THE EFFECTS ON IRRIGATED RATOON CANE OF RIPPING THE INTERROW AFTER HARVEST IN A RANGE OF SOILS IN SWAZILAND

By N. B. LEIBBRANDT

Swaziland Sugar Association, Swaziland

Abstract

Results from nine experiments to test the effects of ripping or chiselling the interrow of irrigated ratoon cane grown on five Swaziland lowveld soils are reported. There were no statistically significant yield benefits from the treatments and in one experiment, deep ripping resulted in a statistically significant yield reduction.

Introduction

The policy on many sugar estates in Swaziland is to rip with tines or chisels the interrows of ratoon cane after each harvest on an annual basis even when soil compaction is not evident. Other reasons given for ripping are to improve the structure of sodic soils, to assist in the reshaping of interrows for surface irrigation, and to facilitate the mounding-up process which improves the efficiency of harvesting machines. Experiments carried out in 1967 to measure the effects of interrow ripping in ratoon cane on a range of soils in the South African sugarbelt indicated that there was generally no yield response to interrow ripping (Moberly[4]). The possibility of increasing yields by ripping or chiselling the soil after irrigated ratoon cane was cut annually in the semi-arid north led to a number of experiments being conducted in Swaziland. The experiments were conducted under average field conditions and were not intended to test responses to ripping under specific harvesting, soil or moisture conditions.

Methods

Experiments were established in fields of ratoon cane of variety NCo 376 on a number of estates with the sites chosen to represent a wide range of important sugar industry soils. Soil series included Rondspring (SA Glendale), Tambankulu, Kwezi (SA Arcadia), Zwide (SA Estcourt) and Homestead (SA Sterkspruit) (Murdoch[5], Macvicar[2]), the latter two being highly susceptible to soil compaction (Moberly[3]). The treatments in all experiments were applied in winter soon after harvesting and prior to the first irrigation of the following ratoon crop. The treatments varied from shallow ripping with tines or chisels to deep ripping with tines. The methods and implements used were the same as those used on the individual estates.

Chisel tine

- Experiments 1 and 3 were conducted in the same field on a Zwide series soil with an 8-tine chisel implement, operating at depths of 150 and 200 mm and drawn by a Ford 4500 tractor. In Experiment 1, chiselling was carried out five weeks after the previous crop was mechanically harvested but in Experiment 3, chiselling was delayed for 11 weeks to determine whether timing of the operation was important. Cane in both experiments was furrow-irrigated and the soil moisture content at the time of chiselling was similar in the two experiments (18 to 20%).
- Experiment 2 was conducted in ratoon cane grown on a deep Rondspring series soil under sprinkler irrigation. Chiselling was done one week after hand harvesting the first crop and four weeks after hand harvesting the second crop. A 6-spring tine chisel cultivator with an operating depth of 300 mm and drawn by a John Deere 3130 tractor was used in both ratoon crops. The chiselling operation was carried out when the soil was dry and hard in both instances. No movement of the cane stool was observed during chiselling because the chisel tines caused very little sideways soil thrust.
- In Experiment 4, a 6-tine chiselling followed a deep ripping operation to reshape the interrows for furrow irrigation, and this treatment was compared with chiselling alone.

Deep ripping

- In Experiment 5, a twin-tine ripper was used to rip the soil in the interrows three weeks after mechanical harvesting. This implement penetrated to a depth of about 550 mm and was drawn by a Case Agri-King tractor fitted with tandem rear wheels. The soil at this site was a shallow Rondspring and the field was irrigated by means of sprinklers. The soil was dry and compacted following mechanical harvesting under wet conditions. The site had been ripped two years earlier. Because the crop was a tenth ratoon, the cane stools were abnormally wide and the ripping operation caused severe damage to the cane row due to excessive soil movement, and emerging shoots were trampled by the tractor tyres. Treatments were applied to the tenth ratoon crop and the effects measured on the tenth, eleventh and twelfth ratoon crops.
- A modified ripper with flanges 150 mm wide welded to the tine tips to increase soil lift was used for deep ripping in Experiment 6. The implement was pulled by a John Deere 3120 tractor and operated at a depth of about 500 mm. The treatments were applied to two successive ratoon crops in heavy Kwezi series soil which was irrigated by sprinklers. The first ripping in this experiment was carried out soon after hand-harvesting the fourth ratoon crop when the moisture content of the surface 200 mm of soil was 26%. The subsoil of these heavy montmorillonitic clay soils rarely dries out sufficiently to cause much disturbance by ripping. On close inspection after the operation the friable soil surface was shattered but despite the additional ripper flanges, the implement had an ineffective slicing action in the subsoil.

