THE MANAGEMENT OF SEVERELY DROUGHTED SUGARCANE

By P. K. MOBERLY

South African Sugar Association Experiment Station, Mount Edgecombe 4300

Abstract

The management of severely droughted sugarcane which is too short to cut and handle in the normal way, was investigated in field trials conducted during the dry years of 1973 and 1980. In five out of the seven trials conducted it was found that the ultimate cane yields were better when the droughted cane (mostly NCo 376) was left standing than when it was cut back. In the remaining two trials, where the variety was NCo 310, it was found that cutting back the droughted cane was undoubtedly the best treatment. An important factor which should influence the management of such cane is the presence or absence of the borer *Eldana saccharina*. Where eldana was endemic the percentage of damaged stalks and the extent of damage was considerably greater when the droughted cane was left standing. Responses to the application of additional fertilizer after the onset of the rains were inconsistent and not substantial. There was some evidence that where the soil levels of phosphorus and potassium were low, fertilizer containing P, K and some N was beneficial when the drought had broken.

Introduction

Droughted cane which is tall enough to be cut and handled in the normal way should be harvested before the cane becomes too desiccated and the quality deteriorates. The regenerating ratoon cane will transpire less than the older, fully canopied crop and moisture stress will therefore be less severe.

Severely droughted cane which is too short to cut and handle with chains in the normal way, poses a different problem. The question arises during severe drought periods as to whether or not it is advisable to cut the cane back to ground level to save the crop, and particularly the root system. The need to apply additional fertilizer to such cane once the drought has broken has also been questioned.

During the severe droughts of 1973 and 1980 field trials were conducted in an attempt to answer these questions.

Method

The 1973 drought

In the summer of 1973 the recorded rainfall was well below average with virtually no rain being recorded from May to August, particularly in many parts of the Natal South Coast. This resulted in some very severely stressed cane and in August 1973 three field trials were established near Mount Edgecombe (Trial 1), Illovo (Trial 2) and Oribi Gorge (Trial 3) to compare different management practices.

Site selection

Because of soil variability, drought symptoms are seldom uniform within a field so the selection of sites where the cane was uniformly stressed was difficult. The degree of stress also varied from site to site but generally the cane which was from six to eight months old, had very little green leaf and the extent of stalk mortality varied from an estimate of 70% to a negligible amount. Details regarding the site, soil, variety, cane age and condition of the cane at the three sites are given in Table 1.

TABLE 1

Details of the first series of trials in 1973

	Trial 1	Trial 2	Trial 3
Site	Illovo	Mount Edgecombe	Oribi Flats
Soil form	Glenrosa	Milkwood	Cartref
Variety	NCo 376	NCo 376	N55/805
Crop	2nd ratoon	4th ratoon	plant
Age of cane when cut back in August (months)	6	8	8
Age of cane at harvest (months)	11 & 17	9 & 17	12 & 18
Condition of crop in August:			
Green leaves	none present	very few visible	some still present
Stalk mortality	c 70%	c 10%	negligible
Buds	soft and discoloured	soft	turgid and healthy
Stalk	desiccated	pithy	becoming pithy

Details of the trials

The plots comprised five rows of cane, 10 to 12 metres long and were in a random block design with six replications of two treatments. In this series of trials cane was either left standing or cut back to ground level and the dry material weighed and removed from the plots. In trials 2 and 3 only the cane that was cut back was topdressed with nitrogen and potassium, each at a rate of 140 kg/ha. Some rain was recorded in August about two weeks after the trials were established and from September onwards rainfall was good.

