UMFOLOZI CANE QUALITY CAMPAIGN: AN INTEGRATED EXTENSION PROJECT

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Abstract

The aim of the 'Umfolozi Cane Quality Campaign' was to improve the quality of sugarcane and reduce extraneous matter delivered by growers to their co-operative mill. Direct analysis of cane showed that, during the six year period of the campaign, the sugarcane delivered contained, on average, 4 200 tons more sugar and 980 tons less extraneous matter per million tons of cane per annum, compared with the six years before the start of the campaign.

Introduction

During the period 1980 to 1985, the quality of cane supplied by members of the Umfolozi Co-operative Sugar Planters (UCOSP) had declined, and ash content had increased. Climatic extremes occur fairly frequently, creating problems at Umfolozi because about 70% of the sugarcane crop is grown on the flood plains of the Umfolozi and Hluhluwe Rivers, and the remainder under marginal rainfall conditions in the adjacent hillside areas. A severe drought in 1983 and devastating floods in 1984 typified these problems.

The decline in quality and the increase in ash content of cane sent to the mill motivated the UCOSP mill manager, a prominent grower and the SASA Experiment Station (SASEX) extension officer to initiate a plan of action with the aim of reversing these unacceptable trends. A cane quality committee was established and the 'Umfolozi Cane Quality Campaign' (UCQC) commenced late in 1985. There was a significant improvement in cane quality and a reduction in ash content during the 1986 season, but a promising start to the 1987 season was reversed by devastating floods in September of that year. The effects of flood damage, a sharp increase in eldana borer infestation and heavy flowering in the cane resulted in a poor quality crop in 1988, causing a serious set-back for the campaign. However, cane quality improved significantly thereafter in the 1989, 1990 and 1991 seasons.

The main objective of the UCQC extension programme was to promote good management at harvest to ensure clean, correctly topped and base cut cane stalks. Other extension and service activities also contributed to improve cane quality, and these are described later. Precise measurement of the benefits from the methods used to improve cane quality are difficult to quantify because of the complex interactions between the growers, the mill management, the extension officer and commercial representatives, who were all involved in the programme which extended over six very different seasons.

Method

The UCQC organisation

It was important to involve the growers at every stage as a requisite for success. A committee was appointed with representatives from eight grower groups, the mill and SASEX. Action plans were developed, using the experience of those involved in a similar project at the Union Co-operative Mill in Dalton, and from results reported by Hemraj (1983), Mann (1980) and Steward and Fischer (1983). Meetings were called to brief growers on the action plan and report progress as it developed. Support staff were employed by UCOSP and the first cane quality co-ordinator started education and training programmes for growers and their employees in 1986.

Measuring cane quality

The definition of cane quality had to be agreed upon, and an attempt was made to define a single measurement acceptable to both the miller and growers. This proved difficult, even though growers were already paid on the existing UCOSP recoverable sugar formula, which rewarded better than average quality cane and penalised that below average quality. Eventually several measurements were used.

Ash % cane: This definition was meaningful to growers and to the mill. It indicated progress in delivering cane with low ash content to the mill and it was easy to calculate bonus payments and penalty deductions. High ash levels caused by mud, sand and flotsam after floods in the 1984, 1987 and 1988 seasons increased mill machinery wear, increased maintenance costs, reduced overall sucrose recovery and forced the mill to install costly additional clarifiers. Removing mud from flood damaged cane, on the other hand, increased grower harvesting costs. It was therefore agreed to introduce an ash bonus/penalty scheme, with the mill group average rated at zero, and the maximum bonus or penalty set at R2/ton. After successful tests in 1986 the scheme was officially introduced in September 1987, but floods that year damaged a large portion of the crop and increased ash levels well above normal. After protracted deliberations it was decided to suspend the scheme during floods and until all the damaged cane had been milled.

Rand value/ton cane (R/tc): The weekly relative sucrose price for A pool was applied to Umfolozi's estimated recoverable sugar (ers) formula to calculate the relative value of a ton of cane in each consignment. This measurement was introduced in 1986 and appealed to growers. Its limitations were that values changed with sucrose prices and actual A:B pool sucrose ratios. They were also distorted by the relative cane payment system when applied to non-rateable cane deliveries.

Cane:sugar ratio (c:s ratio): This is the normal cane quality measurement which was also used to calculate the relative costs of harvest and transport of sugar to the mill.

Estimated recoverable sugar in dry matter (ers % dm): This measurement incorporates all the components of cane with the exception of water and was nearest to the desired single quality measurement.

