

COMBINATION TILLAGE: A NEW METHOD OF SUGARCANE ERADICATION

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Abstract

Combination tillage is the name that has been given to a new technique for killing old sugarcane crops before replanting. The crop is first sprayed with either Roundup (glyphosate) or Fusilade Super (fluazifop-p butyl) herbicides, and the cane stool is then sheared mechanically 100-150 mm below ground surface three to seven days after spraying. The cane roots are severed and the stool lifted but not inverted, thus leaving the stool in its original position in the row. The results obtained from detailed observations indicate that, a) sugarcane can be killed earlier in the season and at a younger age than with conventional minimum tillage, thereby allowing earlier planting so that the crop can benefit from the more favourable summer growing conditions; b) acceptable kill of the old cane stools can be achieved, even at rates of chemicals 50 per cent lower than those now recommended for conventional minimum tillage. Further experiments are needed to confirm these findings.

Introduction

This paper reports on field evaluations of a new method of killing sugarcane stools more efficiently. The tests were conducted on the coastal belt in Zululand and the work began as a result of problems following conventional minimum tillage treatments with Roundup, in spring and early summer. Conventional minimum tillage results are variable early in the season and late regrowth often occurs. The problem is worst on heavier more fertile soils, and in particular those that are sprayed between August and November, when weather conditions tend to be variable.

In these areas the procedure currently adopted for the chemical eradication of the old sugarcane crop is first to slash any regrowth that has occurred, removing apical dominance and inducing any latent tillers to germinate and grow more uniformly. The cane is allowed to regrow to about 50 cm, before spraying during the more favourable period of December to March. Unfortunately this leads to a delay in planting and a loss of production during the best growth period of the year.

Combination tillage was developed to overcome these problems and to reduce the amount of chemical used for minimum tillage. Combination tillage allows earlier planting in the season while still retaining the benefits of minimum tillage, namely earlier planting, good soil conservation, easy identification of regrowth from the old crop and control of problem weeds. It is also possible to plant sooner after heavy rain, rather than having to wait much longer when the field has been ploughed.

Combination tillage is a system in which the crop is first sprayed with either Roundup (glyphosate) or Fusilade Super (fluazifop-p butyl) then the cane stool is sheared mechanically 100-150mm below the ground surface three to seven days after spraying. This severs the cane roots and lifts the stool without inverting it, thus leaving the stool in its original position in the row. Both Roundup and Fusilade Super can be used to kill the old cane crop, each chemical having cer-

tain advantages and disadvantages. Fusilade Super is rain-fast within one hour of spraying, compared with 6-8 hours for Roundup, and it is absorbed through roots as well as foliage, enabling it to be used on younger cane than Roundup. However, Fusilade Super has the disadvantage that it does not kill broadleaf weeds or any of the *Cyperus* species.

Materials and Methods

The blade shear implement used in this work is shown in Figure 1. It consists of a tool bar 1,4-2,5 m long (the latter being better in lighter soils) with two depth control wheels. A ripper shank is attached to the tool bar and is fitted with a V-shaped shear and ripper tip, which on the standard machine produces a cut of 1 m underground.

Experimental areas were sprayed with either a 300 l Sprayrite tractor-mounted sprayer operating at a pressure of 250 kPa, or with a CP3 knapsack sprayer with the pressure setting on 30. The tractor spray boom was mounted 1,3 m above ground level at the back of the spray tank and fitted with three Albuz APM blue nozzles positioned directly above the cane rows. The CP3 sprayer was fitted with a TK5 nozzle which was positioned at a height of 1 m above ground level and directly over the cane row.

The chemicals used were Roundup (359 g a.i. glyphosate per litre) and Fusilade Super (125 g a.i. fluazifop-p-butyl per litre). Bladbuff was added to the spray mixtures to adjust the pH of the spray solution to 5,0-6,0 and buffer against any dissolved solids. Roundup is the registered trademark of Monsanto South Africa (Pty) Ltd.; Fusilade Super is the registered trademark of Imperial Chemical Industries PLC and Bladbuff is the registered trademark of Plaaskem (Pty) Ltd.

Treatment effects on ratoon regrowth were assessed using the hoe unit method (Richardson *et al.*, 1985). Ten metre lengths of row were divided into 250 mm sections and the presence or absence of shoot regrowth recorded. The actual number of live shoots was not considered, as the method is intended to assess the number of strikes with a hoe necessary to remove the regrowth. On some occasions when rows were old and wide and the regrowth widely scattered, two hoe units were recorded for one 250 mm section. On this basis it is possible to have regrowth in excess of 100 per cent.

