BUREAU OF SUGAR EXPERIMENT STATIONS
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STOOL ERADICATION USING MINIMUM TILLAGE OR GLYPHOSATE AND ASSOCIATED PLANTING METHODS

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ABSTRACT

Research designed to establish practical techniques for stool destruction at the end of a crop's cycle is described.

Trials conducted at the Tully Sugar Experiment Station during 1982 and 1983 have shown that glyphosate (Roundup®) can kill sugarcane. The effects of various rates and methods of application of Roundup on eight varieties at four stages of growth are outlined.

Cane planted by four different methods following minimum tillage operations in a trash blanket had a high percentage germination. Shoot and stalk counts at different stages of growth are tabulated.

1. INTRODUCTION

Investigations during recent years into minimum tillage practices and trash conservation farming in the sugar industry have dealt with the ratooning phase of operations. Research conducted at the Tully Sugar Experiment Station in 1982 and 1983 was designed to investigate the practicality of minimum tillage in the planting phase of farming operations.

Two forms of minimum tillage tools were investigated:

(i) mechanical stool destruction by rotary hoe
(ii) chemical stool destruction using Roundup

The use of Roundup is considered more applicable when the block is to be fallowed (Turner, 1980), whilst mechanical destruction is most suitable for the ploughout/replant situation (Iggo, 1974).

The results of stool eradication using mechanical and chemical means, and methods of planting following minimum tillage are presented in this report.

2. MECHANICAL STOOL DESTRUCTION AND PLANTING METHODS

2.1 Experimental Details

A field experiment was conducted in a green cane harvested block on Tully Sugar Experiment Station where the ratoon stool of Q90 was turned out with two passes of a rotary hoe. The rotary hoe strips were 850 mm wide and 150 to 200 mm deep. The test soil was sandy loam in texture. The rotor speed of the rotary hoe was set at 137 $r.min^{-1}$ with a forward speed of 2.6 km/h. Cane was planted 16th September, 1982, three weeks after cultivation, during which time 86 mm of rain fell. Four different planting methods were used.

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Method A - Planted conventionally; depth of planting was 175 mm with 20 mm of cover over setts after rolling.

Method B - Planter with mouldboards removed was raised 25 mm from conventional position; depth of planting was 150 mm with 60 mm of cover over setts.

Method C - As per method B but with furrow filled in at planting; 150 mm of cover over setts.

Method D - Flat planting by hand; depth of planting was 50 mm.

There were slight variations in Method D. In addition to Q90; Q107 was planted to enable a comparison of these varieties anchorage characteristics when planted very close to the surface. The two varieties planted by this method were separated into two sections. The soil covering the setts was left loose in D(i) and (ii) whilst in D(iii) and (iv) the soil was lightly pressed.

The percentage germination was assessed by observing the number of gaps in the cane row. Each metre of row without any shoots was considered as one gap and each additional adjoining half metre without shoots was also termed one gap. Hence the equation:

$$\text{Percent germination} = 100 - \frac{\text{total gaps over 100 metres}}{2}$$

2.2 Results and Discussion

The operation by the rotary hoe was very effective in destroying the cane stool and excellent results were achieved with very few volunteers germinating. Most of the "chopped-up" stool was left at the surface to dry out, by having the back flap of the hoe partly raised.

Shoot counts were conducted between October and April. The count expressed per 10 metres is shown in Table I. There was a 100 percent germination of setts following each planting method except for Method B where the germination was 92 percent.

As only 24 mm of rain fell during the nine weeks after planting, the setts that were planted conventionally, as per Method A, suffered the least moisture stress.

TABLE I

Shoot count at various growth stages of cane planted by different methods (shoots/10 m)

Date of shoot count	Planting method and cane used						
	A Q90	B Q90	C Q90	D(i) Q90	D(ii) Q107	D(iii) Q90	D(iv) Q107
15 Oct. 82	36	28	20	39	13	40	16
16 Dec. 82	108	58	58	78	44	102	86
3 Feb. 83	133	107	105	80	83	117	124
19 Apr. 83	122	106	105	99	76	98	99

Note: The soil over the setts in treatments D(iii) and D(iv) was lightly pressed, whilst treatment A was rolled with a tractor. All remaining treatments received no rolling of the soil.

The results shown in Table I, were obtained under dry conditions. Measuring the possible benefit from "flat" planting under water logged conditions was not possible. Some benefit from rolling or lightly pressing of the soil was apparent when initial shoot counts were made. This was possibly due to an increased soil/sett contact area and associated moisture benefit. The degree of anchorage of varieties Q90 and Q107 when planted close to the surface appeared similar to Q90 planted at depth.

