A NEW APPROACH TO MECHANICAL STOOL ERADICATION

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Abstract

Four field experiments were conducted to compare the efficiency of stool eradication with a shallow mouldboard plough, a conventional disc plough, a conventional chisel plough and a shallow rotary hoe. The soil at one experiment site was a structured clay loam and the other three sites were on Recent Sands. Shallow ploughing with a mouldboard plough followed by a discing or power harrowing was the most effective method of eradicating stools on a clay loam whilst a rotary hoe operating at a shallow depth at 220 rpm and 2,6 km per hour forward speed was the most effective method tested on the Recent Sands. Glyphosate can be used successfully to eradicate the old sugarcane crop on all soil types when sprayed at the rate of 10 litres per hectare on actively growing young cane in summer.

Introduction

Before replanting a field to sugarcane the stools of the previous crop should be destroyed to avoid the likelihood of regenerating shoots transmitting systemic diseases such as ratoon stunting disease (RSD), smut, mosaic and leaf scald to the newly planted crop. RSD is common in all South African sugar growing areas and causes a greater overall loss in yield than any other disease, particularly under rainfed conditions where the reduction can be as much as 40 percent in cane suffering from moisture stress (Anon[1]). Smut and leaf scald are important diseases in the northern irrigated areas and severe outbreaks of mosaic can occur in the cooler southern and midlands regions of Natal (Anon[1]).

The eradication of sugarcane stools by ploughing in the conventional way is generally ineffective in high rainfall areas. Fields to be replanted are usually cut early in the milling season and the stools are then inverted by ploughing in winter after which the field is harrowed repeatedly in an attempt to kill the old stools. Regenerating shoots are then removed by hand before planting early in summer. This method consumes large amounts of fuel and requires a long fallow period or a smother crop to ensure the complete elimination of volunteers; it consequently reduces productivity and may result in masses of regenerating shoots if rain falls soon after ploughing (Anon[2]).

Early attempts by the Experiment Station to improve the efficiency of mechanical stool eradication involved the testing of mouldboard ploughs, disc ploughs, rotary hoes, rippers, potato lifters and groundnut diggers. None proved particularly effective but the efforts resulted in the development of a mechanical stool eradicator which was similar in principle to a potato lifter with a system of screens and beater bars for separating soils from the stools. The machine operated successfully in sandy soils but could not cope adequately with the large volume of soil which accumulated in the screens when operating in heavier soils (Anon[3]).

The discovery in 1973 that glyphosate eradicates sugarcane when applied to actively growing young cane focussed attention on chemical eradication of the old crop (Iggo[4]). However the escalating cost of glyphosate has revived interest in cheaper mechanical systems of stool eradication, particularly on flatter fields.

A number of mechanical systems for eradicating sugarcane stools have recently been tested at the SASA Experiment Station's La Mercy farm and Central Field Station (CFS) and the results of these tests are presented in this paper.

Experimental Procedure

Sites

One experiment was located at La Mercy on the North Coast on a Shortlands series soil which is a deep, structured, red, moderately porous clay loam. Three experiments were located at CFS on the North Coast on a Clansthal series soil which is a deep, red, structureless, porous loamy sand.

The location of the sites, the month of starting each experiment and the various treatments are listed in Table 1.