At Umfolozi, twelve approved cane varieties are grown under irrigation or under a range of rainfed conditions, and are cut at ages ranging from 9 to 18 months. Moisture content in cane deliveries varies accordingly. The mill found that ers % dm correlated better with overall recovery than did c:s ratio. Ers % dm appeared therefore to be technically

correct for milling quality. In the 1990 and 1991 seasons, daily cane test advice forms compared the ers % dm of each consignment with a mill weekly average. If results were below average, growers were encouraged to check for any practices that might be affecting cane quality and to correct the problem. With use, ers % dm became increasingly acceptable to the growers.

Estimated recoverable crystal in dry matter (erc % dm): Erc % dm derived from direct analysis of cane (DAC) is based on SA Sugar Association standards. Erc % dm is used in the results to measure cane quality achievements rather than ers % dm, to avoid any bias due to variations in milling performance at Umfolozi.

Measuring progress

Providing growers with information about their cane quality was given high priority. The Cane Testing Service (CTS) daily reports contained ash % cane and ers % dm in addition to the standard industrial analyses. Ers % dm was compared with the weekly mill average. The CTS weekly reports also included c:s ratio, relative R/tc, ash bonus/penalty and moisture % cane, as well as ers %, tons actual sucrose, and tons relative sugar. In addition, each quota's cane analyses and relative R/tc were compared with the group average by the week, month and season to date. The UCQC committee members received weekly cane quality schedules for all quotas in their zone to enable them to discuss results with the grower concerned. The committee also compared Umfolozi cane quality and mill performance with that of other mills in the industry. Possible reasons for unsatisfactory trends were discussed and possible corrective measures were considered.

Harvesting management

Initially the main extension effort was aimed at promoting good harvest management and was called the 'Clean Cane Campaign'. Correct base cutting, topping and windrowing or stacking were encouraged, and training courses were held for supervisors, loader operators and cane cutters. Growers were grouped according to their cane loading systems and the ash % cane and c:s ratio for every group were recorded and compared. Problems were investigated and corrective action initiated. For example, to reduce the collection of ash, loader grabs were modified and push-piling discouraged.

In 1986 there were significant improvements in ers % dm and ash % cane, but there was also concern that growers were losing economically recoverable sugar by topping cane too low. A 2% non-pol standard was used briefly as a guide for growers to find the correct topping height, until Inman-Bamber (1987) showed that ers % cane at the topping point was a more accurate indicator. This finding led to the UCOSP 'Computop' technique for identifing the topping point, above which the cane stalk contains insufficient recoverable sugar to cover its transport costs to the mill. The procedure was that random green cane stalks were collected from fields about to be harvested and cut into six segments: one from the meristem to the natural breaking point (NBP); four more at 10 cm intervals to 40 cm; and the sixth from the mature stalk. Each segment was analysed by the Cane Testing Service. The analyses were entered into a computer programme incorporating the current sucrose prices and the UCOSP recoverable sugar formula. The printout displayed the relative R/tc value of each segment against a range of A and B pool sucrose ratios. Growers could then choose to top their cane at the appropriate segment which covered its transport costs. Volunteer growers tested 'Computop' in 1987 and the majority improved their cane quality relative to the other growers. However, maintaining an accurate topping height proved difficult. 'Computop' became official in 1988 and the number of fields tested in this way increased steadily to 245 in 1991. However, a major limitation to expansion was the lack of resources at the Cane Testing Service to analyse more samples.

Delays in cane deliveries from burning to cutting and cutting to arrival at the mill were also recorded by the Cane Testing Service. This service was a further opportunity to monitor trends with the aim of improving juice purities.

Use of chemicals

The use of ripeners before harvest was promoted. Growers were satisfied with their early results and the area ripened increased from about 3 000 ha in 1986 to over 9 000 ha in 1991.

Chemical fertilizer is now applied with more discretion. During the five years from 1986 to 1990, SASEX Fertilizer Advisory Service analysed 51% more soil and leaf samples than during the previous six years. This enabled growers to be more precise with the nutrients they applied, particularly nitrogen, which can reduce cane quality when over-applied.

Pest control

The achievements of the Umfolozi Local Pest and Disease Control Committee (LP&DC) may have influenced cane quality.

From 1987 to 1991, average eldana levels in millyard surveys decreased by 75% from 7,4 to 1,8 e/100 stalks sampled. During the period 1980-1985 about 65% of the total cane area was harvested at an approximate age of 18 months. Between 1986-1991 when UCQC was in operation, about 85% of the area was harvested at an approximate age of 14 months. In 1991 an unprecedented 92% of cane area was cut at about 13 months and the highest erc % dm in 18 years was achieved.