Assessment of treatment effects

Recordings of stalk heights and numbers were made at intervals at all sites, and cane and sucrose yields were obtained from trial 3. Unfortunately the cane in trials 1 and 2 was harvested in error by the co-operators but estimates of cane yield for the crops were obtained by use of the following regression equations :

(i) NCo 376 : Yield

$$= 22{,}8 + 3{,}7\ \frac{\text{stalk population } (10^{-3}/\text{ha}) \times \text{stalk height (cm)}}{1\,000}$$

(ii) N55/805 : Yield

$$= -5{,}8 + 0{,}5\ \frac{\text{stalk population } (10^{-3}/\text{ha}) \times \text{stalk height (cm)}}{100}$$

($r = 0{,}89$ and $0{,}93$ for equations (i) and (ii) respectively).

The 1980 drought

The monthly rainfall over most of the north coast was well below the long term mean from January to August 1980, with heavy rains ending the drought in September. Four field trials were established in severely stressed short cane near La Mercy (trial 4), Tongaat (trials 5 and 6) and Compensation (trial 7). Details regarding the site, variety, soil, age and condition of the crop are given in Table 2.

Details of the trials

The plot size was the same as described for the first series of trials and there were six replications of the two treatments in which the droughted cane was either cut back or left standing. In this series of trials the cut-back material was weighed and left as a mulch on the respective plots.

TABLE 2
Details of the second series of trials in 1980

	Trial 4	Trial 5	Trial 6	Trial 7
Site	La Mercy	Tongaat	Tongaat	Compensation
Soil form	Swartland	Glenrosa	Glenrosa	Longlands
Variety	NCo 376	NCo 310	NCo 310	NCo 376
Crop	2nd ratoon	plant	plant	1st ratoon
Age of cane when cut back (months)	11	15	16	12
Month when cut back	July	July	August	September
Age of cane at harvest (months)	12 & 23	12 & 27	11 & 27	11 & 23
Fertilizer applied to half the trial kg/ha	153 N, 30 P, 153 K	150 N	180 N	120 N, 120 K
Condition of crop when cut back:				
green leaf	very little visible	very little visible	none visible	none visible
growing point	some discoloured	some discoloured	mostly discoloured	mostly discoloured
stalks	upper parts flaccid	upper parts pithy	mostly pithy	very desiccated

Additional fertilizer, based on soil analysis, was applied to three of the six replications of each treatment.

Assessment of treatment effects

Crop growth measurements were taken at intervals and harvest data were obtained from each trial.

Results and Discussion

The 1973 series of trials

The calculated and measured yields from the three trials are given in Table 3 and the calculated yield curves of trial 2 are given as an example in Figure 1.

TABLE 3
Cane yields (t/ha) in trials 1, 2 and 3

Trial No.	Cane left standing with no fertilizer applied		Cane cut back and fertilizer applied		Response to being cut back
	Calculated	Actual	Calculated	Actual	
1	72	—	70	—	− 2
2	69	—	59	—	−10
3	100	90	70	56	−30(−34)

At none of the sites was there any advantage in cutting back the droughted cane, whereas the cane that was left standing substantially outyielded the cane that had been cut back in trials 2 and 3. The cane in trials 2 and 3 was less severely stressed than that in trial 1 and was better able to recover when stress was relieved by the September rains. The degree of stress in trial 3 was, however, sufficiently severe to cause side shoots to develop in 30% of the stalks that were left standing. The cost of cutting back droughted cane and the additional cost of re-applying fertilizer with no increase in yield indicated clearly the advantages of leaving droughted cane standing in this series of trials. Problems were experienced with weeds which result from inadequate leaf canopy in the droughted cane, and the side-shoots caused some difficulty at the time of harvest.

The 1980 series of trials

Yields:

The effects on yield of either cutting back droughted cane or leaving it standing are shown in Table 4.

Cane yields of variety NCo 376 were higher ($P = 0,05$ in trial 4) where the cane was left standing, whereas with NCo 310 the cane that had been cut back substantially outyielded ($P = 0,5$ in trials 5 and 6) the cane that had been left standing. The striking differences in the growth patterns of the two varieties after the September rains are shown in Figures 2, 3, 5 and 6. Rainfall on the two sites is shown in Figures 4 and 7.

