

**BUREAU OF SUGAR EXPERIMENT STATIONS
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**THE EVALUATION OF ROPE-WICK APPLICATION OF GLYPHOSATE
AS A METHOD OF CHEMICAL WEED CONTROL
IN SOME TYPICAL FARM LOCATIONS**

by

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SUMMARY

The effectiveness of rope-wick application of glyphosate (as Roundup®) in controlling the common reed Phragmites australis in the Moreton and Rocky Point areas has fostered interest in this method of chemical weed control for general farm use. Further incentive to investigate this potential was provided by reported savings of chemical costs when compared to spray application, and the absence of associated drift problems with non-target species.

In-crop application was estimated to be the area of greatest extra potential for rope-wick technology. Since application in the interspace between sugarcane rows would provide a critical testing situation for general farm application, inter-row strip trials were conducted in growing crops on four sites with an applicator developed specifically for that purpose. Additionally, a trial conducted concurrently with the project has resulted in a more precise evaluation of control of the common reed by the rope-wick method.

Results of the strip trials have demonstrated control of seven major weed species: green summer grass (Brachiaria milliformis), red Natal grass (Rhynchelytrum repens), crowfoot (Eluesine indica), swamp sedge (Cyperus sp.), thick head (Crassocephalum crepidioides), blue top (Ageratum sp.) and sida retusa (Sida rhombifolia).

Given the known reaction of many other weed species to glyphosate, these results indicate that control of a broad spectrum of common weed species could be expected in the interspace.

Herbicide application rates were found to approximate 3 L/ha Roundup®, which represents a 50-66% saving when compared to recommended rates for spray application.

No damage was noted to sugarcane in any of the trials.

In the trial against the common reed, tissue sampling data derived pre- and post-treatment has confirmed the effectiveness of rope-wick application to this species and has indicated that, on average, an 80-90% reduction of reed could be expected in the crop following the one in which rope-wick treatment with glyphosate was carried out.

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REVIEW

Worldwide, effective control of several major weed species by rope-wick herbicide application has been recorded. For example, Wills and McWhorter (1981) found this method to be highly effective against Johnson grass (Sorghum halepense), Messersmith and Lym (1981) recorded effective control of leafy spurge (Euphorbia escula L) with glyphosate and picloram and also noted a reduction in herbicide usage of 75-80% when compared to broadcast spray application rates, and Dale (1979) also achieved excellent control of Johnson grass and broadleaf weeds with picloram and glyphosate.

Excellent control of P. australis was demonstrated in a series of BSES observation trials at Moreton and Rocky Point Mill areas during 1980-82 when a 33% solution of commercial product Roundup® was applied by wicking twice in alternating directions, as suggested by Dale (1979). In several of these trials, including a pilot trial established at Moreton to test control of Paspalum urvillei, control of a number of common weed species in addition to those listed, was indicated. However, the wicking height selected for treatment of reed precluded any real assessment of control of other species.

As grower acceptance of wick application of herbicides increased, reports were made of substantial savings of herbicide application rate. This, and the damage sustained to non-target species, mainly sugarcane, from spray application of Roundup® gave impetus to further investigation of rope-wick technology.

EXPERIMENTAL DETAILS

Trial against the common reed (P. australis)

A randomised block design was used in this replicated trial established in lush, dense reed approximately 1.1 m high in a ratooning field destined for ploughout. Plots were 30 m x 12 m to conform with the dimensions of the application equipment, a 6 m Winstone rope-wick boom, and to enhance even application of the herbicide. Three replicates were possible.

The wicking height was set at 0.75 m above-ground resulting in approximately the top one-third of the reed being treated. Treatments included one pass, two passes, three passes and an untreated control. Multi-wicked treatments were carried out in alternating directions, one pass following immediately the other(s).

Speed of application was 3.5 km/hr and herbicide use was estimated at 2.8 L/ha Roundup®.

Representative above-ground tissue samples were collected immediately prior to treatment and again in the subsequent regeneration of reed which commenced 11 months later. This time elapse occurred as the field concerned was ploughed out

in March 1983 (three months post-treatment), fallowed, and planted in September of that year. Significant reed growth was noted by November 1983 and regeneration was judged to be complete by late January 1984 when resampling occurred.

