THE EFFICACY OF ROUNDUP FOR KILLING SUGARCANE

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Abstract

The results of nine experiments to study factors influencing the efficacy of N-(phosphonomethyl) glycine (as Roundup) in killing sugarcane are reported. These factors include varying rates, methods of application, disturbance of the cane after application, the presence of dew on the foliage during application and the susceptibility of sugarcane varieties. Other factors such as season, soil type and stage of cane growth were also considered.

Ten litres per hectare consistently produced the best kill. Band sprays were superior to overall sprays when the coverage was adequate. Low volume applications were marginally superior to high volume applications. Disturbance of the cane one day after treatment only affected the kill very slightly under favourable conditions, while dew had no effect on cane kill. Varieties differed in their susceptibility but at 11,2 litres per hectare all varieties tested were adequately killed. The kill was unacceptable in all experiments where cane was sprayed in winter. Cane growing on light soils was more susceptible to treatment than cane growing on heavy soils. The stage of cane growth had a marked effect on the kill achieved.

Introduction

Roundup, a formulation of glyphosate containing 360 grammes per litre of acid equivalent of the isopropylamine salt of N-(phosphonomethyl) glycine, was registered in 1975 for killing sugarcane in South Africa. Being a broad spectrum herbicide with no soil residual activity it is ideal for eradicating the old sugarcane crop when using the minimum tillage system to re-establish a new plant crop quickly. Complete eradication of the old crop is essential to prevent the transmission of diseases, particularly Ratoon Stunting Disease (RSD), to the new crop.

Extensive use of Roundup since 1975 has confirmed its ability to kill cane under the right conditions when applied at a rate of ten litres per hectare. Regrowth after such an application can be controlled mechanically or by hand. An increase in the cost of the chemical to about R19,00 per litre however, has created the need to investigate the possibility of using lower rates by means of different application techniques or the use of additives to Roundup.

Commercial applications of Roundup are generally made by means of tractor-mounted boom sprayers or lever-operated knapsack sprayers fitted with floodjets which are held directly over the cane rows. This means that adequate coverage of the interrows occurs at the same time thus killing any weeds that are present, but also resulting in a loss of Roundup on non-target areas. As a result of this some emphasis has been placed in the trials on row only or band sprays of Roundup.

The effects of additives to Roundup, disturbance of the plant after application, stage of plant growth and rates of Roundup on the efficacy of the treatment on various weed and crop plants have been reported by many workers (Anon[1], Baird and Begeman[2], Fernandez and Bayer[3], Parker[5], Suwunnamek and Parker[6]), and it was considered desirable to test these findings on sugarcane.

Experimental

The commercially available formulation of glyphosate, Roundup, was used in all the experiments reported here. All experiments except one were conducted using a randomised block design with four to six replications. Plots consisted of four to six rows which were six to ten metres long, giving 24 to 60 metres of cane row per plot. Eight of the experiments were used to evaluate various methods of application, four were used to test the effects of additives to Roundup, and two included a number of sugarcane varieties. Two experiments included treatments to evaluate the effects of disturbing sugarcane foliage after the application of Roundup and one was used to test the effects of dew on the foliage at the time of spraying. Methods of application included the use of conventional high volume equipment such as the lever-operated knapsack sprayer fitted with various types of nozzle, and low volume equipment such as the controlled droplet applicator and the motorised knapsack sprayer.

High volumes ranged from 150 to 350 litres per hectare and the nozzles used included floodjets such as the Spraying Systems TK5, Demarquest APM3, Delavan D5 and ICI yellow polijet and even-spray fanjets such as the Spraying Systems 8003-E and 8004-E. Nozzles were always held directly over the cane row except when extra nozzles were used to spray the sides of the cane plants. Swath widths varied and full coverage was invariably achieved by using the TK5, APM3 and D5 jets while the swaths produced by the polijet and fanjets were narrower and provided only a band of spray over the row. In the case of the band sprays the rate of Roundup applied per sprayed hectare differed from the rate sprayed per total hectare. All rates in the tables are listed as the rate applied per total hectare.

Low volumes ranged from 19 to 45 litres per hectare and applications were directed over the cane row.