Results

Trial 1

This initial observation trial was conducted in 1989 in the Amatikulu area on heavy soils using a blade plough which moved and inverted the stools. Several rows of sugarcane, giving an area of between 0,5 and 1 ha per plot, received various treatments but there was no replication. Sprayed areas covered a total of 3 ha and the blade ploughed area was 1 ha. Treatments were sprayed on 27 October 1989, blade ploughed one week later and planted the next day. Assessments of regrowth were made on 2 x 10 m lengths of row in each treatment on 12 February 1990, 3,5 months after blade ploughing. The results are presented in Figure 2.

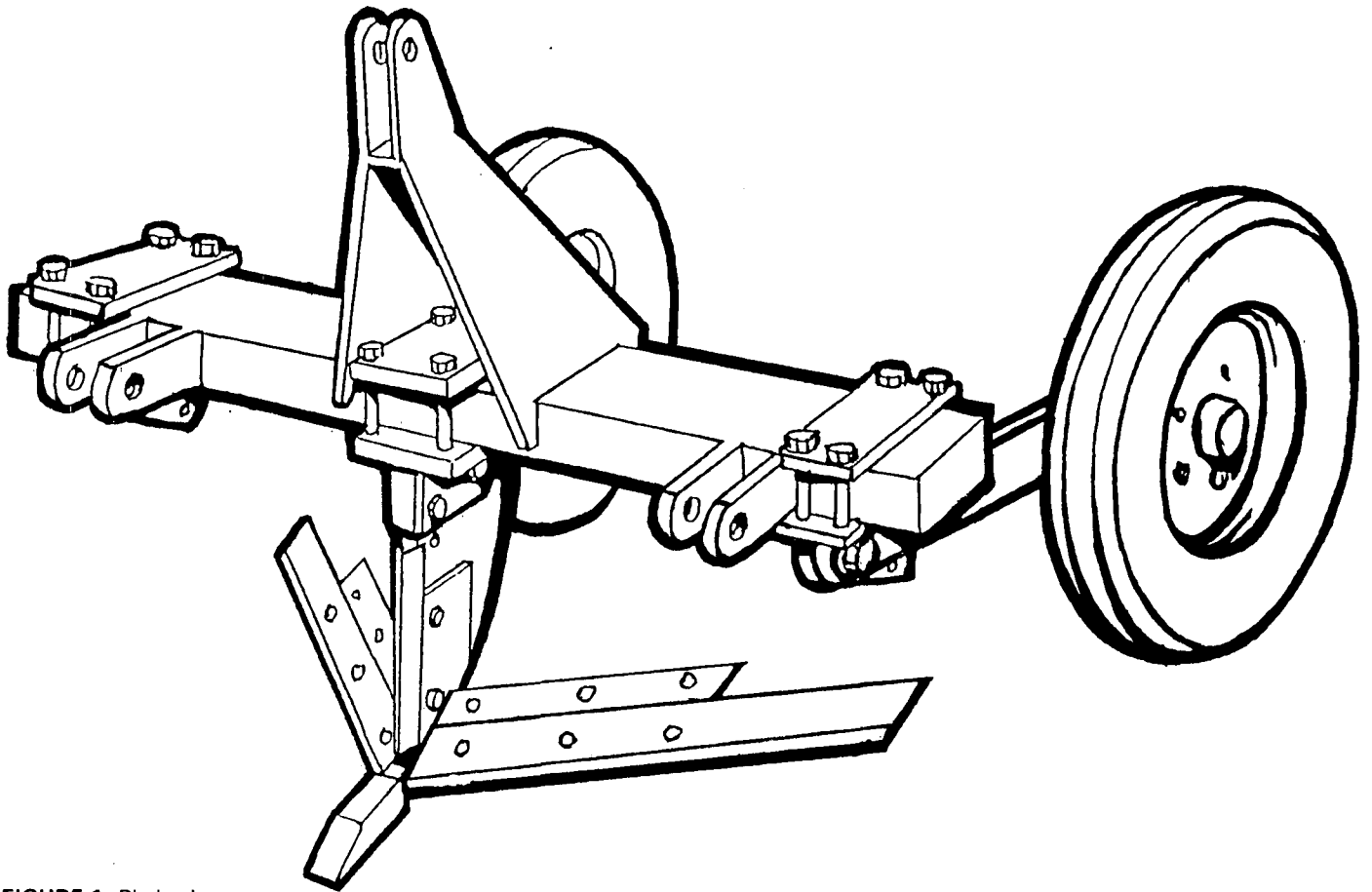


FIGURE 1 Blade shear

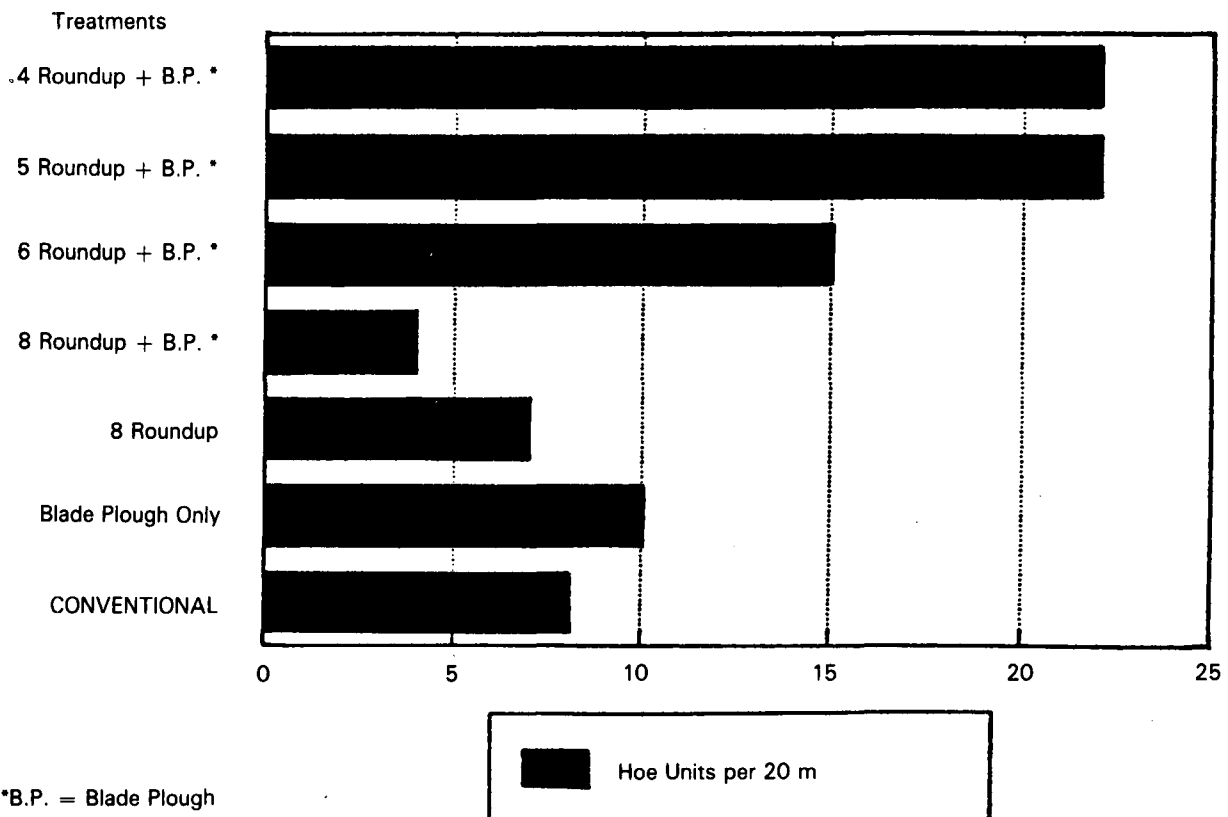


FIGURE 2 Regrowth assessment (Trial 1 – 12/02/90 – 108 D.A.T.)

The results with the blade plough were not particularly encouraging and it was replaced in all further work by the blade shear illustrated in Figure 1. Only 8 l/ha Roundup plus blade ploughing gave acceptable control of regrowth, which was better than either conventional land preparation or blade ploughing alone. The yield from this trial area of 142 tons cane per hectare at 17 months of age was very good, averaging 8,35 tons cane per hectare per month.

The blade plough was not successful because it moved the cane stools, throwing them into the interrow and covering them with soil, thus aiding ratoon regrowth. It was also considered that there would be a greater chance of disease carry over from one crop to the next if the new crop was planted in the row from which the old stools were removed, as was the practice where the blade plough was used. These observations led to the development of the blade shear, designed to shear the roots and leave the cane stools in the original rows. Planting then took place on the interrow as for conventional minimum tillage.