3. STOOL DESTRUCTION USING ROUNDUP

3.1. Experimental Details

Treatments were structured not only to test the efficacy of Roundup in killing a number of varieties out also the influence of crop size on its effectiveness. Spray and wick application techniques were also tested.

Assessment of the efficacy of the chemical was made by noting the number of dead shoots and stools in a plot as well as the total number. Cane harvested at three different times during the season (E-early, M-mid and L-late) was treated in December and some cane harvested late was treated in January, (G). This enabled an assessment of the effect of the chemical at different stages of growth, Table II.

TABLE II

Harvest date	Application date	No. of unfurled leaves
E - 6 July 1982	15 Dec. 1982	10-11
M - 28 Sept. 1982	15 Dec. 1982	8- 9
L - 9 Nov. 1982	15 Dec. 1982	5- 6
G - 9 Nov. 1982	7 Jan. 1983	7- 8

Varieties Q77, Q90 and Q107 were selected for testing as these have major differences in their stool characteristics. However some information from an additional five varieties was also acquired.

Three spray and two wick wiped treatments were incorporated in the experiment. In the spray treatments a one metre wide band was sprayed over the 12 metre long plots. For the early, mid and late season harvested cane treated on 15th December, a lever operated knapsack was used. Two 8003 Teejet nozzles were fitted and operated at 220 kPa to discharge 636 ml of solution in 18 seconds (3.6 km/h). On the 7th January, two 8002 Teejet nozzles were used and were operated at 400 kPa. Applications of six, eight and 10 litres per sprayed hectare were made to the various varieties at the different growth stages.

For the two wick wiped treatments a straight, rope wick applicator was used to apply the 30 percent solution. The wiper was set at 230 mm above the ground when wiping the ratoons of the early and mid season harvested cane and 120 mm above the ground for the late harvested plots. A tractor speed of 1 km/h was used when wiping the ratoons.

The treatments and number of plots of each treatment are detailed in Table III.

TABLE III

Number of plots of each treatment at different growth stages for each of the eight varieties tested

Variety	Spray			Rope wick applicator	
	10 L.ha^{-1}	8 L.ha^{-1}	6 L.ha^{-1}	30% soln - 2 passes	30% soln - 1 pass
Q77	2E,2M,2L,2G	2M,1L,2G	2M,1L,2G	2E,2M,2L,2G	2M,1G
Q90	2E,2M,2L,2G	2M,1L,2G	2M,1L,2G	2E,2M,2L,2G	2M,1G
Q107	2E,2M,2L,2G	2M,1L,2G	2M,1L,2G	2E,2M,2L,2G	2M,1G
Q78	1M			1E,1M,2L,2G	1M,1G
Q82	1M			1E,1M,2L,2G	1M,1G
Q91	1M			1E,1M,2L,2G	1M,1G
Q99	1M			1E,1M,2L,2G	1M,1G
Q100	1M			1E,1M,2L,2G	1M,1G

Note: E, M and L = Early, mid and late season harvest treated 15th December, 1982.
G = Late season harvest treated 7th January 1983.
1,2 = Number of plots treated.

3.2 Results and Discussion

Very little rain fell following ratooning and when application of Roundup was made in December, the cane plants were suffering from moisture stress. This was not the case for the January application as rain fell a few days before the treatments were applied. The monthly rainfall figures are given in Table IV.

TABLE IV

Monthly rainfall data for Tully Sugar Experiment Station during 1982/83 compared with long term average rainfall for Tully

Month	Rainfall (mm)	Long term average
July 82	36	158
Aug.	112	135
Sept.	59	127
Oct.	8	105
Nov.	57	155
Dec.	80	250
Jan. 83	107	673
Feb.	119	724
Mar.	944	712
Apr.	259	444

TABLE V

Percent shoot kill for various applications of Roundup $\frac{(\text{dead \\% x } 100)}{((\text{dead + live})\%)}$