TABLE 1

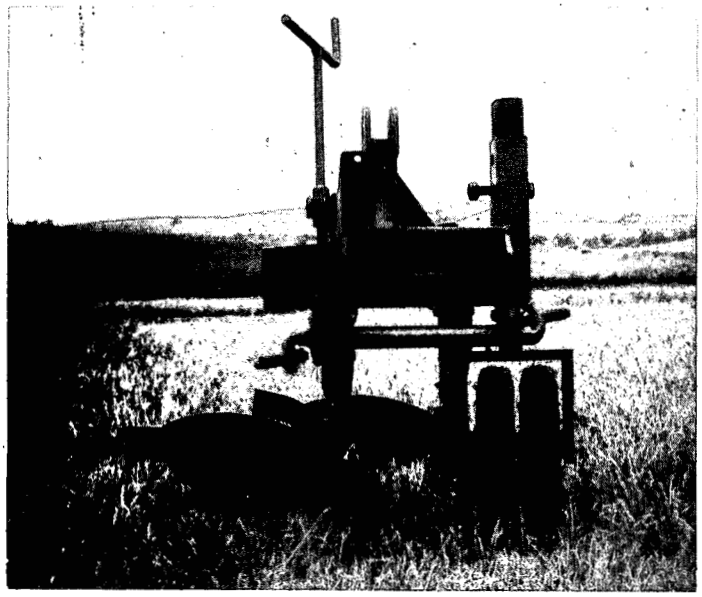
Treatments, location of sites and months in which experiments were started

Treatments					Experiment site and month of starting			
Primary operation			Secondary operation		La Mercy May	CFS Dec	CFS July	CFS July
Shallow mouldboard ploughing			Power harrowing		*	*	*	
Shallow mouldboard ploughing			Discing		*	*	*	
Conventional disc ploughing			Power harrowing		*	*	*	
Conventional disc ploughing			Discing		*	*	*	*
Conventional chisel ploughing			Power harrowing		*	*	*	
Conventional chisel ploughing			Discing		*	*	*	
	Rotor speed rpm	Forward speed km/hr						
Shallow rotary hoeing	175	2,4	Power harrowing			*	*	
Shallow rotary hoeing	175	2,4	Discing			*	*	
Shallow rotary hoeing	153	2,4						*
Shallow rotary hoeing	175	2,4						*
Shallow rotary hoeing	220	2,4						*
Shallow rotary hoeing	175	3,6						*

* indicates the treatments included in each experiment

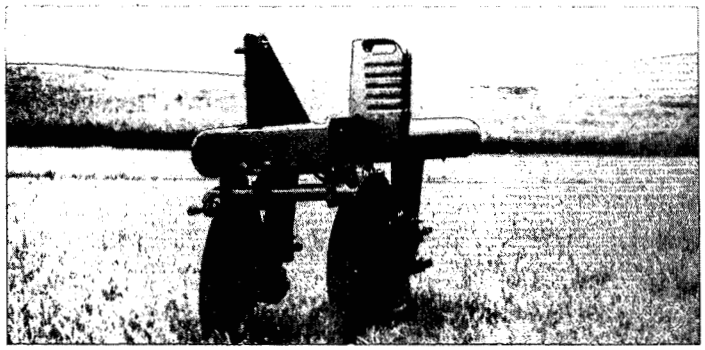
Shallow ploughing

A mounted, one-way, two-furrow Massey Ferguson mouldboard plough fitted with 550 mm shares, 110 mm extensions and a depth control wheel was used to plough to a depth of 100 mm with a single pass over the cane row.



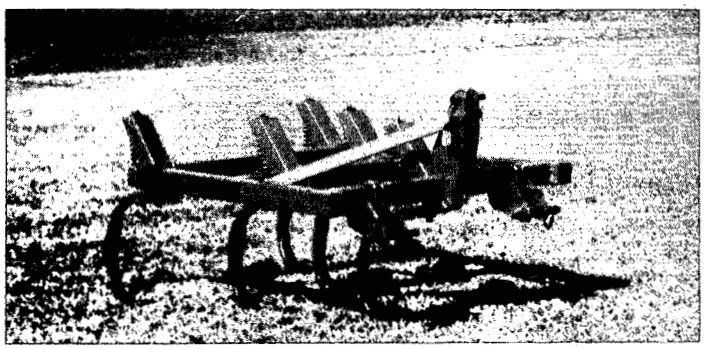
Conventional ploughing

A mounted, one-way, two-furrow Massey Ferguson trash plough fitted with 700 mm diameter discs was used to plough to a depth of 300 mm with a single pass over the cane row.