Trial 2

This trial, comparing reduced rates of Roundup and Fusilade Super plus blade shearing with the registered rates of 8 l/ha Roundup and 6 l/ha Fusilade alone, was on the same farm and on similar heavy soils as Trial 1. Between 6 and 10 rows, about 250 m long per treatment, were sprayed on 2 November 1990 and blade sheared on 9 November 1990. The trial was assessed on 30 January 1991, 2,5 months after the shearing operation and thereafter another two assessments were made at monthly intervals, with 2 x 10 m row lengths being assessed per treatment on each occasion. The results of the assessment on 30 January 1991 are presented in Table 1. The results of the other two assessments are not reported, as the volunteers were removed by the grower after each assessment and the regrowth thereafter was insignificant. In the sprayed treatments there could have been further natural mortality of regrowth if the volunteers had not been removed, as seen in the results of Trial 3 (Table 1). The unsprayed lines would also have produced additional regrowth.

Shearing alone was ineffective; other treatments gave good control of regrowth, and there was little difference between Roundup alone at 8 l/ha and rates as low as 4 or 5 l/ha, plus blade shearing (Table 1). Similarly, using lower rates of Fusilade Super plus shearing gave results almost as good as 6 l/ha Fusilade Super alone.

Trial 3

This trial was done on the heavy fertile alluvial soils of the Umhlatuzi flats. Between four and six lines of 100 m per treatment were sprayed on 21 May 1991 and blade sheared a week later. Three assessments on 2 x 10 m row lengths were made at monthly intervals starting on 10 September 1991, 3,5 months after the shearing operation. The regrowth was not removed after the assessments and there was some mortality at the later assessments, particularly where Roundup and Fusilade Super were sprayed alone.

The results of this trial, sprayed at a time of year when minimum tillage is not normally recommended, confirmed those obtained in Trial 2 (Table 1). It was particularly impressive to see how, in combination with shearing, either 4 l/ha Roundup or 3 l/ha Fusilade Super, gave results similar to those from higher rates of chemical application and, in the case of Roundup, gave better results than the registered rate of 8 l/ha sprayed alone.

Commercial observations

As a result of the success of the above observation trials a number of farmers in Zululand tried out the combination tillage system, using various rates of Roundup. A total of 315 hectares were treated, but comparisons with standard methods were not made and not all farmers have yet reported their opinions of the technique. To date there have been no adverse comments and Table 2 summarises the results from 212 ha on those farms for which detailed comments are available.

Results were good, particularly where rates of 8 and 9 l/ha of chemical were applied. On the heavy, fertile soils to which these rates were applied during September and early October, severe regrowth would normally have occurred, had the blade shear not been used. However, the results presented earlier indicate that rates lower than those recommended can be used with combination tillage, and this was confirmed by several growers.

A major advantage of chemically killing old sugarcane crops compared with conventional tillage is the prevention of soil erosion after rain. A site at Brandon Hill in the Empangeni area, which was on a Glenrosa form soil with an average slope of 20 per cent, was chosen to determine any soil erosion effects. Following shearing in mid February 1991, 107 mm rain fell in four days and 317 mm during the next five weeks. There was no soil wash on the field that had been sheared and this was confirmed by the extension officer for the area.

Table 1
Assessment of regrowth in Trials 2 and 3 (hoe units per 20 m row length)

Treatment	Days after treatment			
	Trial 2	Trial 3		
	89	112	154	195
Blade shear only	108	-	-	-
Roundup 8 l/ha	6	94	44	57
Roundup 8 l/ha + blade shear	5	10	6	3
Roundup 5 l/ha + blade shear	3	15	20	23
Roundup 4 l/ha + blade shear	13	10	9	7
Fusilade 6 l/ha	6	22	6	10
Fusilade 6 l/ha + blade shear	1	5	4	2
Fusilade 4 l/ha	29	-	-	-
Fusilade 4,5 l/ha + blade shear	-	4	9	8
Fusilade 4 l/ha + blade shear	13	-	-	-
Fusilade 3 l/ha	50	-	-	-
Fusilade 3 l/ha + blade shear	15	1	0	0

Table 2

Areas treated commercially with the combination tillage method of land preparation in 1991/92