Strip trials

Four replicated strip trials were established in growing cane of the varieties NCo310, H48-3166 and other mixed varieties. In three trials, cane had reached the boom growth stage but in trial IV growth was retarded and the area over-run by weeds.

Weed growth was treated in the interspaces with an inter-row applicator. As no suitable inter-row apparatus was available commercially it was necessary to first develop such a unit, and this was achieved by modification of an applicator employed in cotton growing areas. The applicator which evolved consisted of a front-mounted boom to which three pipe-wick assemblies were positioned in vertical tandem on a 30° quadrant mounting on a Pasquali 930 inter-row tractor. Photos of the unit are included in the appendices.

Treatments consisted of one pass only with a 33% Roundup solution and untreated controls, replicated four times. Four to six interspaces were included in each treatment.

Ciba Geigy red marker dye was added to the wicking solution to allow observation of wicking efficiency. Herbicide usage rates were measured in two trials, and estimated in the remaining two trials.

Weed species present were recorded prior to treatment and an abundance rating given to each species on a plot basis. A scale of 1 (very rare) to 8 (very abundant) as used by Rochecouste (1967) was adopted for this purpose.

Effectiveness of treatment of each species was scored visually using the European Weeds Research Council (EWRC) scale as described below, at two to three weekly intervals commencing one month after application, until the treatment effect was judged to be complete. Only the effect on weeds actually treated was rated; no allowance was made for 'new' growth although this was recorded in some instances with Ageratum species.

The EWRC scale was taken from Guidelines for Field Evaluation of Herbicides (1979) and is as follows:

EWRC Score	1	2	3	4	5	6	7	8	9
Per cent control	100	99.9	97.9	94.9	89.9	81.9	69.9	54.9	29.9
		-98	-95	-90	-89	-70	-65	-30	-0

RESULTS AND DISCUSSION

Reed trial

A slow reaction to treatment of reed was observed. Within two weeks of application, however, a significant amount of death of treated shoots had occurred and cessation of growth occurred five weeks post-treatment.

Chlorosis, and eventual necrosis, of above-ground reed tissue developed so slowly that even 11 weeks after treatment, no individual treatment indicated better than 70% overall control. A visual evaluation which considered terminal death, growth cessation, leaf and stalk death was carried out at this time. This favoured multiple wickings, especially the three pass treatment in which competition from reed on the cane crop was substantially reduced and the cane appeared to be making satisfactory progress. Visual ratings made at this time are included in Appendix 1b.

The slow reaction described above compared closely with that observed in several of the 1980-82 BSES observation trials and a number of commercial applications carried out during that period. The abnormally dry weather which prevailed in early 1983 probably contributed to this slow reaction.

Evaluation of the effect of treatment was made in the following reed regeneration which commenced in October 1983. The trial area had been subjected to fallowing, planting, and the usual cultivation practices, in the intervening period.

The effect of treatment on population density of regenerating reed was discernible immediately regeneration commenced. The reed was allowed to regenerate fully before sampling again took place on 2.2.84.

A summary of tissue sampling data which include green sample weights and oven-dry sample weights is shown in Table 1. It clearly demonstrates the dramatic effect of rope-wick application of Roundup® on the regeneration population of reed. Statistical analyses have shown that, for green weight, the difference between treated and untreated plots was significant at the one per cent level, and for dry weight, the difference was close to the one per cent level of significance.

Table 1
Plot sample weights for estimation of reed regeneration
B. & S. Radic, Coolum

Treatment	Green weights			Oven-dry weights		
	Pre-applic.	Post-applic.	% Change	Pre-applic.	Post-applic.	% Change
1-1 pass	3 183 g	206 g	- 93.5	1 281 g	66 g	- 94.8
2-2 passes	4 953	448	- 91.0	2 132	144	- 93.3
3-3 passes	4 663	324	- 93.0	1 838	102	- 94.4
Control - nil	4 287	4 204	- 2.0	1 719	1 440	- 16.2

Unfortunately, the data did not differentiate between individual treatments despite the visual differences previously indicated (Appendix 1b). It would appear, therefore, that any advantage gained from multiple pass treatment would relate more to cessation of existing reed growth rather than to a reduction in regenerated reed density. Should only the latter type of control be envisaged, then the single pass treatment, and thus lower rate treatment, should suffice. Apart from this matter, the results confirm those observed in the previous observation trials.