Field observation trials

- Experiments 7, 8 and 9 were established on Zwide and Homestead series soils, which were surface irrigated and the crops mechanically harvested. A D5 crawler tractor and ripper was used to rip interrows to a depth of about 400 mm in Experiment 7. A Ford TW20 and an MF248 tractor pulled an ICI Paraplow in Experiments 8 and 9 respectively. The operating depth of the implement ranged between 250 and 300 mm and in both trials the ploughing was carried out within a few weeks of harvesting. The Paraplow experiments were done in both dry and moist soil conditions, with the soil being shattered but not inverted in both instances.

Layout and design

The formal experiments (1 to 6) had six or eight replications in either randomized block or repeated Latin squares design. Net plots comprised three cane rows between 15 and 30 m in length with adequate distance between plots to allow the tractors to reach the requisite operational speeds before entering the net plot areas. In the larger field observational experiments, treatments were applied to alternate strips of cane to simplify mechanical harvesting and loading. In each trial, the interrows in three panels consisting of six cane rows 200 to 230 m in length, were ripped and three panels were left as controls.

Cane in the replicated plot trials was hand-harvested and weighed using a tractor-mounted offset boom and grab. Twelve stalks were taken at random from the net lines of each plot for sucrose determinations.

Results

Soil moisture conditions at the time of chiselling were similar in Experiments 1 and 3, resulting in the same degree of soil shatter. It was observed that roots from the old crop were broken by the chisel. Yields were not significantly affected by the chiselling operation in either trial but they were slightly reduced (ns) when the operation was delayed by 11 weeks after harvesting (Table 1). The successive crops harvested from Experiment 2 gave similar yields, and in neither crop was there a response to deep tine chiselling. The cane in Experiment 4 has still to be harvested but stalk population counts indicate a 6% decrease due to chiselling. Damage to the cane stools by the chisel tine was reduced when the ripper preceded the chiselling, as the channel formed by the ripper prevented excess wandering of the lighter chisel implement.

TABLE 1

Effects on cane yields (tc ha^{-1}) of chiselling the interrow of ratoon cane after harvest

Experiment no	Soil series	Ratoon	Tine depth (cm)	Yields		LSD (tc ha^{-1})
				Control	Chiselled	(P = 0,05)
1	Zwide	2	15–20	120	119	13
2	Rondespring	3	30	141	143	11
		4	30	145	142	15
3	Zwide	2	25–30	124	118	23

In Experiment 5 on the shallow Rondspring series soil, crop growth measurements showed that ripping affected ratooning adversely (Table 2). There was a statistically significant (P = 0,05) yield depression of 14 tc ha^{-1} due to ripping and 2,2 t ha^{-1} loss in sucrose yield (Figure 1). The trial was continued into the eleventh and twelfth ratoons to measure residual treatment effects. Crop growth measurements showed that stalk populations in the eleventh ratoon were still slightly lower in the previously ripped plots. Yields from the eleventh ratoon showed no statistically significant treatment effects and growth measurements in the twelfth ratoon show the persistence of a slight population depression due to ripping (Table 2).

TABLE 2

Short and long term effects on stalk heights and populations of deep ripping the interrow of ratoon cane grown on a shallow Rondspring series soil

Ratoon	Crop age (mths)	Stalk heights (mm to TVD)			Populations (× 1 000 ha^{-1})		
		Control	Ripped	% decrease	Control	Ripped	% decrease
10	7,5	243	229	6	155	133	14
11	2,3	206	203	1	168	156	7
12	5,5	165	165	0	169	156	8

In Experiment 6 on the heavy Kwezi series soil, crop growth measurements and yields (Figure 1) indicated no treatment responses in the first crop (fourth ratoon). The same treatments were applied to the fifth ratoon crop and growth measurements taken at six months of age indicate no treatment effects.

In observational Experiments 7, 8 and 9 on highly compactible duplex soils, neither ripping with tines nor the use of a Paraplow had any beneficial effect on yield (Figure 1). Although yields from both trials appear to be adversely affected by Paraplowing (Figure 1), the results were highly variable.