Farm	Hectares treated	Variety	Roundup rate l/ha	Date sprayed
Marsabit	22,1	NCo376/N14/N18	4-6	August 91
UVS	98,7	NCo376/N14 NCo310/N55-805	9	Sept 91
Havelock	10,7	NCo376/N18	4-5	Oct/Nov 91
Ngoye View	16,4	NCo376	8	Oct/Nov 91/Jan 92
Sutherlands	17,5	NCo376/NCo310/N13	5	Oct/Nov 91
Belmont	22,4	NCo376/NCo293/CB36-14	7-8	Nov/Dec 91/Jan/Feb 92
Nelthorpe	10,0	NCo376	5	Oct 91
W & R	12,0	NCo376	8	Sept/Early Oct 91
Brandon Hill	2,5	NCo376	8	January 91

Costs

It is difficult to assess the costs of a new operation accurately until appreciable areas have been treated and detailed costings have been kept. An attempt has been made to estimate costs, based on records kept while treating 98 ha, and these are given in Table 3. SASA Experiment Station standards of costing have been used, so that for comparative purposes they are based on treating 20 ha, using a Ford 6600 tractor.

The cost per hectare of the shearing operation, excluding chemical spraying, was R94,64, compared with R105,00 for slashing sugarcane and R112,00 for ridging. The cost per hectare falls as more hectares are treated and for the shearing operation the cost per hectare would be R75,20 for 40 hectares and R65,61 for 80 hectares.

Table 3

Estimated costs of blade shear treatment (using Ford 6600 tractor and excluding chemical costs)

Cost of stool shear	R4 300,00
Shearing cost per ha over 20 ha *	R 94,64
Shearing cost per ha over 40 ha	R 75,20
Shearing cost per ha over 60 ha	R 69,13
Shearing cost per ha over 80 ha	R 65,61
Shearing cost per ha over 100 ha	R 63,86
Slashing cost per ha over 20 ha *	R 105,00
Ridging cost per ha over 20 ha *	R 112,00

* Based on SASA Experiment Station standard costing methods

Discussion

The greatest advantage of the combination tillage method over present methods of minimum tillage is that it allows the successful treatment of crops earlier in spring. On heavy soils combination tillage is especially beneficial, because it eliminates the need to slash back the old crop to ensure uniform tiller development before spraying. The cost of mechanically shearing stools is faster and cheaper than a slashing operation and indications are that it also results in a better kill of the old crop. It is therefore possible to re-plant earlier, allowing the new crop to take full advantage of summer growing conditions.

The alternatives are to prepare fields conventionally by ploughing out in May/June, or to spray with chemicals in the latter half of the growing season to ensure a good kill (Chedzey and Findlay, 1985). Either way it is more expensive and will take longer before the new crop is planted. Measurements in Trial 1 showed that this can mean a loss of up

to 8 tons of cane per hectare per month. Replanting in early spring can expose fields to the dangers of soil erosion, but there was no indication that combination tillage increased the risk, even when heavy rain followed treatment on a field with an average slope of 20 per cent.

The results obtained indicate that combination tillage gives acceptable control of ratoon regrowth, even at reduced rates of chemical application. However, this must be verified by fully replicated trials. If chemical rates can be lowered it will mean a considerable saving to the sugarcane grower. The choice of chemical and the rate required in combination tillage operations will probably be determined by the weed spectrum expected in the field to be re-established.

Prevention of disease carry over from one crop to the next is also important and combination tillage provides the same advantages as minimum tillage. The new crop can be planted in the interrows of the old crop with minimum chance of re-infection. Any regrowth which may occur is therefore easily identified and its removal requires a minimum of labour and effort, as the shearing operation undercuts the old stools. The indications from the regrowth assessments made and from comments of the co-operating farmers are that combination tillage does a better job of killing the old crop, so reducing further the chance of disease spread.

Another advantage of combination tillage is that by allowing crops to be planted earlier in spring they should reach full canopy before winter and there will be savings in herbicide costs. One long term herbicide with appropriate follow-up treatments should suffice, compared with the more comprehensive measures required for crops planted between February and April that do not canopy before the following spring. There is little doubt that combination tillage represents a substantial improvement over current methods of stool eradication.

Acknowledgments

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REFERENCES

Chedzey, J and Findlay, JBR (1985). An assessment of application techniques for Roundup herbicide for killing sugarcane. *Proc S Afr Sug Technol Ass* 59: 179-185.
 Richardson, FE, Marsh, CM and Jupp, DA (1985). Enhanced efficacy from the addition of the adjuvant Frigate to Roundup for killing sugarcane. *Proc S Afr Sug Technol Ass* 59: 186-189.