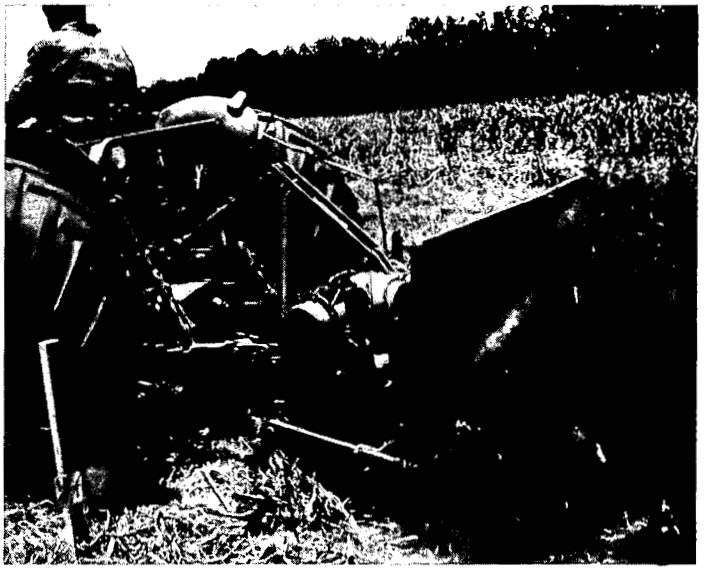
Chisel ploughing

A mounted Agrico chisel plough fitted with five broad, spring-loaded tines spaced 300 mm apart and arranged in two staggered rows, with two tines in front and three behind, was used to plough to a depth of 300 mm over and across the cane rows.



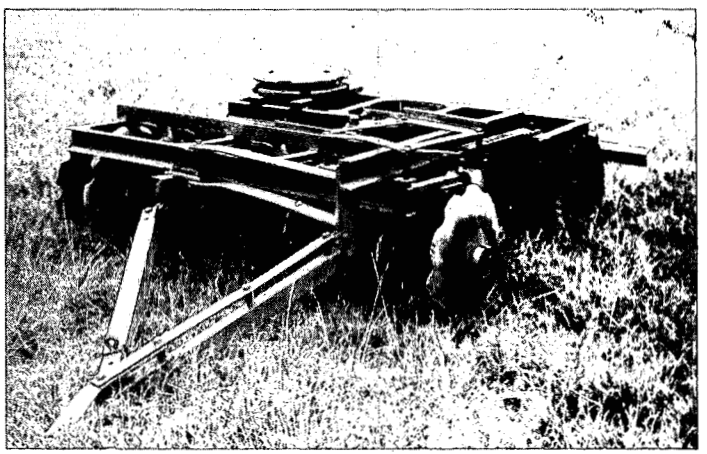
Rotary hoeing

A 1 270 mm wide Howard Rotavator fitted with a transverse rotor with six flanges, each having three left hand and three right hand L-shaped blades, was used to plough to a depth of 100 mm in a single pass over each row. The rear shield was opened to allow chopped-up stools to be thrown clear. Three rotor speeds and two forward speeds were tested.