Discussion

In none of the trials conducted was there a positive response to ripping or chiselling the interrow of irrigated, winter-cut ratoon cane. Deep ripping of older ratoons under dry conditions led to excessive root and stool damage resulting in yield loss. The opinion held by some that benefits from ripping are only perceived in subsequent ratoons was not corroborated in this

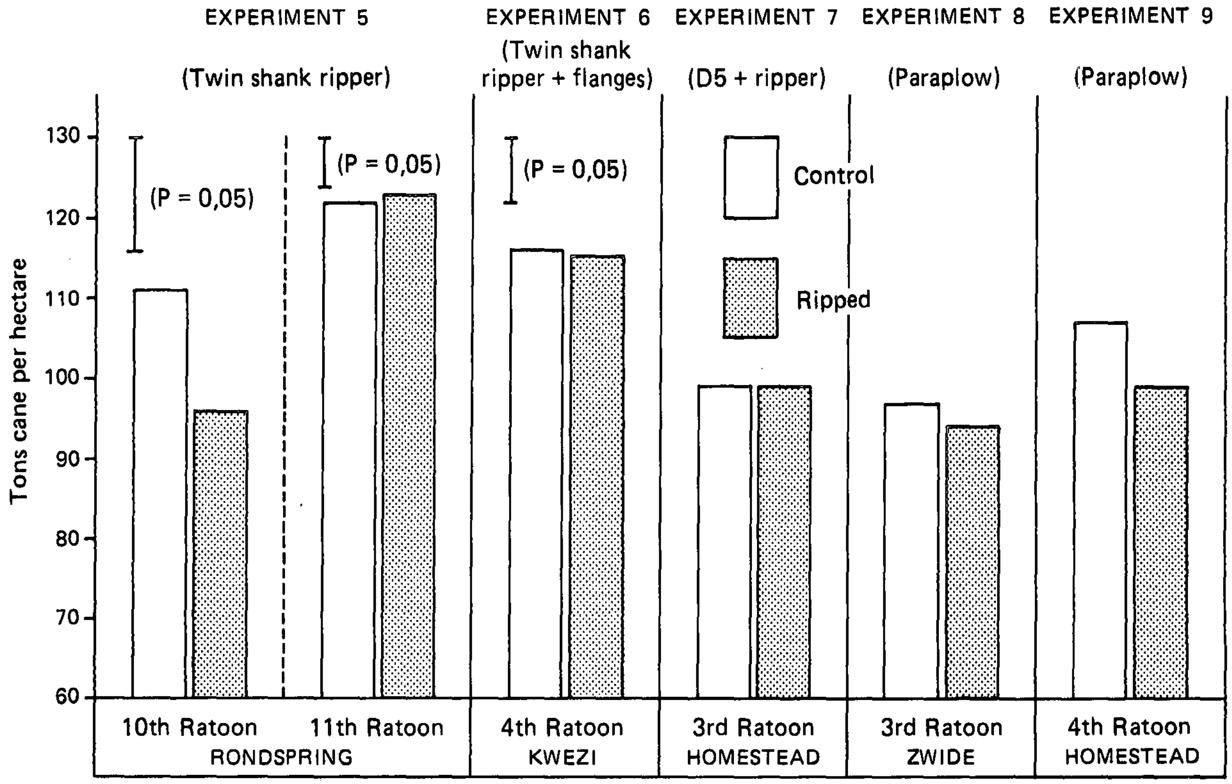

FIGURE 1 Effect on ratoon cane yields of ripping the interrow after harvest.

investigation. The soils of the sugar industry appear not to require ripping even though they may appear compacted immediately after harvesting. Earlier studies carried out at Pongola (Johnston[1]) on a Makatini sandy clay of the Hutton form showed no significant yield effects due to compaction under comparable conditions. Many soils in the Swaziland lowveld have swelling and self-mulching characteristics due to a high montmorillonitic clay fraction (Sutcliffe[6]) and the effects of compaction probably disappear once they are irrigated.

Ripping after harvest appears generally to be unwarranted and uneconomical but may possibly be necessary after mechanical harvesting of cane on sandier duplex soils which have obviously been compacted in wet conditions. Swinford[7] reported yield responses due to ripping a compacted Longlands form soil (equivalent to Swaziland Z set soils) only where the topsoil had been intentionally and severely compacted. Field observations (M Workman, personal communication) have shown that ripping poorer soils where surface irrigation is practised increases water intake capacity and waterlogging may result if irrigation is not strictly controlled.

Conclusion

Periodic or annual ripping or chiselling of irrigated ratoon cane with the normal range of equipment appears to be undesirable. The essential post-harvest operations of interrow shaping and mounding-up should be limited to a shallow chiselling operation as the extra expense incurred by deep ripping is unwarranted. There is evidence to show that any unnecessary interference of cane stools either by implements or tractor tyres can have a detrimental effect on yields. Post-harvest ripping or chiselling operations should therefore be abandoned unless there is visual evidence of severe soil compaction, when shallow tines or chisels should be used to break the hard capped soil surface.

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