The LP&DC programme also promotes the planting of newer, higher yielding and more disease resistant cane varieties. The changes in variety disposition between 1983 and 1991 are shown in Table 1, together with their sucrose and purity means, relative to NCo376.

Table 1

Variety disposition in 1983 and 1991 as a percent of total cane area. Cane quality components are taken from SASEX industry trials data

Year	NCo376	Nco310	Nco382	N52/219	N55/805	N8	N12	N14	N17	N18	N19
1983	28,0	30,5	2,5	1,2	8,3	10,3	0,5				
1991	32,8	4,4		0,2	0,4		12,7	26,2	11,1	2,1	5,2
Dry matter	100%	106%	109%	101%	103%	107%	104%	97%	107%	102%	105%
Purity	100%	103%	97%	102%	99%	98%	101%	101%	102%	101%	106%
Sucrose	100%	112%	90%	108%	105%	94%	105%	100%	107%	106%	116%

The newer varieties therefore are also contributing to changes in cane quality reported in the results.

Shorter milling season

A milling season from early April to mid-December became a UCOSP strategic objective. With a high percentage of the mature cane harvested before the main flood danger period it was hoped to reduce the amount of damaged cane to be milled in times of flood. The low sucrose months of January and February would also be avoided. This objective was partially achieved in 1990 and fully achieved in 1991 when the mill closed before Christmas.

Results and Discussion

Improvements in erc % dm, ash % cane and in cane composition per million tons of sugarcane were achieved during the six years of the UCQC.

Estimated recoverable crystal in dry matter (erc % dm)

Figure 1 plots the mean annual erc % dm as determined by DAC, for the period 1980-1991, together with trends over the six year periods before and after UCQC.

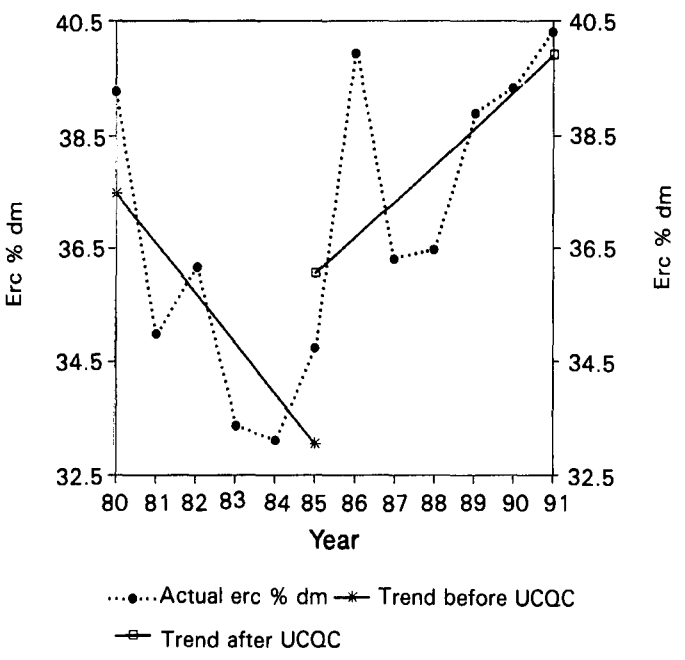

FIGURE 1 ERC per cent dry matter at Umfolozi mill (1980/81 to 1991/92).

The effect of the 1983 drought, which was the worst in living memory, was substantial. Then in 1984 floods caused by two cyclones damaged the crop severely. In 1985, with the cane quality still poor, there was strong motivation to plan the UCQC. This resulted in a greatly improved trend in 1986, but the devastating floods in 1987 affected the crop adversely in both the 1987 and 1988 seasons. In 1989 a late flood was less destructive, as much of the crop had been harvested and new flood protection measures on the Umfolozi river were partially effective. The 1986, 1990 and 1991 seasons were unaffected by natural disasters, and resulted in new peaks in erc % dm. The mean annual erc % dm achieved in the two periods were 35,27% in 1980-1985 and 38,57% in 1986-1991, when the seasons 1986, 1989, 1990 and 1991 ranked 2nd, 5th, 3rd and 1st when measured over a period of 18 years.

Ash % cane

Figure 2 shows the mean annual ash % cane recorded for the period 1980-1991, and the six year trends before and during UCQC.