The rate of stalk elongation of both varieties in the plots where the cane had been cut back was considerably greater than where the cane had been left standing. The varieties responded differently to the treatments. Where cane of variety NCo 310 had been left standing, the rate of recovery in terms of stalk elongation was slow compared with that of variety NCo 376. Where NCo 376 was left standing the stalks were longer and had a population similar to the cane that had been cut back. In variety NCo 310 the stalks were slightly shorter and the population markedly lower than where the cane had been cut back.

The mean stalk population per hectare at harvest for variety NCo 376 where it had been left standing was

TABLE 4
Treatment effects on mean cane yields/ha in trials 4 to 7

Trial No.	Variety	Cane left standing		Cane cut back	
		tons cane/ha	tons sucrose/ha	tons cane/ha	tons sucrose/ha
4	NCo 376	78*	8,3	63	6,7
7	NCo 376	59	7,1	55	6,5
5	NCo 310	40	4,6	59*	6,6*
6	NCo 310	72	7,6	92*	10,8*

* Statistically significant at $P = 0,05$.

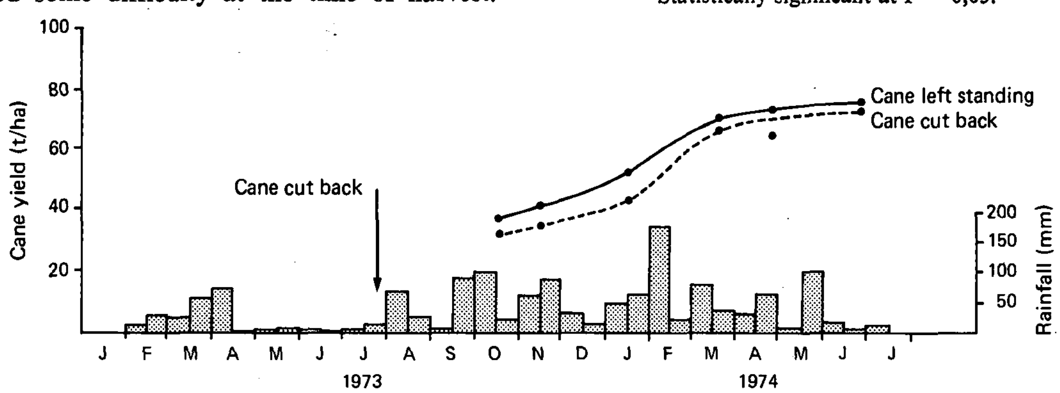

FIGURE 1 Calculated cane yields in tons/ha after treatments were applied to variety NCo 376 in trial 2 at Illovo, and rainfall for the relevant period.

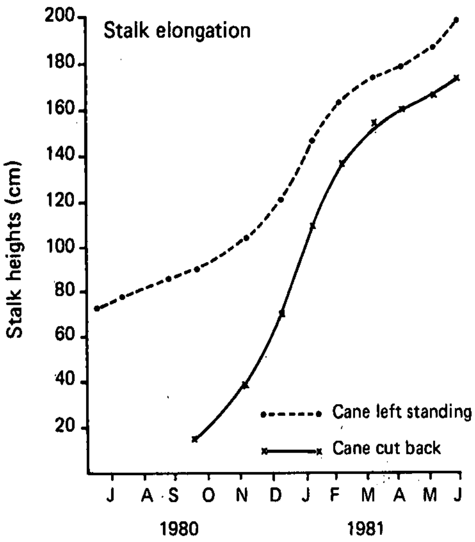

FIGURE 2 Stalk elongation following the various treatments to variety NCo 376 in trial 4 at La Mercy.