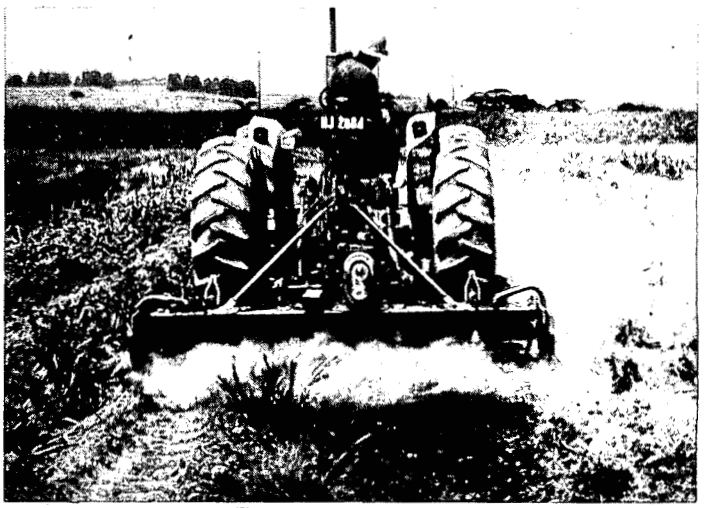
Disc harrowing

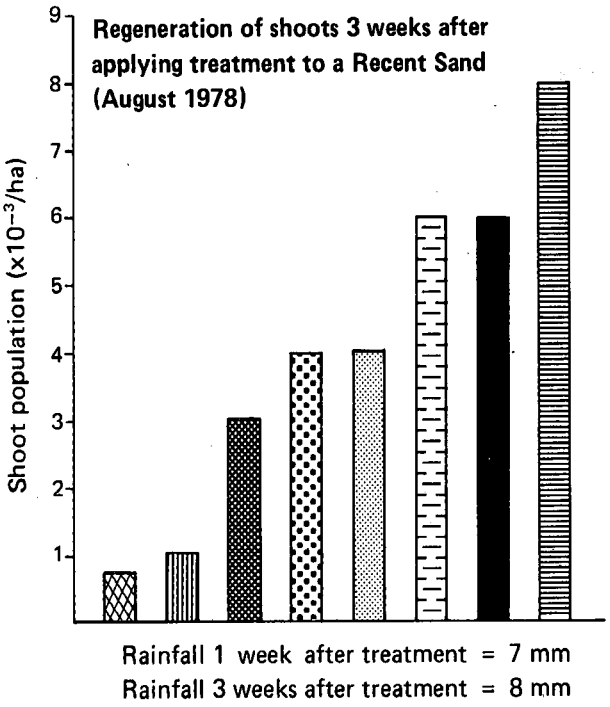
A trailed Nammcor offset disc harrow 2 200 mm wide with two axles, each mounted with ten 550 mm discs, scalloped on the front gang and round on the rear gang, was used to cut up and pulverise the inverted stools with a single pass over each row.

