible to alachlor the day after planting. In the last trial, therefore, alachlor was applied with ametryne which, it was hoped, would provide better control of germinated grasses. This combination proved excellent on *Panicum maximum*, but requires further investigation (Table 8).

TABLE 4
Pre- and post-emergence trial 2, weed control and cane damage ratings

Product/s	Rate product/ha	Applied (days after planting)	Ratings after 60 days		
			broad leaf	grass	cane damage
Ametryne 80 W.P. + atrazine 80 W.P. (no wetter)	3 kg+3 kg	22	2	2	4
Ametryne 80 W.P. + atrazine 80 W.P. (no wetter)	1 kg+1 kg	22	2	5	2
Ametryne 80 W.P. (no wetter)	4 kg	22	2	3	4
Atrazine 80 W.P. + alachlor	2 kg+3 ℓ	1	3	3	1
Atrazine 80 W.P.	3 kg	1	4	5	1
Cyanazine + ametryne 80 W.P. + tronic (0,5%)	3 kg+3 kg	22	2	2	4
Metribuzin (no wetter)	4 kg	22	1	2	3

TABLE 5
Pre- and post-emergence trials 3, weed control and cane damage ratings

Product/s	Rate product/ha	Applied (days after planting)	Ratings after 72 days		
			broad leaf	grass	cane damage
Atrazine 80 W.P. + ametryne 80 W.P.	4 kg+4 kg	14	1	3	2
Atrazine 80 W.P. + ametryne 80 W.P.	2 kg+2 kg	14	2	4	2
Atrazine 80 W.P. + alachlor	2 kg+3 ℓ	1	1	4	1
Cyanazine + ametryne 80 W.P.	3 kg+3 kg	14	1	3	2
Metribuzin + agral (0,5%)	4 kg	18	2	2	2

TABLE 6

Pre- and post emergence trial 4, weed control and cane damage ratings

Product/s	Rate product/ha	Applied (days after planting)	Ratings		
			broad leaf	grass	cane damage
Atrazine 80 W.P. + ametryne 80 W.P.	2 kg+2 kg	15	1	1	3
Atrazine 80 W.P.	3 kg	1	1	2	1
Atrazine 80 W.P. + alachlor	1 kg + 4 ℓ	1	1	1	1
Atrazine 80 W.P. + alachlor	2 kg + 3 ℓ	1	1	1	1
Ametryne + cyanazine	2 kg+2 kg	15	1	2	3
Ametryne (no wetter)	3 kg	15	1	3	3
Ametryne (no wetter)	2 kg	15	1	3	3
Ametryne + agral (0,5%)	1 kg	15	2	3	2
Ametryne + tronic (0,5%)	2 kg	15	1	2	3
Ametryne + tronic (0,5%)	1 kg	15	1	4	2
Metribuzin	4 kg	15	1	1	3
Cyanazine	3 kg	1	2	1	1

TABLE 7

Pre-emergence trial 5, weed control ratings

Product/s	Rate product/hectare	Weed control ratings after 54 days
Alachlor + 2,4-D (Lasso D)	5 ℓ	3
Alachlor + 2,4-D (Lasso D)	7 ℓ	3
Alachlor	5 ℓ	5
Alachlor + atrazine 80 W.P.	4 ℓ+1,4 kg	2
Alachlor + diuron	4 ℓ+2,2 kg	4
Cyanazine	3,9 kg	3
Cyanazine + atrazine 80 W.P.	3,9 kg+4 kg	2

TABLE 8

Pre-emergence trial 6, weed control ratings

Product/s	Rate product/ha	Weed control ratings after	
		34 days	53 days
Ametryne 80 W.P. + alachlor	2 kg+2 ℓ	2	4
Ametryne + asulox	1 kg+8 ℓ	5	7
Ametryne 80 W.P.+diuron	2 kg+2 kg	2	4
Cyanazine	3 kg	7	7
Diuron	3 kg	6	7
Diuron+M.C.P.A.	2 kg+4 ℓ	5	6
Diuron + asulox	2 kg+8 ℓ	6	7
Asulox	8 ℓ	5	8
Metribuzin	3 kg	3	4

Possibly the best single pre-emergence product is metribuzin (Sencor), which is unfortunately relatively expensive when compared with other herbicides available (Table 6).