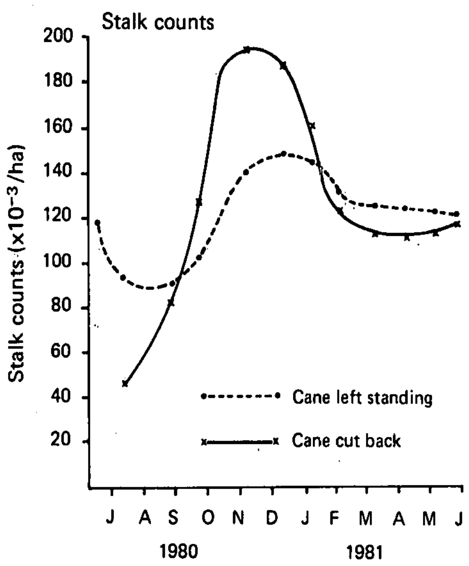

FIGURE 3 Stalk populations following the various treatments to variety NCo 376 in trial 4 at La Mercy.

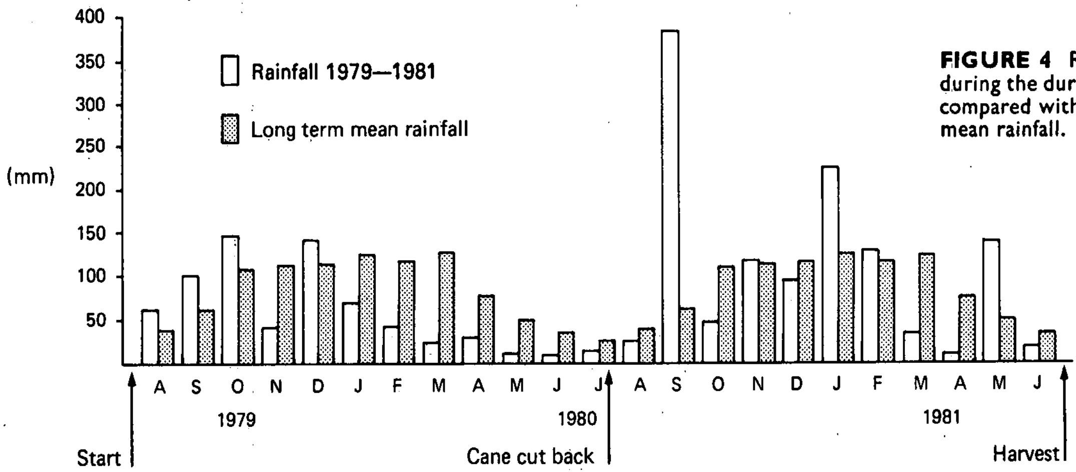

FIGURE 4 Rainfall recorded during the duration of the crop compared with the long term mean rainfall.

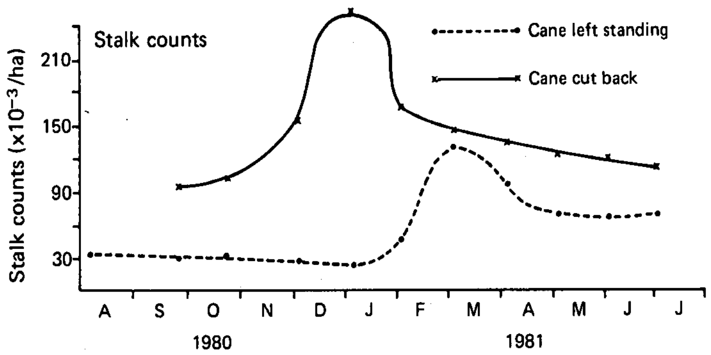

FIGURE 6 Stalk populations following the various treatments to variety NCo 310 in trial 5 at Tongaat.