Strip trials

Weed infestations in the four sites selected were considered typical for the Moreton Mill area and ranged from very dense (two trials) to moderately dense (two trials).

Two weed species - green summer grass and blue top - were abundant in all trials; seven species were sufficiently common within specific trials to allow a valid evaluation of their reaction to rope-wick application.

A summary of EWRC ratings applied to those seven species is shown in Table 2. Relevant plot records are included in Appendix 2.

As the EWRC rating system sets an arbitrary efficacy limit between scores four and five, it is noted that all species listed were effectively controlled. Only in trial IV (Mantyla) were EWRC scores above the arbitrary limit for two species - swamp sedge and blue top. This trial was heavily weed infested, the crop was poorly grown and remained completely open throughout the trial period. As a result, the rating of treatment effects was difficult due to continual regeneration of those two species.

Table 2
EWRC scores for inter-row strip trials

Weed species	Trial I*	Trial II ⁺	Trial III ⁺	Trial IV ⁺
Red Natal grass	3	-	-	-
Crowsfoot grass	4	-	4	-
Summer grass	2	3	3	5
Swamp sedge	-	-	4	6
Blue top	3	4	5	7
Thick head	3	3	-	-
Sida retusa	3	-	-	-

* 66 days

+ 44-49 days

In assessing efficacy of treatment, however, weed abundance both within trials and overall, should be considered. Thus, treatment can be considered most efficient against those species with high abundance ratings and low EWRC scores viz. red Natal grass, crowsfoot grass, green summer grass and blue top.

As these trials were scored on a knockdown effect only, no assessment of overall longevity of weed control was contemplated. However, new generations of two species - blue top and thick head - occurred in three of the four trials and some assessment of control longevity was possible. EWRC scores increased to 8 and 6 respectively in these species at termination of scoring at 46 and 66 days, indicating that as with spray application timing of wick treatment relative to stage of weed growth could be critical.

Rate of application was measured in two trials (I and II), and estimated in the remaining two (III and IV). It was found that 2.2 L/ha Roundup® had been applied where weed density was medium, increasing to 2.96 L/ha in high weed density. Application rate approximated 3 L/ha Roundup® in the two trials where an estimate only of application rate was possible.

CONCLUSIONS

- (a) It was confirmed that cessation of growth of the common reed can be achieved by rope-wick application of a 33% solution of Roundup® in water.

However, death of above-ground tissue may be slow and may not appear complete despite the apparent degradation of reed.

- (b) Following such treatment a considerable reduction in the regeneration population of a reed infestation is likely. Comparative sampling of pre- and post-treatment reed populations has indicated the reduction could be in the order of 80-90% in the first regenerating reed crop.
- (c) Effective inter-row control of existing weed growth of seven common weed species by rope-wick application of a 33% solution of Roundup® in water, is possible.
- (d) Rope-wick treatment is possible in growing sugarcane both inter-row and over-the-row, without damage to the cane crop.
- (e) Given the known reaction to Roundup® of many weed species found in sugarcane crops, it could be expected that broad spectrum weed control would be attainable by the rope-wick method of application of this herbicide.
- (f) When compared to recommended spraying techniques, a very significant reduction in Roundup® application rates should occur where the rope-wick method is adopted. Even in dense weeds stands rates should not exceed 3 L/ha Roundup®. This represents a saving of from 50 to 66% of spray application rates.
- (g) The trials have demonstrated considerable potential for the rope-wick method of application of Roundup®. Such potential deserves further investigation, which could be extended to include (a) the testing of various dilution rates of Roundup® with the view of increased treatment economy, (b) the use of other systemic herbicides, and (c) the control of sparse populations of weeds where conventional spray application would be wasteful and costly.