Consistently poor results have been obtained with diuron (Tables 3 and 9), but there appears to be great potential in combining this product with ametryne, as there is considerable synergism (Table 8).

TABLE 9

Pre-emergence trial 7, weed control and cane damage ratings

Product/s	Rate Prod/ha	Weed control ratings after		Cane damage ratings after 20 days
		39 days	85 days	
2,4-D	3,1 ℓ	1	2	3
2,4-D	4,7 ℓ	1	2	5
Diuron	2,2 kg	3	2	1
Diuron	3,3 kg	2	1	1
Ametryne + 2,4-D	13,6 ℓ	1	1	5

Cyanazine (Bladex) at a rate of 3 kg product per hectare has produced variable results (Tables 3, 7 and 8).

Post-emergence applications

Ametryne was the most consistently successful post-emergent herbicide, and provided excellent control of a wide range of broad leafed and grass weeds (Tables 4, 5, 6, 10, 11, 12, 13, 14, 15 and 16). However, it is important that the grass weeds should not be too advanced at the time of spraying (Table 17).

TABLE 10

Post-emergence trial 8, weed control and cane damage ratings

Product/s	Rate prod/ha	Weed control ratings after			Cane damage rating
		21 days	40 days	50 days	
Diuron	2,2 kg	6	9	8	1
Diuron	4,4 kg	7	9	9	2
Ametryne	3,3 kg	2	3	3	3
Ametryne (no wetter)	3,3 kg	2	3	3	3
2,4-D amine	4,2 ℓ	5	9	8	6
Ametryne + 2,4-D	10,5 ℓ	2	4	4	8
Ametryne + alboleum	3,3 kg	3	5	5	4

TABLE 11

Post-emergence trial 9, weed control ratings

Product/s	Rate prod/ha	Weed control ratings after		
		53 days	85 days	119 days
Ametryne 80 W.P.	1,4 kg	2	2	2
Ametryne 80 W.P.	2,8 kg	1	1	2
Diuron	2,1 kg	3	2	3
2,4-D amine	4,7 ℓ	2	3	3

TABLE 12

Post-emergence trial 10, weed control and cane damage ratings

Product/s	Rate product/ hectare	Weed control ratings after			Cane damage rating
		14 days		59 days	
		Portulaca	Grass		
Ametryne 80 W.P.	1,4 kg	1	3	3	3
Ametryne 80 W.P.	2,1 kg	1	2	4	4
Ametryne 80 W.P.	2,8 kg	1	2	3	4
Cyanazine. . .	3,3 kg	1	8	3	2
Diuron+paraquat	2,1 kg+1,4 ℓ	1	4	3	8
2,4-D (no wetter)	3,1 ℓ	4	8	6	1
2,4-D	3,1 ℓ	4	9	8	4

TABLE 13

Post-emergence trial 11, weed control and cane damage ratings

Product/s	Rate product/ hectare	Weed control ratings after 14 days		Cane damage rating
		Aristida	*Chloris*	
Ametryne	4 kg	5	6	4
Ametryne 80 W.P. + atrazine 80 W.P. . .	2 kg+3 kg	4	7	4
Ametryne 80 W.P. + atrazine 80 W.P. . .	2 kg+2 kg	6	8	4
Ametryne 80 W.P. + atrazine 80 W.P. . .	1,5 kg+2 kg	7	8	3
Ametryne 80 W.P. + atrazine 80 W.P. . .	1,5 kg+3 kg	7	6	3
Ametryne 80 W.P. + cyanazine	2 kg+2 kg	5	8	3
Ametryne 80 W.P. + cyanazine	2 kg+1,5 kg	7	8	3
Ametryne 80 W.P. + cyanazine	1,5 kg+1,5 kg	6	9	3
Metribuzin	1,5 kg	9	8	2
Metribuzin	1,0 kg	9	9	2
Cyanazine + M.S.M.A.	3 kg+2 ℓ	1	4	3