The soil series and clay contents of the soils on the experiment sites and the season in which each experiment was conducted are indicated in Table 1.

TABLE 1

Soil series and clay contents of the soil on each experiment site, and the season in which each experiment was conducted

Experiment No.	I	II	III	IV	V	VI	VII	VIII	IX
Soil series . . .	Clansthal	Waldene	Waldene	Waaisand	Clansthal	Phoenix	Cartref	Clansthal	Swartland
Clay content, % .	8	*8	14	12	8	39	*10	*8	31
Season	Summer	Spring	Winter	Summer	Summer	Summer	Summer	Winter	Spring

* Approximate clay contents (from analysis of soil samples from adjacent fields)

Treatments were evaluated by means of visual ratings of cane kill and green shoot or stool counts two to six months after spray application. Visual ratings were based on the European Weed Research Society 1-9 scale where 1 = no effect and 9 = 100% kill. Shoot or stool counts represent either the number which survived treatment or the number which had regenerated after the crop had apparently been killed.

Experiment I

The experiment was conducted in January 1975 on a Clansthal series soil. The objective was to test the effects of additives to Roundup and to determine the time required for effective translocation of Roundup from the foliage to the root zone of the crop. Roundup was applied by means of a lever-operated knapsack sprayer fitted with a Spraying Systems TK5 floodjet delivering 350 litres per hectare. Where a lower volume of 150 litres per hectare was required a TK2,5 floodjet was used. The sugarcane variety was N55/805 which had 5 or 6 leaves unfurled per shoot and a canopy height of approximately 0,5 m at the time of spraying. The nozzle was held directly over the cane row at spraying. The additives to Roundup were 5 kg of ammonium sulphate and 10 kg of citric acid per hectare.

To determine the rate of foliar translocation the above-ground parts of the crop were cut off at ground level three, seven or fourteen days after spraying. The soil was dry at the time of application but 0,8 mm of rain fell on the same day.

Results

Visual ratings of cane kill and stool survival counts four months after treatment are presented in Table 2. The most effective rate of Roundup was 10 litres per hectare and there was no apparent difference between 350 and 150 litres of total volume per hectare. The addition of ammonium sulphate increased the activity of Roundup but not sufficiently to warrant a decrease in the rate below 10 litres per hectare. There was no indication that citric acid increased the activity of Roundup. In this experiment no decrease in the efficacy of Roundup resulted from removing the foliage at any stage after spraying and thus it appears that Roundup was translocated to the root system rapidly, and within a minimum of three days, after treatment.

TABLE 2

Visual ratings of cane kill and the number of surviving stools four months after treatment

Treatment	Water volume litre/ha	EWRS ratings		Stool survival No./ha
		4 weeks	8 weeks	
10ℓ Roundup	350	8,0	9,0	690
3 ℓ Roundup + 5 kg $(NH_4)_2SO_4$	350	6,5	7,0	3 360
6ℓ Roundup + 5 kg $(NH_4)_2SO_4$	350	6,5	7,0	4 950
3ℓ Roundup + 10 kg citric acid	350	4,5	5,0	9 600
6ℓ Roundup + 10 kg citric acid	350	5,0	5,5	9 800
6ℓ Roundup	350	5,5	6,0	9 200
10ℓ Roundup	150	8,0	8,5	1 180
10ℓ Roundup — cut back after 3 days	350	9,0	8,5	890
cut back after 7 days	350	9,0	9,0	590
cut back after 14 days	350	9,0	8,5	2 180

Experiments II and III

These two experiments were designed to study the possibility of alternative methods of application with a view to reducing the amount of Roundup required for an adequate kill. Experiment II was conducted in September 1976 on a Waldene series soil at Shakaskraal. It was superimposed on an old variety x herbicide experiment containing varieties NCo 376, NCo 293, N51/168, N53/216 and NCo 310. The heights of the leaf canopy of the varieties at the time of spraying ranged from 0,3 – 0,5 m.

Experiment III was conducted in August 1976 on a Waldene series soil at La Mercy, using a commercial canefield of variety NCo 376 which was due to be ploughed out. The height of the leaf canopy at the time of spraying varied from 0,5 to 0,6 m.