RECOMMENDATIONS

In consideration of the above conclusions the following recommendations are made:

- (a) The current recommendation for treatment of the common reed as outlined in BSES publication 84A, i.e. two passes in alternate directions with a 33% solution of Roundup® in water, remain unaltered.
- (b) Where treatment of weed growth in the interspace is judged to be warranted, one pass only of a suitably shielded inter-row applicator which would apply a 33% solution of Roundup® in water at a time when maximum control of the existing weed growth could be expected, is recommended.
- (c) Further investigation of rope-wick technology should be directed against weed species, or to situations, where contact application of a non-selective herbicide is desirable, and/or to where there exists significant potential for application rate economics and/or a lessening of drift problems. Typical examples could include inter-row application in blocks where trash conservation is practiced, and the control of tall erect weed species or weed infestations with minimum ground cover.

REFERENCES

- Aust. Weeds Committee (1979). Guidelines for field evaluation of herbicides, Aust. Govt. Pub. Service, Canberra. A1/3.
- Dale, J.E. (1979). Application of equipment for Roundup - The rope-wick applicator. Beltwide Cotton Prod. Conf. 3rd Cotton Weed Science Res. Conf. Phoenix, Az. 138.
- Messersmith, C.G. & Lym, R.G. (1981). Roller and wick application of Picloram for leafy spurge control. Down to Earth, 37, 9-12.
- Rochecouste, E. (1967). Weed control in sugar cane, Mauritius Sugar Ind. Res. Inst. 45.
- Wills, G.D. & McWhorter, C.G. (1981). Developments in post emergence herbicide applicators. Weed Science, 337.

Appendix 1

Rope-wick application of Roundup® to common reed
B. & S. Radic, Coolum

Application date: 25.11.82

Remarks at application: Reed very dense, approximately 1.3 m high, lush.
Cane approximately .6 m high, completely dominated by reed.(a) Table of green and oven dry sample weights

GREEN WEIGHTS

Treatment	Replicate	Pre-treatment sampled 24.11.82	Post-treatment sampled 2.2.84	Per cent change
1 pass	1	3 240.00 g	368.00 g	
	2	2 530.00 g	125.00 g	
	3	3 780.00 g	125.00 g	
	Average	3 183.33 g	206.00 g	- 93.5
2 passes	1	4 790.00 g	444.00 g	
	2	5 370.00 g	899.00 g	
	3	4 340.00 g	nil	
	Average	4 953.33 g	447.66 g	- 91.0
3 passes	1	6 160.00 g	126.00 g	
	2	5 450.00 g	669.00 g	
	3	2 380.00 g	178.00 g	
	Average	4 663.33 g	324.33 g	- 93.0
Control	1	4 260.00 g	7 757.00 g	+ 82.1
	2	3 480.00 g	3 019.00 g	- 13.3
	3	5 120.00 g	1 836.00 g	- 64.1
	Average	4 286.60 g	4 204.00 g	- 2.0

OVEN DRY WEIGHTS

1 pass	1	1 254.00 g	116.00 g	
	2	989.00 g	40.00 g	
	3	1 599.00 g	42.00 g	
	Average	1 280.66 g	66.00 g	- 94.8
2 passes	1	1 988.00 g	160.00 g	
	2	2 447.00 g	272.00 g	
	3	1 962.00 g	nil	
	Average	2 132.33 g	144.00 g	- 93.3
3 passes	1	2 433.00 g	39.00 g	
	2	2 136.00 g	209.00 g	
	3	945.00 g	59.00 g	
	Average	1 838.00 g	102.30 g	- 94.4
Control	1	1 666.00 g	2 761.00 g	+ 65.7
	2	1 483.00 g	942.00 g	- 36.5
	3	2 007.00 g	617.00 g	- 69.3
	Average	1 718.60 g	1 440.00 g	- 16.2

(b) Arbitrary visual control ratings (0 - nil control, 100 - death)

Per cent control

(11 weeks post-treatment)

Treatment	Rep. 1	Rep. 2	Rep. 3	Average
1 pass	33	33	33	33
2 passes	50	50	60	53
3 passes	65	75	65	68
Control	0	0	0	0

Appendix 2a

Inter-row rope-wick application of Roundup®

EWRC scores

TRIAL I W.J. O'Hanlon, Yandina

Date of application: 10.2.84

Remarks: Very dense weed growth across entire interspace and well entrenched in row also. All species in early seeding stage except for blue top. Weed growth to .7 m, lush. Roundup® use measured at 2.96 L/ha.