Growth stage	Variety	5/1/83					3/2/83					4/3/83					19/4/83				
		A	B	C	W	X	A	B	C	W	X	A	B	C	W	X	A	B	C	W	X
E	Q77	48	-	-	-	65	73	-	-	-	73	85	-	-	-	70	93	-	-	-	63
	Q90	58	-	-	-	68	83	-	-	-	80	93	-	-	-	83	98	-	-	-	88
	Q107	65	-	-	-	68	80	-	-	-	73	80	-	-	-	65	83	-	-	-	63
M	Q77	60	60	55	53	70	75	85	83	60	68	78	85	85	50	45	85	95	90	60	50
	Q90	58	60	38	58	73	85	90	78	65	78	98	95	85	48	73	96	100	93	53	78
	Q107	73	65	63	60	75	85	73	78	55	75	80	75	80	40	55	83	80	78	40	58
L	Q77	50	40	40	-	73	70	50	70	-	80	63	40	60	-	55	78	60	80	-	65
	Q90	83	80	70	-	90	90	85	85	-	88	95	100	90	-	75	98	100	90	-	73
	Q107	70	50	65	-	70	73	60	73	-	68	55	20	45	-	35	65	55	60	-	40
G	Q77						80	70	60	45	80	83	80	78	25	70	93	90	93	40	75
	Q90						78	73	70	50	88	98	98	98	45	95	100	98	100	50	98
	Q107						75	73	60	50	68	78	75	73	30	65	90	88	78	45	78
M	Q78	90	-	-	60	85	100	-	-	70	85	100	-	-	70	75	100	-	-	80	85
	Q82	75	-	-	65	90	80	-	-	75	85	95	-	-	55	75	95	-	-	60	80
	Q91	75	-	-	60	80	95	-	-	60	85	95	-	-	60	65	100	-	-	65	75
	Q99	75	-	-	55	85	95	-	-	70	90	95	-	-	75	75	100	-	-	80	85
	Q100	70	-	-	45	85	80	-	-	55	85	95	-	-	40	75	90	-	-	90	80

Notes:
1. Key to growth stage outlined in Table II.
2. Treatment : Description
   - A : Spray 10 $L.ha^{-1}$
   - B : Spray 8 $L.ha^{-1}$
   - C : Spray 6 $L.ha^{-1}$
   - W : Wipe 30% soln - 1 pass at 0.9 km/h
   - X : Wipe 30% soln - 2 passes at 0.9km/h in opposite directions

The effect of the chemical on the plants was observed six to 10 days after application, with death in some shoots occurring within two weeks. Root and stool rot began six to eight weeks after treatment. The per cent shoot kill for the various treatments is given in Table V.

The per cent stool kill was similar to the per cent shoot kill. Assessment of the per cent kill showed that this fluctuated within plots through the season. This was due to shoots, that appeared from below ground after the first assessment date. Some of these shoots withered and died whilst others remained green. Some leaves that were scorched when the chemical was applied remained partly alive.

Six of the varieties tested were highly susceptible to an application of 10 $L.ha^{-1}$. The remaining two varieties Q77 and Q107 were less susceptible. At all growth stages and spray rates, Q90 was very susceptible and for the remaining varieties the difference in effectiveness of the various spray rates was not greater than 20 per cent.

The straight pipe ropewick applicator used in the trial did not produce good results in the December treated plots which were suffering from moisture stress. The effectiveness of the applicator seemed high, as indicated by the earlier assessments, however shoots growing below the ground at the time of application, came away resulting in a lower March rating. Wiping in one direction was 20 per cent less effective than when two passes were made.

4. CONCLUSION

A 850 mm wide strip cultivated to a depth of 150 to 200 mm allows cane setts to be planted conventionally. A strip of narrower width may be practical and cane may be planted in a near conventional manner without major modifications to the planter being required.

Ratooning stools of Q90 were totally destroyed by mechanical means and also by the most effective treatments in the chemical trials. The minimum growth stages at which various rates of Roundup were found more than 90 per cent effective are shown in Table VI, for moisture stressed and unstressed cane.

TABLE VI

Effective rates of Roundup

Variety	Stressed condition		Unstressed condition	
	Effective rate $L.ha^{-1}$	No. of unfurled leaves	Effective rate $L.ha^{-1}$	No. of unfurled leaves
Q77	10	10	6	7
Q78	8	5		
Q82	10	8		
Q90	6	5	6	7
Q91	8	8		
Q99	8	8		
Q100	10	8		
Q107	10	10	10	7

An assessment of the treated, moisture stressed cane showed the early and mid season harvested plots were more susceptible than cane harvested last.

Roundup rates of less than 6 $L.ha^{-1}$ may prove highly effective for Q78, Q82, Q90, Q91, Q99 and Q100 at the six leaf stage, should the chemical be applied when the plants are not suffering from any moisture stress. The lowest effective rates determined in this trial are to be used in future research when assessing the practicalities of planting in the old interspace.

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