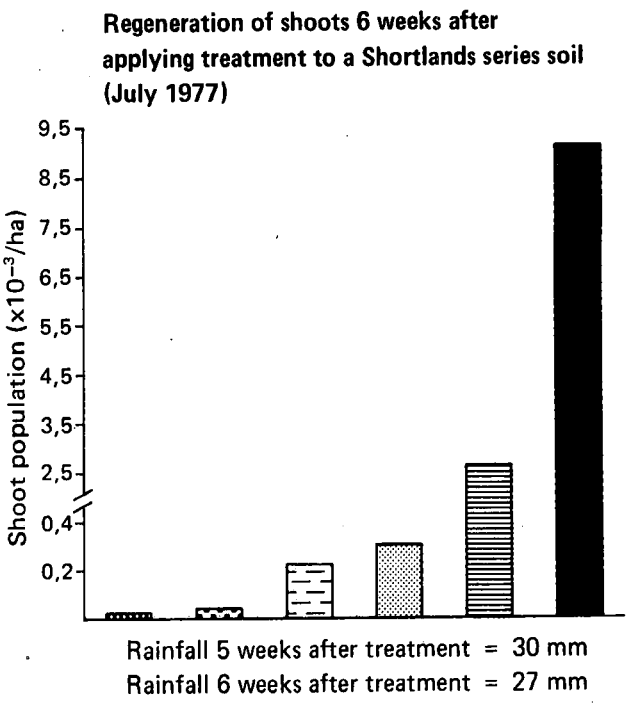


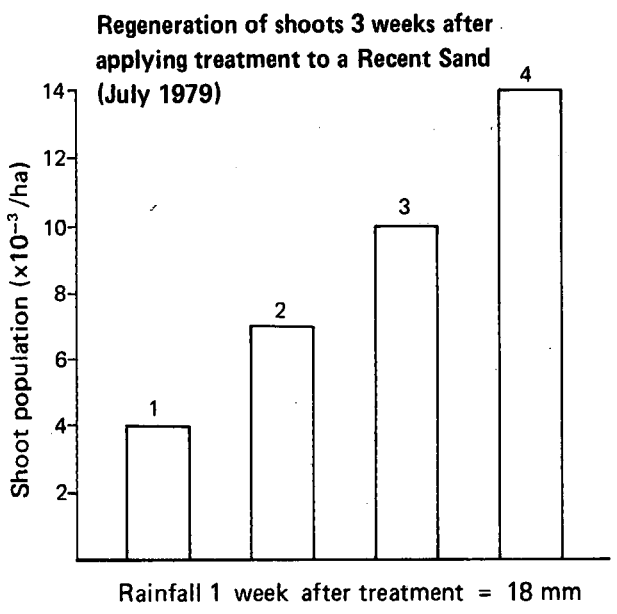
Power harrowing

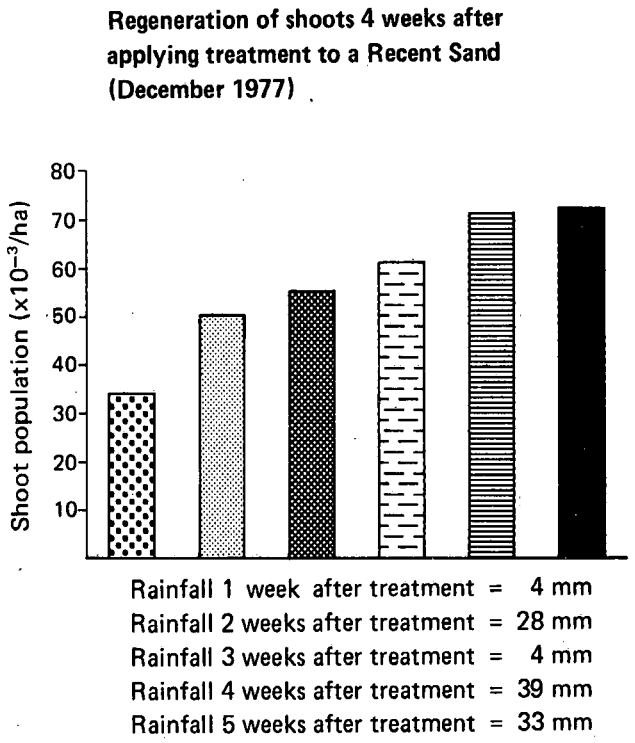
A mounted Lely Terra powered rotary harrow with eight contrarotating rotors, each fitted with two straight 240 mm long tines, was used to pulverise the stools with a single pass over each row.











Rotary hoeing

1. Rotor speed 220 rpm, forward speed 2,4 km/hr
2. Rotor speed 172 rpm, forward speed 2,4 km/hr
3. Rotor speed 153 rpm, forward speed 2,4 km/hr
4. Rotor speed 172 rpm, forward speed 3,6 km/hr

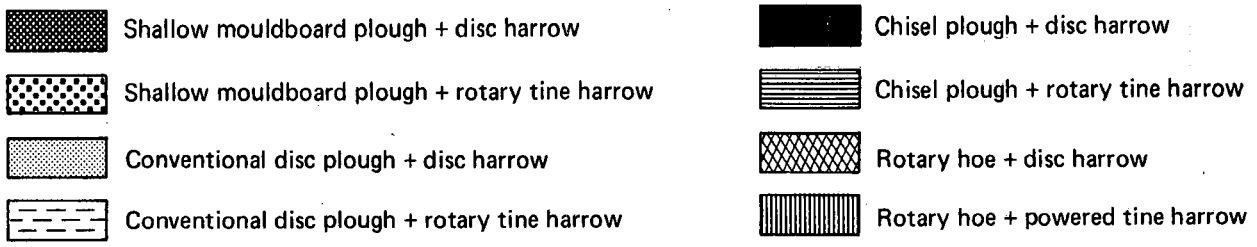


FIGURE 1 The effect of different methods of mechanical stool eradication on the number of regenerating shoots.