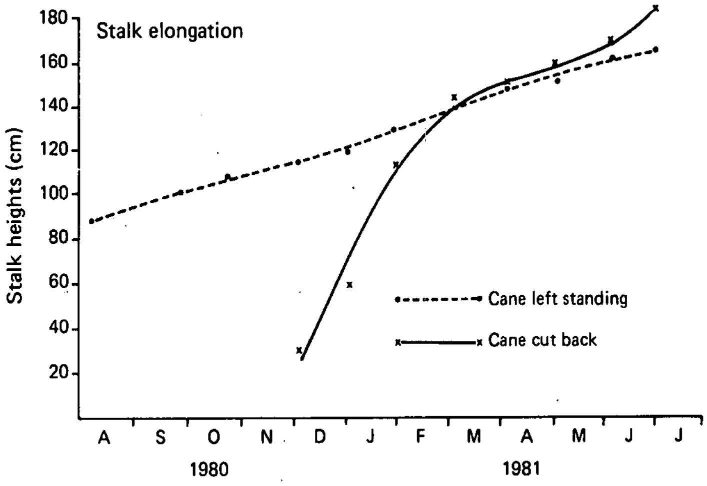

FIGURE 5 Stalk elongation following the various treatments to variety NCo 310 in trial 5 at Tongaat.

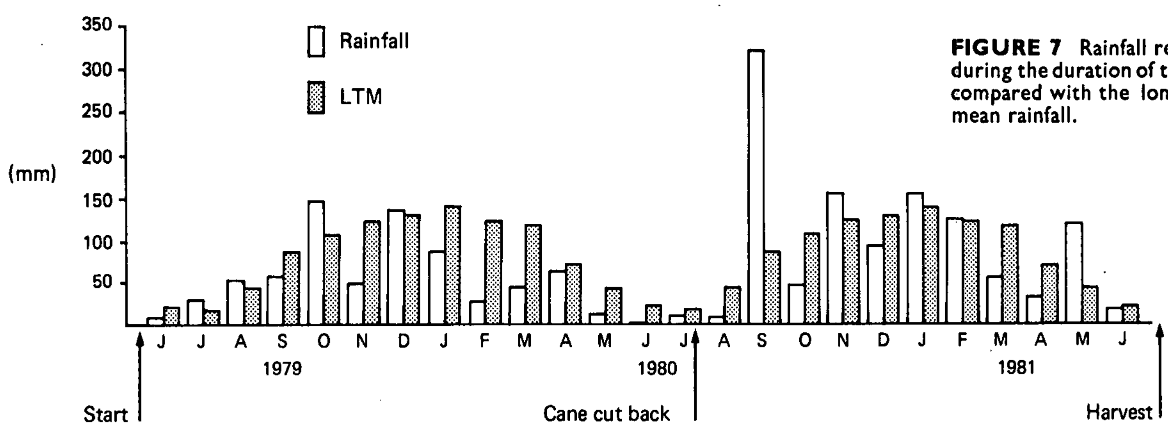

FIGURE 7 Rainfall recorded during the duration of the crop compared with the long term mean rainfall.

110 000, of which 58% comprised bullshoots, whereas with NCo 310 the stalk population was only 80 000 of which 81% were bullshoots.

Eldana borer

Stalk damage by eldana larvae was evident in all four trials but the damage was particularly noticeable in the older cane stalks where the droughted cane had been left standing. In trials 5 and 7 the percentage of eldana-damaged stalks at the time of harvest was 46% and 55% respectively where the cane had been cut back and 71% and 67% where the cane had been left standing. The damage was greatest in older stalks.

Fertilizer effects

The responses obtained from re-applying fertilizer to cane that was either cut back or left standing are shown in Table 5.

TABLE 5

The response in tons of cane and sucrose per hectare to the application of additional fertilizer in trials 4 to 7

Trial No.	Cane left standing tc/ha	Cane left standing ts/ha	Cane cut back tc/ha	Cane cut back ts/ha
4	− 1	− 0,8	+ 12*	+ 1,2
7	+ 10	+ 1,2	+ 1	Nil
5	− 11	− 1,5	+ 7	+ 1,0
6	+ 3	+ 0,7	− 1	+ 0,7

The responses were not consistent except that, where positive responses were obtained in trial 4 (+ 20%, P = 0,05) and trial 7 (+ 18%, n.s.), the available phosphorus and exchangeable potassium levels in the soil were close to or below the current threshold values. The soil P and K levels in trials 5 and 6 were relatively high. The available P values in ppm at the sites of trials 4, 7, 5 and 6 were respectively 11; 13; 46 and 68. The exchangeable K values for the same trials were 64; 88; 217 and 372 ppm.