Variety: NCo310, cane to approximately two metres, lush and out of hand at application.

EWRC SCORES

Species	Rep. I				Rep. II				Rep. III				Rep. IV				Average all Reps. 66 days
	A*	Days			A	Days			A	Days			A	Days			
		31	49	66		31	48	66		31	49	66		31	49	66	
Red Natal grass	7	3	3	2	6	3	3	2	6	3	3	2	7	3	3	3	3
Crowsfoot grass	6	4	3	3	7	3	4	3	7	6	4	4	6	6	4	4	4
Summer grass	6	3	3	2	5	3	3	2	4	3	3	2	4	3	3	2	2
Japanese millet	6	3	3	2	-				-				-				-
Blue top	5	3	3	2 (4)	5 +	3	4	2 (4)	4	3	6	4 (8)	4	3	3	3 (9)	3
Thick head	4	3	3	2 (4)	4	3	3	2 (7)	3	3	6	4 (8)	3	3	3	3 (8)	3
Sida retusa	-				-				3	3	3	2	4	3	3	3	3

A* - Arbitrary abundancy rating scale (after Rochecouste, 1967)

8	Very abundant	4	Fairly frequent
7	Abundant	3	Occasional
6	Common	2	Rare
5	Frequent	1	Very rare

+ () Overall EWRC score including 'new' growth not treated.

Appendix 2b

TRIAL II A. & L.I. Pavan, Bridges

Date of application: 1.3.84

Remarks: Weed growth moderate to .4 m, mainly in interspace. Main species limited to three, flowering commenced but not advanced. Growth lush, ground cover moderate, heavy in patches. Roundup® use measured @ 2.2 L/ha.

Variety: H48-3166, growth to approximately 2.5 metres, out of hand but not yet fully covered in.

Species	A	Days		A	Days		A	Days		A	Days		Days
		25	46		25	46		25	46		25	46	
Summer grass	8	3	2	8	3	3	8	3	2	8	3	2	3
Blue top	8	6	4 (8)	7	4	3 (4)	5	4	3	8	6	3 (4)	4
Thick head	3	3	2	4	4	3	4	4	3	2	?	?	3

TRIAL III P.V. & K.M. Mantyla, The Punt

Date of application: 3.3.84

Remarks: Weed growth light to moderate, mainly in interspace. Growth to approximately .4 m. Summer grass seeding. Roundup® usage estimated at approximately 3 L/ha.

Variety: H48-3166, well grown with fully closed canopy.

EWRC SCORES

Species	A*	Rep. I		Rep. II		Rep. III		Rep. IV		Average all Reps. 44		
		Days		Days		Days		Days				
		31	44	A	31	44	A	31	44	A	-	
Summer grass	8	3	3	8	3	3	5	3	3			3
Crowsfoot grass	3	6	4	3	3	3	6	3	3			4
Swamp sedge	6	6	4	6	3	4	7	3	3			4
Blue top	5	6	6 (8)+	4	6	4 (6)	7	4	4 (8)			5

*A Arbitrary abundancy rating

+ () Overall EWRC score including 'new' growth not treated.

Appendix 2c

TRIAL IV P.V. & K.M. Mantyla, The Punt

Date of application: 3.3.84

Remarks: Weed growth very dense and out of hand to .7 m high, in both interspace and drill. Crop poorly grown and completely open. All species flowering. This trial proved very difficult to score because of continuous regeneration of weed species, particularly blue top. Roundup usage estimated together with trial III at 3 L/ha.

Variety: Mixed varieties, plant, poor growth, open.

Species	A	Days		A	Days		A	Days		A	Days		Days
		31	44		31	44		31	44		31	44	
Summer grass	3	4	3	7	4	3	7	6	6	7	8	7	5
Swamp sedge	8	6	6	7	6	6	7	6	6	7	6	8	6
Blue top	8	8	7	7	6	7	7	6	6	7	6	8	7

Appendix 3a



The front-mounted inter-row rope-wick applicator with shrouds in 'normal' operating position.

Appendix 3b



The 3-tiered pipe-wick assemblies in the 'upright' position adopted for tall dense weed stands.