TABLE 14

Pre- and post-emergence trial 12, cane damage ratings and hand weeding rates

Product/s	Rate product/ha	Application	Cane damage rating	Hand weeding (metres row/8 hour day)		
				12/4/73	26/4/73	31/5/73
Ametryne 500 + agral	4,8 ℓ	Post (22/3/73)	6	—	8 704	15 600
Ametryne 500 + agral	3,2 ℓ	Post (22/3/73)	5	—	8 768	8 770
Ametryne 500 + agral	1,6 ℓ	Post (22/3/73)	3	—	5 760)*	6 064)*
Ametryne 80 W.P. + agral	1 kg	Post (22/3/73)	3	—	5 760)	6 064)
Cyanazine	2 kg	Pre (6/3/73)	1	1 497	mislaid	13 516

*results averaged.

TABLE 15

Post-emergence trial 13, hand weeding rates

Product/s	Rate product/ha	Band (metres)	Volume water (ℓ/ha)	Metres row weeded/8 hr day		
				22/11/74	21/12/73*	5/1/74
Ametryne 80 W.P.	1 kg	Overall	200	5 318	—	2 890
Ametryne 80 W.P.	1 kg	0,75	100	5 914	—	2 578
Ametryne 80 W.P.	1 kg	0,5	200	1 546	—	2 160
Ametryne 80 W.P.	1 kg	0,75	200	2 645	—	2 722
Ametryne 80 W.P.	2 kg	0,75	200	5 184	5 496	5 496

*other treatments not weeded because of rain.

TABLE 16

Post-emergence trial 14, hand weeding rates

Product/s	Rate product/ha	Band metres	Volume water (ℓ/ha)	Metres row weeded per 8 hour day
Ametryne 500 + atrazine 500	3,2 ℓ+1,6 ℓ	0,75	200	3 957
Ametryne 500 + atrazine 500	3,2 ℓ+1,6 ℓ	1,0	U.L.V.*	4 126
Ametryne 500 + Cyanazine	2 kg+1 kg	0,75	200	4 727
Ametryne 80 W.P.	1 kg	0,75	200	1 590
Ametryne 80 W.P.	1 kg	0,75	120	2 008
Ametryne 80 W.P.	1 kg	Overall	200	2 644

*U.L.V.—Ultra low volume "Handy" sprayer

There appears to be no advantage in using a wetting agent with ametryne if it is applied at rates in excess of 2 kg product per hectare, and there are indications that wetting agents may accentuate phytotoxicity (Table 10).

Combinations of ametryne with atrazine and cyanazine have proved highly successful (Tables 4, 5, 6, 13 and 17), but these must also be sprayed at an early post-emergence stage. The combination with cyanazine seems more effective on grasses, as indicated by the greater distance weeded in Trial 14 (Table 16).

TABLE 17

Post-emergence trial 15, weed control and cane damage ratings

Product/s	Rate Product/ha	Weed control rating after 20 days	Cane damage rating
Ametryne	3,2 ℓ	7	3
Ametryne 500+atrazine 500	3,2 ℓ+1,6 ℓ	7	3
Ametryne 80 W.P.+cyanazine	2 kg+1 kg	7	3
Ametryne 500+asulam	3,2 ℓ+8 ℓ	4	3
Asulam	8 ℓ	3	3
Asulam+diuron	8 ℓ+2 kg	3	3
Diuron	3 kg	9	3
Metribuzin	3 kg	6	3

Metribuzin must be sprayed at an even earlier stage of weed development than ametryne to ensure post-emergent control (Tables 4, 5, 6, 13 and 17). This product is slightly weak on *Brachiaria deflexa* and is recommended at 3 kg product/ha.

MSMA has proved successful on troublesome grasses like *Chloris pycnothrix* and *Aristida* spp. (Table 13), but is not recommended because the necessity for controlling these weeds is not sufficient to justify the application of an arsenical herbicide.