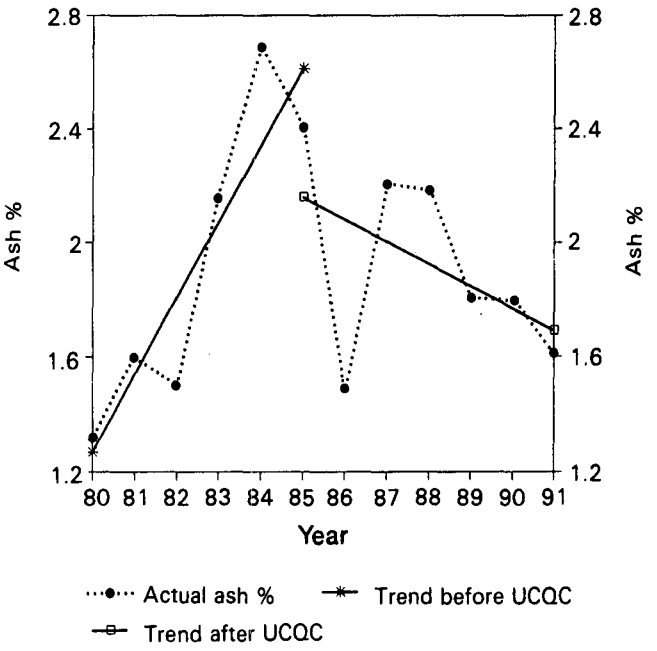

FIGURE 2 Ash per cent cane at Umfolozi mill (1980/81 to 1991/92).

The effects of drought in 1983 and floods in 1984, 1985, 1987 and 1988 were apparent when high levels of ash were recorded. The mean annual ash % was 1,84% during 1986-1991 compared with 2,07% in 1981-1985, representing a mean improvement of 11,1%. The aim of reversing an undesirable trend of increasing ash % cane was achieved.

Benefit to the mill group

The mean annual crop for the period 1980-1991 was 1 016 272 tons cane. In Table 2 the mill average DAC results for 12 seasons was applied to an assumed standard crop of one million tons of sugarcane per annum, and the seasons are grouped into the two six year periods, before and during the UCQC. Cane quality variations can be traced in the recordings for juice purity, erc % dm and estimated sucrose recovery.

Cane quality of the crop for Period A (1986-1991), when the UCQC was in operation, was superior to Period B (1980-1985) in every respect. Mean relative annual increases achieved were: 2 800 t sucrose, 4 200 t erc, 0,86% in juice purity, 3,25% in erc % dm and 1,46% in estimated sucrose recovery. Mean annual relative decreases during the two periods were 980 t non-pol, 16 000 t fibre, 980 t ash, and 14 700 t dry matter.

Benefit to individual growers

Growers producing above average quality cane with below average ash content benefited from Umfolozi's recoverable sugar formula and the UCQC ash bonus/penalty scheme. Table 3 compares the benefits to two selected growers in each of three different cane growing conditions.

Table 2

Average annual components (DAC analysis) per million tons cane harvested in Umfolozi from 1980 to 1991

Period	Season	Tons in 1 000 000 tons sugarcane by DAC analyses						Cane quality		
		Dry matter	Pol	ERC	Non-pol	Fibre	Ash	Purity %	Erc % dm	Estimated recovery
A (6 yrs)	1991	290 100	132 500	116 900	21 900	135 700	16 100	85,82	40,30	88,23
	1990	292 100	131 600	114 700	21 200	139 300	17 900	86,13	39,27	87,16
	1989	297 900	131 700	115 700	24 800	141 400	18 000	84,15	38,84	87,85
	1988	293 800	122 200	107 200	23 400	148 200	21 800	83,93	36,49	87,73
	1987	284 000	118 100	103 100	23 600	142 300	22 000	83,35	36,30	87,30
	1986	282 000	127 800	112 600	23 200	131 000	14 900	84,64	39,93	88,11
Mean A 1986-91		290 000	127 300	111 700	23 020	139 600	18 450	84,67	38,52	87,73
B (6 yrs)	1985	301 500	121 000	104 700	25 300	155 200	24 000	82,71	34,73	86,53
	1984	310 200	118 000	102 700	22 800	169 400	26 900	83,81	33,11	87,03
	1983	304 600	121 400	101 700	25 100	158 100	21 600	82,87	33,39	83,77
	1982	303 400	127 300	109 700	24 900	151 200	15 000	83,64	36,16	86,17
	1981	300 700	121 700	105 300	23 200	155 800	16 000	83,99	35,02	86,52
	1980	307 700	137 800	120 700	22 700	147 200	13 100	85,86	39,23	87,59
Mean B 1980–85		304 700	124 500	107 500	24 000	156 200	19 430	83,81	35,27	86,27
Means A–B		(−14 700)	2 800	4 200	(−980)	(−16 600)	(−980)	0,86	3,25	1,46