Tractors

A Ford County 754 (56 kW) tractor with fixed four-wheel drive was used at sites one and two. A Same Saturno 80 (60 kW) tractor with two-wheel drive and four-wheel drive was used at site three and a John Deere 1030 (32 kW) two-wheel drive tractor was used at site four.

Experiment design

The object of the experiment was to observe for several months the effect of treatments on the number of regenerating cane shoots.

Each treatment was replicated four times in a randomised block design and plots comprised five rows 15 metres to 20 metres long and 1,4 metres apart.

Results and Discussion

Results in terms of the number of cane shoots regenerating after treatment are presented diagrammatically in Figure 1.

Shallow mouldboard ploughing followed within two weeks by discing or power harrowing gave excellent results in eradicating sugarcane stools in a clay loam in winter when the soil was dry. A shallow pass over the cane row at a depth of 100 mm with a mouldboard plough removed only the upper portion of the stool to which the buds were attached, leaving the old root system intact. The stools were inverted without being buried and the follow-up treatments effectively exposed the inverted stools to desiccation. This system is not as effective in summer because rainfall soon after ploughing can result in the regeneration of masses of shoots. Fields with narrow row spacings will be completely ploughed and the likelihood of burying stools is greater but at wider row spacings only the cane row will be ploughed. Ploughing to depths less than 100 mm results in buds being missed which allows shoots to regenerate. When the soil is heavy and very dry it is difficult to penetrate and maintain a constant depth with the mouldboard plough, particularly when the entire field is not ploughed. The depth wheel can be replaced successfully by an inexpensive skid which can be fitted to all mouldboard ploughs. A reversible mouldboard plough fitted with a depth control attachment should be used for shallow ploughing on hillsides where a one-way mouldboard plough is difficult to handle when turning the furrow slice uphill, since there is insufficient mouldboard suction to counteract the side thrust. After completely eradicating the old crop the field should be reploughed to a depth of about 200 mm to prepare for a seedbed. The second ploughing buries the dry stools and leaves a clean surface for land smoothing and planting. This system reduces by half the fuel required for the conventional system (Anon[4]) and improves field hygiene.

Shallow ploughing followed by a discing or power harrowing gave unsatisfactory results in the Clansthal series soil in both summer and winter. Stools tended to be bulldozed and buried by the plough and profuse regrowth resulted. A rotary hoe operating to a shallow depth was more effective than the shallow mouldboard plough in Recent Sands. The upper portions of the stools were chopped off and most of the material was thrown out through the open shield, deposited on the soil surface and desiccated. The optimum rotor speed was found to be 220 rpm with a forward speed of 2,6 km per hour.

Ploughing to the conventional depth with a disc plough followed by a disc or power harrowing did not eradicate stools in a dry clay loam in winter and in a moist Recent Sand in summer and winter. Ploughing in the normal way inverts and buries the stools and repeated harrowing is necessary to kill the many shoots which regenerate.

The minimum tillage system with chemical eradication of the old crop can be successfully used on all soil types where field layout is satisfactory. The old crop is eradicated by spraying in summer with glyphosate at the rate of 10 litres per hectare about six weeks after cutting and when the new growth is 450 mm tall. The new crop is planted in the old interrows (Iggo and Moberly[6]).

To avoid the cost of glyphosate some cane growers use the minimum tillage system but eradicate the old stools by hand hoeing and replanting in the old cane furrows. The labour requirements for hand hoeing are approximately 48 man days per hectare (Lamusse[7]).

Conclusions

The following procedures are recommended for eradicating sugarcane in the rainfed areas of the industry :

Sandy soils :

(Recent Sands, TMS sandy soils and sandy alluviums).

* In winter use a rotary hoe to a depth of approximately 100 mm at 220 rpm and a forward speed of 2,6 km per hour.
* Spray actively growing young cane in summer with glyphosate.

All other soils :

* In winter use a mouldboard plough with a depth wheel attachment at approximately 100 mm folowed in one or two weeks by a disc or power harrowing.
* Spray actively growing young cane in summer with glyphosate.

Hand hoeing should be practised to remove any surviving shoots shortly before planting.

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