In spring more hardy grasses, like *Eragrostis* spp., germinate profusely, and if ametryne is not applied while these are very young, poor control can be expected. Under these conditions asulam in combination with ametryne or ioxynil + 2,4-D, provided excellent control even at 8 ℓ product/ha (Table 17). Similarly, when virgin lands are first planted to cane and heavy infestations of grass weeds can be expected, the use of asulam mixtures is to be recommended.

Consistently poor results have been obtained from applications of diuron and it seems that the rapid drying of the surface of the soil in the treated area, which appears advantageous for ametryne applications, is not suitable for diuron application.

Post emergence applications of 2,4-D to plant cane should be avoided because of phytotoxicity (Tables 10 and 12).

Pre- vs Post-emergence

Post-emergence applications of very low rates of ametryne proved superior to cyanazine when this chemical was applied pre-emergent (Table 14). This assessment may have been partly due to slight control of weeds in the unsprayed inter-row of post-emergence treatments (drift), but also because of the later date of spraying post-emergence treatments. Since good control of weeds is obtained with such low rates of ametryne that serious phytotoxicity is unlikely, it seems that post emergence applications have a distinct advantage over pre-emergence applications in the Rhodesian Lowveld.

Pre-emergence applications have not been satisfactory on basalt soils, and one trial was abandoned because of poor weed control. This was due not only to the high clay content, but also to cracking of soil and the subsequent movement of surface soil by flood irrigation.

Post-emergence applications have an added advantage under furrow irrigation, as farmers will know at a later stage whether to spray the inter-row or not; weeds only grow in the dry inter-row if rain falls.

Phytotoxicity

Applications of 2,4-D to plant crop NCo 376 resulted in reductions in cane yield (Tables 18 and 19) which, though not significant, were very marked. (In trial 17, differences were observed but they were not confirmed in the analysis of variance.) The yields of recoverable sugar showed similar trends to cane yield, but were more variable because of variable recoverable sugar contents. Although the visible effect of MCPA appeared to be just as marked as that of 2,4-D, this was not reflected in yields.

TABLE 18

Phytotoxicity trial 16, plant and 1st ratoon harvested crop data

Product per hectare				Plant crop				1st ratoon			
				tc/ha	ERS%C	TERS/ha	Stalk counts '000s/ha	tc/ha	ERS%C	TERS/ha	Stalk counts '000s/ha
2,4-D (amine)	1,5 ℓ	nonidet 0,5%	6-7 leaves	185,4	9,87	18,29	154,4	180,9	8,41	14,83	165,9
2,4-D (amine)	3,1 ℓ	nonidet 0,5%	6-7 leaves	179,6	9,20	16,54	161,2	185,8	9,36	17,33	161,8
2,4-D (amine)	6,2 ℓ	nonidet 0,5%	6-7 leaves	173,0	9,10	15,73	161,7	180,9	9,19	16,65	179,1
2,4-D (amine)	3,1 ℓ	no wetter	6-7 leaves	171,3	9,47	16,33	149,3	184,4	10,04	18,38	172,4
2,4-D (amine)	3,1 ℓ	no wetter	3 leaves	191,1	8,36	15,91	155,9	193,5	8,08	15,56	168,7
Ametryne	2,1 kg	no wetter	3 leaves	191,6	9,30	17,81	148,4	190,8	8,67	16,46	170,0
Ametryne	2,1 kg	teepol 0,5%	3 leaves	203,1	9,26	18,86	156,0	201,4	8,30	16,58	172,2
Ametryne	2,1 kg	nonidet 0,5%	3 leaves	182,7	9,20	16,84	142,7	171,5	8,18	13,78	158,9
Ametryne	4,2 kg	no wetter	3 leaves	183,9	10,08	18,67	140,6	194,7	8,84	17,19	172,2
Control				196,3	10,19	20,20	160,5	182,3	7,82	14,60	173,4
L.S.D. 5%				26,0	1,58	4,57	20,2	28,0	2,47	4,24	21,08
1%				35,1	2,14	6,17	27,3	37,7	3,34	5,73	28,47
C.V.%				9,6	11,6	18,0	9,1	10,3	19,58	18,12	8,57