Table 3

Six year mean cane quality levels and net R/tc values achieved during UCQC by three groups of two growers each. 1991 actual tons sugar produced is shown as a percentage of 1986 totals

Grower Grouping	Group 1		Group 2		Group 3	
Grower	A	B	C	D	E	F
erc % dm	41,31	36,45	40,84	38,83	37,92	33,72
Ash % cane	1,00	2,12	1,45	1,72	1,91	2,48
R/tc	66,15	59,26	61,68	59,02	61,42	49,28
Ash bonus/penalty (R)	0,93	(−0,6)	0,33	0,07	(−0,06)	(−0,87)
Nett cane value (R)	67,08	58,66	62,01	59,09	61,36	48,41
Gain R/tc/year	8,42	Nil	2,92	Nil	12,95	Nil
1986 tons sugar	100%	100%	100%	100%	100%	100%
1991 tons sugar	238%	128%	138%	139%	183%	110%

Six year mean R/tc values were calculated using an A pool sugar price of R530/ton as the standard. Ash bonus/penalty values were taken from UCQC records.

Group 1 comprises two neighbouring farmers, not affected by floods, growing rainfed sugarcane on recent sands. Grower A is progressive, meticulous and a SASEX co-operator. He achieved an average of 1% ash in his cane during the UCQC period, and increased the tons of sugar produced each year from 1986-1991. The six year average net cane value he achieved was R8,40/ton more than his neighbour.

Group 2 comprises neighbouring irrigated farms which can be affected by floods. Both growers are progressive co-operators. Grower D started well by adopting UCQC recommendations but then changed his harvesting methods, topping higher to send more mass of stalk to the mill, and his loading operations were less efficient. Consequently, the average net cane value achieved by Grower D was R2,92/ton less than Grower C.

Group 3 comprises two farms situated in the flood-prone areas of the Umfolozi flood plain. Grower E is co-operative and is paying attention to improving his methods for quality control. Grower F is slow to adopt new practices. The average net cane value received by Grower E was R12,95/ton more than that received by Grower F.

Conclusions

The growers and their co-operative milling enterprise benefited by producing an average of 4 200 tons more sugar per million tons of cane per annum, while the ash content of the cane was reduced by an average of 980 tons per annum. The cleaner cane also had more favourable milling characteristics with reduced dry matter content.

There were many factors contributing to these achievements during the UCQC. The main aim of the extension programme was to reverse the downward trends in cane quality and extraneous matter delivered to the mill, to which most of the Umfolozi growers responded. Penalties for above average ash content proved counter-productive and took up a disproportionate amount of committee time. Ers % dm calculated on daily cane tests was a means for growers to improve quality while harvesting, but most found it difficult to relate to dry matter measurements. 'Computop' proved to be an expensive service, limited by the capacity of the CTS laboratory; but the concept was sound. The harvest to crush delay programme was a valuable tool, but was used only to a limited extent. The one significant loss from the UCQC was a reduction of 16 600 tons of bagasse used for boiler fuel, resulting in a somewhat higher fuel cost for the millers.

The 'Umfolozi Cane Quality Campaign' was an effective extension project. The growers and the miller gained from the experience, and the aims of improving cane quality and reducing ash in cane were achieved. Seasonal variations beyond the control of the growers have significantly affected cane quality, and floods and droughts will continue to be an occasional major hazard in the future.

Acknowledgements

The achievements during UCQC resulted from the integrated efforts of Umfolozi's sugar community, who all deserve credit for the success of the project recorded in this paper.

REFERENCES

Hemraj, V (1983). Getting more tons sugar from each ton of cane. Fiji Sugar Corporation, Research and Development.

Inman-Bamber, NG (1987). Use of quality data of mill consignments to advise on topping heights. Report to SASEX Cane Quality Discussion Group.

Mann, QV (1980). "Operation low top" - a planned project in the Umvoti area. *Proc S Afr Sug Technol Ass* 54: 118-120.

Steward, EAW and Fischer, WB (1983). Operation clean cane. *Proc S Afr Sug Technol Ass* 57: 8-9.