The treatments in both experiments were :

	Roundup rate (1/ha)	Applicator	Output (1/ha) Expt. II	Output (1/ha) Expt. III
1.	8	Micron Herbi.	24	19
2.	6	Motorised knapsack + Jacto head.	45	45
3.	8	Motorised knapsack + Jacto head.	45	45
4.	6	Lever-operated knapsack + TK5 nozzle.	320	376
5.	8	Lever-operated knapsack + TK5 nozzle.	320	376
6.	10	Lever-operated knapsack + TK5 nozzle.	320	376

Micronol oil adjuvant was added at a rate of ten percent of total volume to the Roundup in treatment one.

Results

The percentages of shoot survival three months after treatment in Experiment II are presented in Table 3 while Table 4 contains the percentages of shoots which had survived two months after treatment in Experiment III. In

TABLE 3

The number of living shoots three months after application of Roundup to five sugarcane varieties, expressed as a percentage of the number of shoots per plot before treatment

Treatment	Round-up rate 1/ha	% survival					Mean
		NCo 376	NCo 293	N51/ 168	N53/ 216	NCo 310	
Micron Herbi	8	2	27	8	7	3	9
Motorised knapsack	6	5	26	5	7	3	9
Motorised knapsack	8	3	21	10	8	4	9
Lever-operated knapsack	6	4	22	7	18	6	11
Lever-operated knapsack	8	4	18	10	11	5	10
Lever-operated knapsack	10	4	20	8	6	3	8
Mean	—	4	22	8	9	4	—

TABLE 4

The number of live shoots two months after application of Roundup to sugarcane variety NCo 376, expressed as a percentage of the number of shoots before treatment

Treatments	Roundup rate (ℓ/ha)	% shoot survival
Micron Herbi	8	20
Motorised knapsack	6	27
Motorised knapsack	8	12
Lever-operated knapsack	6	29
Lever-operated knapsack	8	13
Lever-operated knapsack	10	6

Experiment II marked differences in shoot survival were evident between varieties. NCo 376 and NCo 310, which showed the most uniform growth at the time of application, were most severely affected. NCo 293 was more tolerant than other varieties. It is of interest that shoot survival was not related to the pattern of early foliar scorch, NCo 310 having been very slow to develop symptoms. Although not large, the differences in shoot survival between treatments were fairly consistent for each variety. Low volume applications appeared to be marginally superior to high volumes and high rates of Roundup were slightly better than low rates.

In Experiment III differences between the treatments in terms of the degree of kill were apparent and the trends were similar to those in Experiment II, except that the applications made with the Micron Herbi were slightly less effective in this trial. This may be attributed to the moderate breeze which blew at the time of application, and markedly affected the distribution of the application from the Micron Herbi.

Experiment IV

When using Roundup in the minimum tillage system for re-establishing sugarcane it is desirable to plant the seed in the interrows between the rows of the old dying crop soon after spraying. The new furrows are drawn by a ridger body mounted on a tractor and the tractor wheels generally run over the recently sprayed cane rows. It was necssary to ascertain the effect of this trampling operation on the efficacy of Roundup. An experiment was therefore established in March 1977 at Mtunzini on a Waaisand series soil and the rate of Roundup applied was 9,4 litres per hectare. The sprayed cane was then trampled one, four, ten or 21 days after spraying, and the control plots were sprayed but not trampled. The trampling was effected by means of a tractor passing twice over each cane row, with the wheels on the row, to simulate the ridging and then the planting operations.

Since the efficacy of Roundup can be affected by rainfall shortly after application it was suspected that heavy dew on the cane foliage at the time of spraying might have a similar adverse effect. A second experiment was therefore conducted on an adjacent site. Cane in some plots was sprayed early in the morning when it was saturated with dew, whilst later in the day cane in other plots was sprayed after the dew had evaporated. The height of the leaf canopy was approximately 0,62 m and four leaves were unfurled per shoot at the time of spraying.