TABLE 19
Phytotoxicity trial 17, harvested crop data

Product per hectare	Stage sprayed	tc/ha	ERS%C	TERS/ha	Stalk counts '000s/hectare
Ametryne 80 W.P. 2 kg + agral 0,5%	5 leaf	146,9	7,29	10,82	155,4
Ametryne 80 W.P. 5 kg + agral 0,5%	5 leaf	144,3	6,48	9,43	153,9
Ametryne 80 W.P 2 kg + atrazine 80 W.P. 1kg + agral 0,5%	5 leaf	150,1	6,58	9,88	153,0
M.C.P.A. 7 ℓ + agral 0,5%	3 leaf	156,3	6,83	10,67	160,5
2,4-D amine 4 ℓ + agral 0,5%	3 leaf	139,4	6,80	9,34	138,7
Ametryne 80 W.P. 1,25 kg + 2,4-D 2 ℓ + agral 0,5%	5 leaf	156,0	6,13	9,53	163,2
Diuron 2,5 kg + 2,4-D 4 ℓ + agral 0,5%	5 leaf	136,2	6,86	9,27	152,8
Asulam 11 ℓ + ioxynil + 2,4-D 5 ℓ	5 leaf	148,8	7,20	10,65	155,2
Cyanazine 4 kg	Pre-emer.	149,3	7,50	11,08	158,7
Dalapon 6 kg + agral 0,5%	Directed	131,0	8,25	10,69	134,2
Paraquat 3 ℓ + agral 0,5%	3 leaf	159,4	7,06	11,34	156,6
Control	—	163,1	7,62	12,36	157,9
L.S.D. 5%		22,45	1,40	2,64	15,62
1%		30,17	1,88	3,54	21,00
C.V. %		10,51	13,76	17,59	7,08

The phytotoxic effect of ametryne was much less marked, only the higher rates (4,2 and 5 kg product/ha) tending to affect yield (NS). Nonidet as a wetter apparently caused greater phytotoxicity. It is consequently recommended that ametryne 80 WP should not be applied at rates greater than 3 kg product/ha, and if applications of over 2 kg/ha are necessary, wetters should not be added.

Although applications of dalapon significantly decreased the number of stalks per plot, this was compensated for by a higher sucrose content of the cane and little or no effect on sugar yield was observed (Table 19).

Applications of paraquat resulted in severe burning of cane, but this was not reflected in cane or sugar yields.

Phytotoxicity symptoms were more severe in trial 17 than has been observed anywhere else. This is presumably because the 5 leaf stage treatments were sprayed on a hot, extremely humid day which was followed by a week of cold wet weather. As a result growth was severely retarded. Despite this, the application of 11 ℓ asulox + 5 ℓ ioxynil + 2,4-D per hectare had very little effect on yield.

Very little phytotoxicity was observed in a ratoon crop. (Table 18). However more recent work has shown that damage may be similar to that in the plant crop, but yield data are not yet available. Herbicides are rarely applied to ratoon crops in Rhodesia.

Experience has shown that phytotoxicity is far more marked if weed competition is severe. Thus, if spraying is delayed and weeds reach an advanced stage, the temptation to raise the level of herbicide to kill the weeds should be curbed. It would be better under these circumstances to use asulam or an asulam mixture.

It is worth noting that there is virtually no interest in the use of directed herbicide applications in the area, because a single application of herbicides is generally made at a stage of development (of cane) precluding directed sprays. In addition, band application over the row is generally practised because herbicides are applied to the plant crop, which is always irrigated down the row in furrow irrigated fields.

Water volumes

The "Handy" ultra low volume sprayer was suitable for post-emergent applications of liquid formulations of ametryne and atrazine (Table 16). This observation and others (Tables 15 and 16) tend to show that the volume of water used does not seriously influence the efficiency of ametryne. It is possible, however, that the effects of other products have been reduced due to the application of as little as 100 ℓ of water per hectare (Table 1), and in future research this volume will be substantially increased.