It is not clear why the cane that was cut back in trial 4 responded to the re-application of fertilizer and the cane that was left standing did not respond, whilst in trial 7 the opposite trends were evident.

Analyses of third leaf samples taken from all trials indicated that the yield responses obtained were likely to occur. In trials 5 and 6 the third leaf values showed adequacy of N, P and K in samples taken from all plots. In trial 4 the levels of N, P and K were initially below the threshold level in all instances and the application of fertilizer was consistent with the concentrations of N, P and K in the third leaf samples as they increased with time. An increase in third leaf N, P and K concentrations with time also occurred in the samples taken from the cane which had not been re-fertilized. This implies that the nutrients became available slowly from the soil and probably from the desiccated plant material (after the rain). In trial 7 the response to re-applied fertilizer was clearly reflected only in respect of P and K in the leaf samples taken from the cane that was left standing. Surprisingly the N levels were adequate in the samples taken from cane in all plots. This evidence points to the importance of considering the nutrient status of the soil when deciding on the need for fertilizer. The requirements for N were probably less than those for P and K because of the relatively large quantities of N that were mineralized following the wetting of a severely droughted soil. The third leaf data for samples taken in trial 4 are given in Table 6.

Material cut back

The mass and moisture content of the material cut back will naturally depend on many factors but primarily on the age of the crop and degree of stress suffered by the crop. In the second series of trials the mass of material cut back and used as a mulch varied from four to about 18 tons of dry matter per hectare.

On average the N, P and K contents % dry matter were as follows :

	Tops	*Trash*	*Stalk*
N	0,96	0,31	0,88
P	0,17	0,03	0,07
K	1,71	0,41	1,57

The range in total nutrient content of the dry material was considerable and in five of the seven trials the average values in kg/ha were 84 N, 15 P and 275 K. The extent to which the nutrients became available to the regenerating crop is not known but it is likely that the rate of release was too slow to benefit the new crop substantially.

Conclusions

- In areas where eldana borer is endemic, severely droughted cane should be burnt and cut back to limit the increase in the eldana population.
- Where eldana borer is not endemic severely droughted NCo 376 should be left to recover and not cut back. There is evidence that variety NCo 310, on the other hand, performs better if cut back when the drought breaks.
- The crop should receive additional fertilizer after the rains start only if the P and K status of the soil is low. The quantity of fertilizer required is estimated to be about half the normal requirements of N, P and K. The cut back material should be left on the soil as a mulch.
- Where cutting back of droughted cane is intended, it should be done only after good rains have fallen because cutting back during the drought will only stimulate the regeneration of cane shoots which will immediately be severely stressed and the cane stool will probably die.

TABLE 6

Third leaf analytical data from trial 4

Treatments		N%				P%				K%			
	Months Age (m)	Jan 6	Feb 7	Mar 8	Apr 9	Jan 6	Feb 7	Mar 8	Apr 9	Jan 6	Feb 7	Mar 8	Apr 9
Cane cut back	no fertilizer	1,6	1,7	1,9	1,7	0,17	0,19	0,21	0,23	0,88	0,98	1,09	1,27
	with fertilizer	1,8	1,9	2,0	1,8	0,19	0,20	0,23	0,23	0,92	1,04	1,17	1,34
	Age (m)	17	18	19	20	17	18	19	20	17	18	19	20
Cane left standing	no fertilizer	1,7	1,7	1,8	1,8	0,17	0,19	0,21	0,21	0,76	0,94	1,07	1,17
	with fertilizer	1,9	1,8	2,0	1,8	0,18	0,19	0,23	0,21	0,87	1,03	1,20	1,27