Results

Visual ratings of cane kill taken 73 days after application, stool survival and the numbers of regenerated shoots three and five months after spraying are shown in Table 5. The

TABLE 5

Visual ratings of cane kill 73 days after application together with stool survival counts three months after spraying and shoot regeneration counts five months after spraying

Treatments	EWRS rating 73 days after spray	Stools surviving 3 months later No./ha	New shoots 5 months later No./ha
No trampling	8	107	1 179
Trampled —			
1 day after spray	9	643	3 929
4 days after spray	8,5	1 250	3 393
10 days after spray	9	285	2 071
21 days after spray	9	464	2 857

effects of Roundup appeared to occur more quickly in cane that had been trampled, but the subsequent kill was slightly better in untrampled plots. The kill in all plots was acceptable. No difference was detected between cane that was treated when wet with dew and when dry, and the ratings were similar to those for untrampled cane.

Experiments V and VI

The following two experiments were established to investigate the possibility of using band sprays at lower rates of Roundup per hectare and to observe any differences between the cane kill on light and heavy soils. The experiments were conducted at Mount Edgecombe on soils of the Clansthal (Expt V) and Phoenix (Expt VI) series. Treatments were applied in both experiments on the 6th December, 1977. Roundup was applied by means of a lever-operated knapsack sprayer fitted with either one TK5 floodjet, one 8003-E fanjet or three 8003-E fanjets. Treatments with the single fanjet were applied with the jet held directly over the row, and when three fanjets were used, one jet was held above the crop and there was one on each side of the cane row.

The cane had reached a leaf canopy height of approximately 0,8 m with seven to eight leaves unfurled per shoot at the time of spraying. Based on previous results (Iggo[4]) the cane was too well grown for an adequate kill to be expected.

Results

Mean visual ratings of cane kill on heavy and light soils are presented in Table 6. The rate of 10 litres per hectare

TABLE 6

Mean ratings of cane kill on light and heavy soils taken one, three and six months after Roundup application

Treatments	Roundup rate per ha	EWRS ratings					
		Months after spray					
		Light soil			Heavy soil		
		1	3	6*	1	3	6*
TK5 overall spray	10	7,7	8,9	8,3	6,7	8,5	6,0
TK5 overall spray	4	6,0	7,9	4,6	3,3	4,0	1,3
Single 8003-E jets band sprayed	4	6,2	7,6	5,3			
Three 8003-E jets band sprayed	4	5,8	8,1	6,2			
Single 8003-E jets band sprayed	5				5,0	5,7	2,7
Three 8003-E jets band sprayed	6				4,0	7,2	4,3

* These ratings also take the amount of regrowth into account.

was generally superior to other treatments although on the light soil after three months all treaments appeared to have resulted in a good kill. Regrowth was unacceptable where the lower rates were used. Band sprays with 4 litres of Roundup per hectare resulted in slightly less regrowth compared with the comparable overall spray with a TK5 floodjet. On the heavy soil the effects of Roundup were slower to develop and the 10 litre per hectare rate caused a similar degree of kill to that obtained on the sandy soil only after three months. Regrowth in the treated plots was unacceptable. The ratings consistently indicated that a better kill was obtained at the higher rates.

Experiment VII

Varieties had been shown in previous work (Iggo[4]) to be differentially susceptible to Roundup, and further results were obtained by spraying the cane in an old variety trial with Roundup. The experiment was established on the 21st March, 1978 on a Cartref series soil at Paddock near Port Shepstone. The cane growth stages at the time of application varied between varieties and these are indicated in Table 7. Application was made at a rate of 11,2 litres of Roundup per hectare by means of a lever-operated knapsack sprayer fitted with an APM3 floodjet.

Results

Visual ratings of cane kill based on the EWRS 1-9 scale and the mean number of new shoots developed per 100 metres of cane row four months after spraying are also presented in Table 7. All varieties were effectively killed by 11,2 litres of Roundup per hectare. Differences between varieties occurred both in respect of visual effects on the foliage and the extent of regrowth. N6 was the most susceptibe and NCO 293 the most tolerant of the eight varieties tested.

Experiments VIII and IX

Two experiments were conducted to gain further information on winter applications, the effects of soil type, methods of application, the effects of additives to Roundup, and to assess the value of using repeated sprays of paraquat for killing sugarcane. The experiments were established at Mount Edgecombe (Expt VIII) on the 3rd August 1979 on a Clansthal series soil, and at La Mercy (Expt IX) on 5th September 1979 on a Swartland series soil. The treatments used in the two experiments are listed in Table 8.