Labour and herbicides

Herbicides are used in the Rhodesian Lowveld primarily to boost the output of labour, or to supplement labour. Thus it is not necessary to obtain complete control of weeds as herbicide applications can be followed by hand-weeding. In fact, it is recommended that herbicide applications should be followed by hand-weeding as it is hoped that this practice will prevent or retard the weed spectrum from changing to species resistant to herbicides. Any practice which ensures that labour will enter the field, e.g. banding or 90% control of weeds, is encouraged.

Problems with herbicides

Although *Tragus berteronianus* is easily knocked down by herbicides, it is generally the first weed to germinate after herbicide treatment. *Chloris pycrothrix* is neither easily knocked down by ametryne mixtures nor controlled by residual effects. As neither of these grasses is a vigorous grower, they do not seriously compete with cane and are fairly easily controlled by hand labour, but not before they have seeded. Herbicides which can provide residual control of these grasses at competitive prices, would be welcomed by the industry.

A potentially dangerous weed is *Rottboellia exaltata*, which is becoming more common and could increase the costs of herbicides well above present levels. No serious infestations have yet been observed but it is recommended that farmers try to eradicate the weed before it seeds.

Other herbicides

A large range of herbicides has been tested and a list is provided in Appendix 1. The most promising combination not mentioned in this report is ioxynil + 2,4-D (actril D) + ametryne, which exhibits excellent synergism and gives a rapid knock-down of weeds.

Apparent residual effects

The apparent residual effects of extremely low levels of ametryne (Table 14), which were not expected, led to the suspicion that these were not genuine. This was confirmed in trial 17. A week after spraying with the paraquat treatment,

an adjacent hand weeded plot was weeded. One week later (2 weeks after spraying the paraquat) there were practically no weeds where the paraquat was sprayed but there was a dense stand of young weeds on the hand weeded plot. As there should have been no residues of paraquat on this sandy clay loam (Fryer & Evans[1]), an "apparent" residual effect is clearly demonstrated.

The reason for this effect appears to be that weed germination in the Rhodesian Lowveld occurs in "flushes" and if the first "flush" is killed without disturbing the soil, there is little germination for as long as 2 or 3 weeks, until the second "flush" germinates.

It is consequently recommended that if the residual effects of herbicides are to be fully understood, they should be measured against a plot sprayed with paraquat.

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REFERENCE

1. Fryer, J. D. and Evans, S.A. (1968). Weed control Handbook. Vol. 1: Principles. 5th Edn. Adlard & Son Ltd., Dorking.

APPENDIX 1

List of herbicides and mixtures tested

Trade names of herbicides mentioned in test

Alachlor	—	Lasso E.C.
Ametryne	—	Gesapax 80 W.P., Gesapax 500
Atrazine	—	Gesaprim 80 W.P., Gesaprim 500
Asulam	—	Asulox 40
Cyanazine	—	Bladex
Dalapon	—	Gramevin, Dowpon
Diuron	—	Karmex, Diurex, Diuron
Ioxynil + M.C.P.A.		2,4-D — Actril D
Metribuzin	—	Sencor
M.S.M.A.	—	Ansar
Paraquat	—	Gramoxone
2,4-D	—	KOP 24 amine

Other trade names/numbers tested

A 3587
A 3588
A 3589
A 3611
A 3615
A 3783
A 3797
Afalon
Basagran
C 9122
C 15935
CP 50144
CP 53619
Cotoran
Fenac
GS 14254
Igran
Lasso D
Maloran
Mon 097
1815
17020
Patoran
Planavin
Preforan
Track Chemical X
U2797

Other mixtures tested (Trade names)

Actril D + Diuron
Actril D + Bladex
Asulox + Bladex
Bladex + Ansar
Bladex + Gesaprim
Bladex + Planavin
Cotoran + Planavin