Paraquat treatments were repeated in Experiment VIII on the 20th August, and in both Experiments on the 21st September, 2nd October and the 11th October, while a further application was made to Experiment IX on the 18th October.

In Experiment VIII the height of the leaf canopy was approximately 0,3 m on 3rd August and 0,4–0,5 m on 20th August. In Experiment IX the height of the leaf canopy and stalk height were recorded for both varieties. They were :

	N55/805	NCo 376
Leaf canopy height (m)	0,31	0,29
Stalk height (m)	0,13	0,15

Treatments 5 and 6 in Experiment VIII were applied 17 days later than were all the other treatments.

Results

Mean visual ratings of cane kill based on the EWRS 1-9 scale in both experiments, and the number of healthy shoots per metre of cane row after 3½ months in Experiment VIII, are presented in Tables 9 and 10. Although after two months the cane kill in Experiment VIII appeared acceptable where the treatment was 10 litres per hectare, subsequent regrowth was unacceptable. The addition of ammonium sulphate improved the cane kill when six litres of Roundup were applied per hectare, but there was still less regrowth when ten litres were applied per hectare without ammonium sulphate. The addition of Actipron Super caused the effect of the treatment to be quicker and there was less regrowth. Band sprays using the 8003-E fanjets were no better than the full cover spray with a TK5 jet at equivalent rates. Paraquat treatments never provided an acceptable kill of sugarcane and there was little difference between the effects of the six and three litre per hectare rates.

In Experiment IX band sprays with 8004-E fanjets and a D5 floodjet, as well as the low volume application with the Micron Herbi showed better effects than those obtained with the conventional floodjet nozzle. However, some cane was missed at the time of spraying due to the narrow swath of the 8004-E fanjets. (A similar problem had occurred in Experiment VIII where poor ratings were due to the presence of cane which was missed when spraying). It thus appears difficult to apply band sprays effectively due to uneven row widths. The addition of Actipron Super in this case decreased rather than increased the effect of Roundup. N55/805 was not controlled to the same degree as was NCo 376 except at the 10 litre per hectare rate applied with a TK5 floodjet. Paraquat treatments were unacceptable at all stages. Generally the kill achieved was unacceptable in this experiment and the subsequent regrowth was extensive.

TABLE 7

Growth stages at the time of spraying, mean visual ratings of cane kill and the number of newly developed shoots in eight sugarcane varieties after treatment with Roundup at 11,2 litres per hectare

Variety	Growth stage at spraying			EWRS ratings			No. of new shoots per 100 m four months after spraying
	No. of leaves unfurled/shoot	Leaf height (m)	Growth condition	Months after spray			
				1	3	4	
N6	4-5	0,4	fair	7,9	8,9	9	0
CB36/14	5-6	0,6	poor	7,5	8,3	8,9	1
N50/211	6	0,7-0,8	fair	7,7	8,9	9	1,3
NCo 376	7	0,7	good	6,9	7,6	8,4	4
N55/805	6-7	0,7	fair	6,5	7,9	9	4,2
NCo 382	6	0,7	poor	7,6	8,4	9	8,2
N53/216	6-7	0,7	fair	6,4	7,4	8,5	9,7
NCo 293	5-6	0,6-0,7	poor	7,0	7,5	8,9	16,5

TABLE 8

Treatments used in Experiments VIII and IX

EXPERIMENT VIII

Treatment No.	Chemicals	Rate in ℓ or kg prod/ha	Application method	Output, ℓ/ha
1	Roundup	10	Knapsack sprayer TK5 floodjet	342
2	Roundup	10	Knapsack sprayer 8004-E fanjet	161
3	Roundup	6	Knapsack sprayer 8004-E fanjet	161
4	Roundup + $(NH_4)_2SO_4$	6 + 10	Knapsack sprayer TK5 floodjet	342
5	Roundup	6	Micron Herbi	19
6	Roundup + Actipron Super	6 + 20% V/V	Micron Herbi	19
7	Paraquat	6 + 3 + 3 + 3 + 3	Knapsack sprayer TK5 floodjet	342
8	Paraquat	3 + 3 + 3 + 3 + 3	Knapsack sprayer TK5 floodjet	342

EXPERIMENT IX

1	Roundup	10	Knapsack sprayer TK5 floodjet	256
2	Roundup	6	Knapsack sprayer TK5 floodjet	256
3	Roundup	6	Knapsack sprayer 8004-E fanjet	114
4	Roundup	4	Knapsack sprayer 8004-E fanjet	114
5	Roundup	6	Knapsack sprayer D5 floodjet	244
6	Roundup	6	Micron Herbi	19
7	Roundup + Actipron Super	6 + 20% V/V	Micron Herbi	19
8	Paraquat	3 + 3 + 3 + 3 + 3	Knapsack sprayer TK5 floodjet	256

TABLE 9

Mean visual ratings of cane kill taken 0,5, 2,0 and 3,5 months after treatment and the number of live shoots per metre of cane row 3,5 months after treatment with Roundup

Treatment No.	Treatments		EWRS Ratings months after spray			No. of live shoots per metre after 3½ months
	Chemicals and rates	Applicator/Nozzle	0,5	2,0	3,5	
1	Roundup 10 ℓ/ha	TK5	3,8	8,3	7	4,2
2	Roundup 10 ℓ/ha	8004-E	3,8	8,5	7,5	4,8
3	Roundup 6 ℓ/ha	8004-E	3,8	7,5	6,3	6
4	Roundup 6 ℓ/ha + $(NH_4)_2SO_4$ 10 kg/ha	TK5	3,5	8	7,3	7,9
5	Roundup 6ℓ/ha	Micron Herbi	—	6	6,5	10,3
6	Roundup 6 ℓ/ha + Actipron Super 20% V/V	Micron Herbi	—	7,3	8,3	6
7	Paraquat 6 + 3 + 3 + 3 + 3 ℓ/ha	TK5	6	7	3,8	10,8
8	Paraquat 3 + 3 + 3 + 3 + 3 ℓ/ha	TK5	6	7	5,3	10,9

TABLE 10

Mean visual ratings of cane kill taken 1,0 and 2,5 months after application of Roundup to sugarcane varieties N55/805 and NCo 376

Treatment No.	Treatments	EWRS rating			
		Months after spray			
		1,0		2,5	
		N55/805	NCo 376	N55/805	NCo 376
1	Roundup 10 ℓ/ha TK5	4	6	6,7	6,7
2	Roundup 6 ℓ/ha TK5	3,3	4	4,3	5,5
3	Roundup 6 ℓ/ha 8004-E	3,5	6,7	6,5	7
4	Roundup 4 ℓ/ha 8004-E	4	4,7	5,7	6
5	Roundup 6 ℓ/ha D5	3,7	5	5,3	6,5
6	Roundup 6 ℓ/ha Micron Herbi.	4	6	5,5	6,3
7	Roundup 6 plus Actipron Super 20% V/V Micron Herbi	3,3	4,5	4,8	5
8	Paraquat 3 + 3 + 3 + 3 + 3 TK5	5,5	5,8	3	2,8

Discussion

Rates

Results have confirmed past findings that 10 litres of Roundup per hectare is the most suitable rate for killing sugarcane. Rates of six litres per hectare are too low unless applied under ideal conditions or as a band application in situations where good coverage is possible. Eight litres per hectare are adequate in most situations provided good follow up operations are carried out to eradicate surviving stools. The rate chosen should depend on the costs of removing volunteers and regrowth.

Methods of application

Low volume applications with the Micron Herbi and motorised knapsack sprayers were superior to conventional high volume applications, although the differences were small. The improvement would probably not warrant the purchase of such equipment specifically for cane killing. Band sprays on the cane row only were also superior to conventional applications with floodjets when the coverage was adequate. Nozzles such as the 8003-E and 8004-E however, were generally unable to cope with the uneven row widths often occurring in fields due to be ploughed out. The effectivesness of the D5 floodjet was similar to that of the TK5 floodjet, while the ICI yellow polijet gave too narrow a swath width and inadequate coverage. The use of three 8003-E fanjets situated at each side and over the top of the cane row would be difficult to position correctly and the application would be poor when uneven row widths occur. Coverage of the target plant has been shown to be an important factor in the control of *Cynodon dactylon*, although it is not so critical at high rates of Roundup (Fernandez and Bayer[3]).

Additives

The addition of five kilograms of ammonium sulphate per hectare improved the efficacy of Roundup slightly in these experiments. Suwunnamek and Parker[6] showed that the effects of Roundup on *Cyperus rotundus* were improved by the addition of ammonium sulphate in pot trials, but this has been diffcult to reproduce in the field. Work with other weed species has shown more variable results (Parker[5]). Actipron Super decreased the efficacy of Roundup slightly in two experiments but increased the effects in a third experiment. Tests were conducted with both high and low volume. The reasons for this variable effect are not clear.

Disturbance of growth after application

Removing the sugarcane foliage after spraying or trampling the treated cane rows soon after spraying both reduced very slightly the effect of Roundup. In both cases Roundup was used at an adequate rate, and the effects of disturbance after treatment could depend on the rate of Roundup. Thus it may be possible that at marginal rates (ie 6 litres per hectare) the effects of foliage disturbance after treatment may be significant. Further work is required to confirm this.

Dew

Dew on the sugarcane foliage at the time of spraying had no adverse effects on the efficacy of Roundup application. Again, such effects are most likely to occur when marginal rates of Roundup are used. Rainfall within eight hours after application has been shown to affect markedly the ability of Roundup to kill plants (Anon[1], Baird and Begeman[2]). Light applications of water which do not result in runoff actually improved the effect of Roundup in pot experiments (Anon[1]).

Varietal susceptibility

Past results have shown that varieties differ in their susceptibility to Roundup (Iggo[4]). This was confirmed in the three experiments reported here. It was found, however, that the rate of development of symptoms did not correlate well with the final effects. Variety NCo 310 developed symptoms slowly after spraying compared with NCo 376, but the kill was similar for both varieties. Of the varieties tested NCo 293 was more resistant than other varieties and N55/805 was more difficult to kill than NCo 376. N6 was the most susceptible variety in Experiment VII.

Soil type

As Roundup is inactivated in the soil and has no residual action it could be assumed that the efficacy of Roundup would be the same on cane grown on different soil types. In two instances in the experiments reported here, cane growing on light soils was more affected than cane growing on heavy soils. On one occasion the cane growing on heavy and light soils was sprayed on the same day. Cane growth was very slightly more advanced on the heavy soil, but in spite of this the better kill achieved on the light soil was considered to be due mainly to the effect of soil type.

Seasons

Winter applications of Roundup had been shown to be comparatively ineffective on sugarcane (Iggo[4]). Results from spraying in winter were again definitely inferior to those obtained from summer spraying.

Stage of growth

Cane was killed most easily when the height of the leaf canopy was between 0,4 m and 0,75 m. Possibly the leaf area is too small and the number of tillers are too low in the shorter cane, while the leaf area is too great for adequate coverage when the cane is taller. Cane also appears more difficult to kill once some stalk has been produced.

Coverage

Assuming cane is at the correct stage of growth and is growing vigorously, coverage appears to be the single most important factor in achieving an adequate kill. Methods of application are only effective if they are able to distribute the chemical over more shoots.

Conclusion

It is now well established that certain conditions are essential for an acceptable cane kill due to treatment with Roundup. These are : active cane growth, a suitable growth stage, and a minimum rate of Roundup per hectare. Many other factors may influence the efficacy to some extent. These are : additives, soil type, cane variety and method of application. Other factors such as disturbance after application and dew covered foliage at the time of application showed very little effect in these experiments under ideal conditions. Their effects under less suitable conditions need to be investigated.

The most promising means of reducing the rate of Roundup required is by using alternative methods of application. These should provide adequate coverage with less wastage of the chemical on non-target areas. No method tested in the experiments reported here met these requirements. Using the present conventional method of overall application with floodjets, the rates could be lowered under ideal conditions depending on the cost of removing volunteers.

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